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MONOGRAPH

YouTube as an Educational Resource in Medical Education: a Scoping Review

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Abstract

YouTube has emerged as a growing educational resource for medical learners and educators; yet, its broad implementation may lack guidance from evidence-based evaluations. This article presents a scoping review of the utility, effectiveness, and validity of YouTube video resources in medical education. Of the 113 articles identified, 31 articles met inclusion criteria that focused on use of YouTube in medical education. Only 19.4% of the articles ($n = 6$) reported evaluative outcomes related to the use of YouTube for instructional purposes. Recommendations are offered for improving the usefulness and quality of YouTube videos as an educational resource in medical education.

Keywords Social media · YouTube · Evaluation · Medical education · Scoping review

Introduction

Advances in digital technologies and social networking sites are providing learners with opportunities to learn and collaborate without the restrictions of time and place [1–3]. Social networking tools are now part of medical education and enable learners to acquire knowledge, stay up-to-date, present their knowledge to others, effectively and quickly communicate with others, develop a sense of community [4–6], and allow learners to control content delivery, including the sequence, pace, and time [7, 8]. We recently presented a broad scoping review of digital, social, and mobile technologies within health professional education aimed to inform educational practices in health sciences education on effective integration and application [4]. While such technologies are widely accepted, sought by learners, and currently utilized by medical and health sciences educators, peer-reviewed and evidence-based assessments demonstrating effectiveness within health professional education remain underreported [4]. Through that review [4], along with subsequent studies of medical practitioners' perceptions of mobile and social networking adoption in continuing professional development [9], we identified a gap between the broad integration and use of YouTube in health professional education and established evidence-based evaluations of its impact.

YouTube, the largest Internet video-sharing site at the time of this review, is used extensively for patient, public, and health professional education to share, edit, and comment on educational information [10–13]. Video can be highly effective as an educational tool in e-learning environments and blended courses [14–18], and is often the primary multimedia delivery strategy in online courses, such as massive open online courses [19]. In medical education, learners have reported high levels of satisfaction with the brief and concise nature of educational videos, ease of access and use, and ability to view videos in a variety of settings to supplement clinical experiences and consolidate their learning [20]. YouTube also hosts easy-to-use feedback tools. Viewers can comment on videos to review or discuss content, share additional resources, or ask and answer questions through peer-to-peer forums, as well as indicate support for the content or comments using the "like"

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feature [21, 22]. As this platform is freely available and easily accessible, learners and educators are increasingly combining YouTube videos with other medical educational resources to meet their learning needs [10, 23, 24].

The purpose of this scoping review was to examine the utility, effectiveness, and validity of YouTube video resources in medical education where evaluated and reported in the peer-reviewed literature.

Methods

A scoping review was undertaken to explore key thematic concepts and evaluative evidence supporting the use of YouTube in medical education. Scoping review studies are useful in examining the extent and nature of research activity in a topic area, summarizing key research findings, and identifying theoretical, methodological, and practical gaps in existing literature [25]. We followed Arskey and O'Malley's [25] scoping review strategy that involved several key stages including the following: identifying the research question; identifying relevant studies; study selection; charting the data; and collating, summarizing, and reporting the results.

Identifying the Research Question

The review was directed by a specific research question: *How useful, effective, and valid is YouTube as an educational resource in medical education?*

Identifying Relevant Studies

Arskey and O'Malley [25] suggest that adopting inclusion and exclusion criteria, similar to the strategy used in systematic review methods, is helpful in eliminating irrelevant literature that does not address the central research question. The inclusion criteria for the studies included in this review were as follows: (a) the article was available in English; (b) the article was published between January 2005 and August 2017; (c) the focus of the article was on medical education; and (d) the purpose of the article was to understand the effectiveness and/or usage of YouTube across the medical education continuum. Articles were excluded if they focused exclusively on the use of YouTube for patient education or other health professional education purposes (e.g., not medical education).

A combination of key search terms and literature databases was included in the initial search strategy. Several online databases were searched, including the following: PubMed, which primarily accesses the MEDLINE database of references and abstracts on life sciences and biomedical topics; ERIC, an online index of information sources on teaching, learning, and research in education; and CINAHL, which also covers topics in biomedicine and alternative/complementary medicine. These databases were searched using a combination of the following terms: "YouTube," "education," "medical education," "medicine," "social media," and "social networking."

Study Selection

The selection process followed a defined three-step process (Fig. 1). Following the initial search, the first round of the review involved screening article titles and abstracts to ensure the articles were focused on medical education. In the second round, copies of full articles were reviewed to ensure the articles focused specifically on the effectiveness and/or usage of YouTube across the medical education continuum. The final grouping of articles, which fit the inclusion criteria, was obtained and analyzed by members of the research team using a data extraction tool as a guide to chart key items of information from each paper.

Charting the Data

Charting has been described as a technique for synthesizing and interpreting qualitative data by sifting, charting, and sorting material according to key themes [25]. In a systematic review, this is also referred to as data extraction. We adopted an approach similar to Arskey and O'Malley [25] that involved charting the type of study design (e.g., quantitative or qualitative), the target audience and level of learner (e.g., pre- and/or post-licensure), the level of evaluation outcomes measured [26], and key outcomes and/or results. These data were stored in an Excel file.

Collating, Summarizing, and Reporting the Results

Unlike systematic reviews, scoping reviews do not seek to weigh evidence or to aggregate findings from different studies. The goal of a scoping review is to present a narrative account of existing literature [25]. Therefore, in the third round of the review, a frequency analysis was used to summarize data that represented general study characteristics. This was followed with a thematic analysis of the entries to identify common themes emerging from the literature. Thematic analysis is a common form of analysis in qualitative research and includes identifying, examining, and recording patterns (or "themes") within data [27]. Themes typically represent patterns that emerge and are important in describing a particular phenomenon. The main source of data for the thematic analyses in the scoping review was narrative comments from the researchers summarizing key ideas, concepts, and findings raised across the articles reviewed.

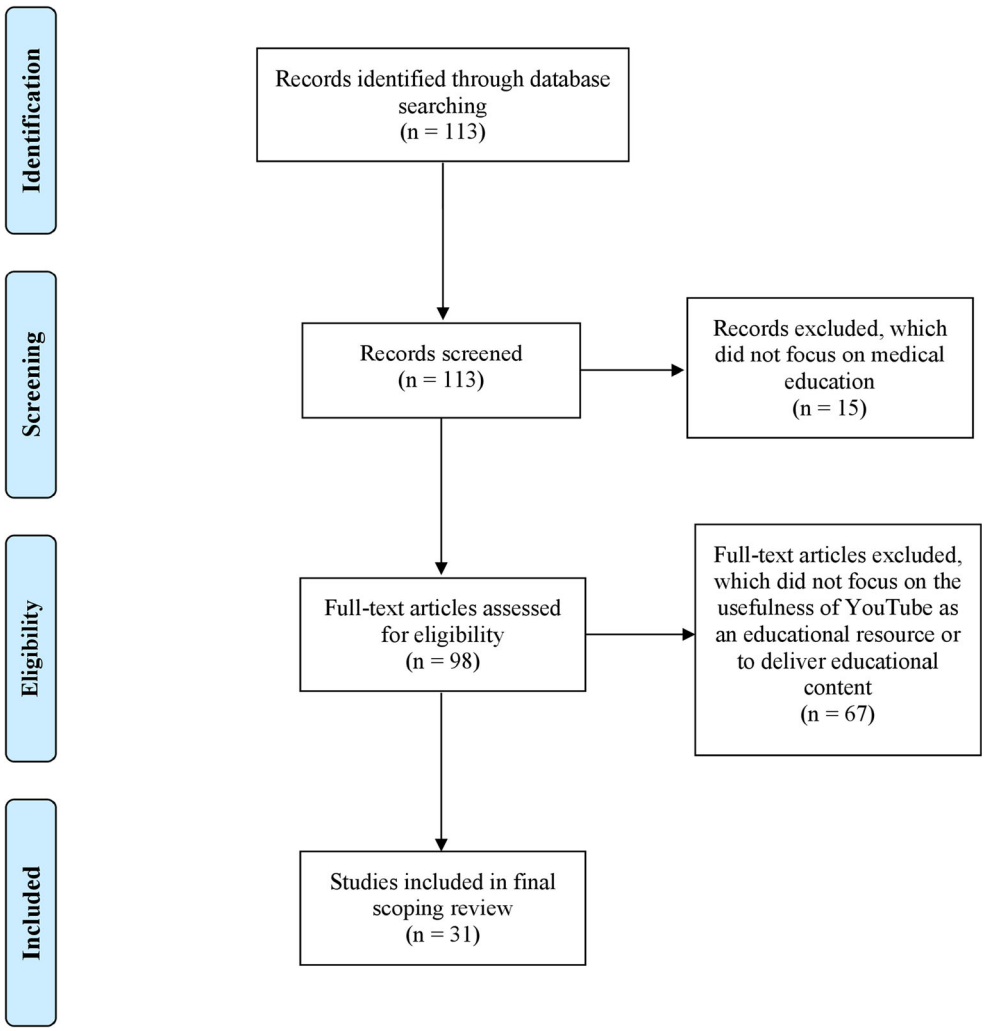

Fig. 1 Scoping review search strategy

Results

The initial searches in PubMed, ERIC, and CINAHL yielded 113 articles. Following a review of abstracts, 15 articles focused exclusively on the use of YouTube for patient or other health professional education purposes were excluded. Further review of the remaining articles resulted in the exclusion of an additional 67 articles that did not specifically focus on the usefulness of YouTube as an educational resource or a tool for delivering educational content. Thus, a total of 31 articles met the inclusion criteria and were included in this review. A majority of these articles ($n = 25$ or 80.6%) were categorized as commentary or review type articles which did not report any evaluative outcomes related to the use of YouTube as an educational intervention, while 19.4% ($n = 6$) reported evaluative outcomes that reflected learner's reaction/satisfaction with the use of YouTube videos for instructional purposes. One article reported evaluative outcomes that demonstrated acquisition of knowledge as a result of the use of YouTube as an instructional resource [28]. In Rayner et al. [28], a single 3-min YouTube video was presented to a convenience sample of 49 clinical staff, summarizing the content of a recent guideline on the management of heart failure in an effort to increase the dissemination of guidelines among physicians. The majority of respondents agreed that the content was relevant to their day-to-day practice (79.5%), that YouTube videos were a useful format (61.2%), and that they would watch further updates in this format (77.4%). Mean immediate subject knowledge improved by 39.7%. None of the articles evaluated modification of attitudes or perceptions, behavioral change, change in practice, or benefits to patients.

Studies that involved an educational intervention which reported evaluative outcomes ($n = 6$) explored the use of YouTube in providing educational content across a variety of subject areas, including the following: nephrology [29], geriatric care [20], anatomy [30], otology/neurotology [31], surgery [32], and heart failure [28]. Overall, results indicated a high level of learner satisfaction with the delivery of educational content via YouTube. For example, Desai et al. [29] explored the teaching potential of a nephrology-focused

YouTube channel for healthcare providers, which consisted of 87 videos. Participants were asked to complete a questionnaire regarding the accuracy, currency, objectivity, and usefulness of the digital format of the teaching videos. The majority of respondents agreed that the YouTube format was useful (81.0%), that the videos were accurate (85.0%), and that the videos were current or objective (83.0%). Garside et al. [20] created a series of Mini Geriatric E-Learning Modules (Mini-GEMs) hosted on YouTube and targeted junior doctors working with older people. Viewing data were recorded and a focus group was conducted with UK junior doctors, to explore their experiences with Mini-GEMs. Participants valued the brevity and focused nature of Mini-GEMs, and reported increased confidence in managing older patients.

A key theme to emerge from the scoping review was that the majority of the articles in the scoping review ($n = 17$ or 54.8%) focused on the assessment of YouTube videos for educational quality or usefulness across a wide variety of medical topics (Supplementary Table 1). Generally, these studies involved a search of YouTube for relevant videos on a specific medical topic and a screening of the search results using a defined set of topic-specific inclusion/exclusion criteria. Most often, videos included for assessment featured a healthcare professional speaker or were associated with a reputable institution. Videos that constituted news/advertisements, featured a layperson speaker, were directed at non-healthcare professionals, and/or were presented after the 10th page of the YouTube relevance-based search results list were often excluded. Various metrics on the videos were recorded, such as the author, name of video, duration, upload date, number of views or hits, and the professional credentials or institutional affiliation of the performer. An analysis of the quality, validity, and accuracy of the content of the videos, as well as the educational utility, using a set of topic-specific criteria and scoring system was then undertaken and reported on by the authors.

Taking Azer's studies [10, 33–36] as an example, the five studies adopted similar evaluation tools to examine the utility and quality of YouTube videos across different medical specialties. In each study, the author set both major and minor topic-specific criteria that covered four main elements, namely, video content, technical aspects, authority, and pedagogical approaches. Two scores were assigned to each major criterion and one score was assigned to each minor criterion. The videos that met all major criteria and at least three minor criteria were regarded as educationally useful videos in each study. Azer's study [10] on cardiovascular mechanisms indicated that 55.2% ($n = 16$) of the YouTube videos included in the study were educationally useful. Azer's study [36] on pharmacokinetics indicated a higher percentage (62.5%, $n = 30$) of educationally useful videos and suggested medical educators be aware of the popularity of YouTube and of the significant impact of YouTube on student's learning. This study also indicated that there were no correlations between video total score and number of viewers, "Likes," "Dislikes," comments, or share, suggesting users do not rely on those engagement parameters for evaluating the quality of videos. The percentages of educationally useful videos in the other three Azer's studies [33–35] were relatively low. For instance, Azer's study [33] on surface anatomy indicated that a minority of the videos (27%, $n = 15$) were educationally useful and suggested that YouTube was an insufficient medium for learning surface anatomy. Another study by Azer [35] showed that 45% ($n = 9$) of videos on cardiovascular examinations were educationally useful and 19.4% ($n = 7$) of videos on respiratory examinations were educationally useful. The study reported that a large percentage of non-educationally useful videos failed to meet one of the major criterion items. All five studies indicated that the majority of educationally useful videos were created by physicians and professional bodies/institutions, and were linked to reputable organizations.

A study by Raikos and Waidyasekara [24] examined YouTube as a platform for learning heart anatomy based on seven criteria on anatomical content and thirteen criteria on general quality. In terms of the scoring process, the authors assigned one point per criterion and labeled a "pass" for the videos with a minimum score of 5 for Anatomical Content Score and a minimum score of 13 across the sum of Anatomical Content Score and General Quality Score. Among the 294 videos on human heart anatomy assessed, only 25.9% ($n = 76$) of the videos achieved a pass, which echoed the low percentage of educationally useful videos on surface anatomy reported in Azer's study [33]. Raikos and Waidyasekara [24] suggested that this low pass rate was mainly because of the poor coverage of the anatomical content and was partly due to low General Quality Score. The authors highlighted the importance of the quality control of YouTube videos.

They suggested that their evaluation criteria could be used by medical educators to assess heart anatomy videos on YouTube or other social media platforms.

Some studies set evaluation criteria focusing mainly on video content. For instance, in the study by Borgersen et al. [37] on direct ophthalmoscopy, the authors examined the coverage of four themes, including handling of the ophthalmoscope, optimizing the environment, approaching the patient, and fundus examination, and set a total of 18 sub-points for evaluation. The results showed that a median of 12 sub-points were covered in the 27 videos assessed and no videos contained all of the 18 sub-points. Rössler et al. [38] identified five key points and three safety indicators to evaluate videos on lumbar puncture and spinal anesthesia. Among the 38 videos that met inclusion criteria, most videos addressed one or two key points and one safety indicator. No videos included information on all five key points and three safety indicators. Five of the 38 videos were classified as misleading due to

incorrect information or poorly performed procedures. The study suggested that high-quality videos on lumbar puncture and spinal anesthesia were lacking and that a peer review system needed to be established to improve the quality of medical videos. Şaşmaz and Akça [39] evaluated videos on trauma management based on ten criteria listed in Advanced Trauma Life Support (ATLS) guidelines. Each criterion received a score of 1 for a max score of 10 per video and a video with a score of 8 or higher was considered educationally sufficient. The study reported that the mean score of the 67 videos assessed was 6 and that only 14% of the videos ($n = 9$) were educationally sufficient. The study suggested that the quality of YouTube videos on trauma management was generally low and that the reliability of videos uploaded by a reputable institution was higher than the reliability of other videos.

Sood, Sarangi, Pandey, and Murugiah [40] assessed YouTube videos on kidney stone disease by classifying them as useful, misleading, or personal experiences. Among the 199 videos fulfilling inclusion criteria, 58.3% ($n = 116$) of the videos were classified as useful. A relatively small percentage of the videos (18.1%, $n = 36$) contained misleading information, and 23.6% ($n = 47$) of the videos were classified as personal views. The study indicated that most videos classified as useful contained information on prevention, symptoms, or treatment options, and that 50% of the misleading videos supported herbal remedies, which had not been proven in the literature.

Apart from the 6 articles involving educational interventions and the 17 articles focusing on the assessment of YouTube videos for educational utility, the remaining 8 articles discussed a variety of topics, including the role of YouTube in anatomy education [41, 42], the role of YouTube in dermatologic surgery education [21], YouTube as an educational tool for surgeons [23], pediatric surgery on YouTube [43], academic publishing on YouTube [22, 44], and YouTube in medical education [45].

Overall, our scoping review analysis indicated that videos deemed educationally useful or of high quality were more likely to feature a health professional and/or be associated with a reputable educational institution or medical organization. While the criteria and scoring processes used by authors varied across studies, several articles suggest that the process of assessing video content via clear, concise criteria may be useful for learners and educators attempting to identify useful educational resources for learning. Key criteria commonly used across studies included the following: accuracy, comprehensiveness, and the quality of video content; technical quality, such as sound and image clarity; credibility of authorship; and the quality of teaching demonstrated.

These studies raise concerns with content quality, validity, and accuracy of publicly accessible YouTube videos. The majority of studies identified a large number of videos, ranging from 235 to 68,366, which related to their chosen medical topic. Approximately 47.0 to 99.6% of videos were excluded in any given review, with the majority of studies excluding > 90.0% of identified videos. While this varies by medical topic and the specific inclusion/exclusion criteria, in some studies, the search strategies used identified thousands of potentially relevant videos to be screened [13, 34, 36–38, 46]. A minority of reviewed videos, ranging per study from approximately 14.0 to 62.5%, were considered to be educationally useful or of high quality.

Discussion

The scoping review indicated that a large number of YouTube videos exist across a variety of medical topic areas. Despite a recognized potential for this medium, at the time of our scoping review, there remained a general lack of evaluative studies to demonstrate the educational effectiveness of YouTube videos as an educational resource in medical education. Several studies did report high levels of learner satisfaction [11, 20, 28, 30], increased levels of confidence [20], and increased knowledge [28]. Cartledge et al. [47] reported similar findings regarding YouTube, indicating that higher order evaluative measures were rare in the literature, with methodological rigor lacking. Cheston et al. [48] also found that while many experimental studies reported positive learner reactions to social media, most studies lacked any comparison group. Davis et al. [49] reported that it is the "lack of established metrics" in combination with "logistical difficulties in collecting certain data" that is to blame for the apparent lack of "data from rigorous program evaluations supporting the theoretical, and anecdotal, advantages of social media."

Generally, the literature demonstrates a growing usage of YouTube among learners and practitioners as an informational and educational resource. Barry et al. [41] found that the vast majority of undergraduate medical and radiation therapy students in their survey study had employed web-based platforms to source information, with 78.0% using YouTube as their primary source of anatomy-related video clips. In another, Rapp et al. [32] found that YouTube was selected by 86.0% of fourth-year medical student and faculty respondents, making it the preferred source for both learners and faculty preparing for surgical procedures. Jaffar [30] found that 98.0% of second-year medical students used YouTube as an online information resource.

A main theme that emerged from the scoping review was a lack of peer review process by which experts or reviewers can edit, correct, or verify content before publishing to YouTube, leaving the accuracy, validity, and reliability of educational content unconfirmed [10, 13, 21]. Nonetheless, social networking sites such as YouTube are a growing source of information and educational material for medical students and

practitioners [32, 41]. Camm et al. [50] found that top-scoring YouTube videos varied in quality, and the search algorithm used by the site was not well calibrated for searching for educational content. Desai et al. [29] also reported there was no correlation between learner engagement and quality of YouTube videos, with learners being no more likely to engage with an optimal (accurate, credible, suitable) video than one of questionable content. It has been suggested that today's medical professionals should have the ability to assess the quality of medical websites and effectively use mobile health devices, applications, and associated tools in communications and keeping up-to-date [5, 51]. Digital literacy has been defined as the ability to effectively and critically navigate, evaluate, and create information using a range of digital technologies [5]. Medical schools could assist medical learners to apply professional standards in the use of digital, social, and mobile technologies [51]. This recommendation might reasonably be extended to support teaching and learning across the medical education continuum, including continuing medical education.

A key limitation to the interpretation of the findings of this scoping review was the variable approaches used by many authors in evaluating content accuracy of YouTube videos on medical education topic areas. In many articles, only publicly accessible video content was searched and reviewed, and there was minimal control for source credibility in the search strategies. However, many institutions and organizations may use YouTube as a repository of their video content but make the videos unlisted or private to take advantage of the closed captioning and translation features of the platform, and then embed or link the videos on other learning management systems. It is possible that this content may be of higher quality and credibility than publicly available YouTube videos, but would not be accessible as part of a general search of YouTube. Obviously, an evaluation of these types of YouTube videos would only determine the actual validity and credibility of such content. Given this, it may not be surprising that many of the articles involving searches of publicly available YouTube videos found such content to be of questionable quality and validity.

The scoping review findings do confirm similar findings by Sutherland and Jalali [52]. In their study, Sutherland and Jalali [52] conducted a systematic review of empirical evaluation and research studies on the use of social media and open-learning resources in medical education. They also found a paucity of outcome-based, empirical studies assessing the impact of social media in medical education. The few identified empirical studies tended to focus on evaluating the affective outcomes of social media in medical education and YouTube was one of the most commonly evaluated social media tools [52]. These authors also found that the small number of studies focusing on assessing YouTube content was consistent in their evaluation that YouTube was often an inadequate source of information for learning medical content due to the highly variable content [52].

Despite the variable quality of content observed in the studies of YouTube reviewed in this scoping review, video does have an important role in medical education as an educational resource and instructional tool. The limited studies that evaluated the use of YouTube as an educational intervention do suggest that video was well received by learners. Video has been described as a more effective means to gain audience attention, present greater information in a given amount of space and time, simplify complex concepts, and demonstrate concepts/subjects that are in motion and/or relate to one another [53]. Dual coding theory, in particular, supports the use of video as an instructional resource to enhance learning. Dual coding theory suggests that working memory has two channels for information acquisition and processing: a visual/pictorial channel and an auditory/verbal processing channel [54]. The representation of both visual and verbal information in a complementary manner can create separate representations for information processed in each channel and enhance the quality and level of comprehension, facilitate the integration of new information into existing cognitive structures, and improve memorization of the information [55].

When educators in collaboration with knowledgeable healthcare professionals control the production of evidence-based content, editing, and addition of video to YouTube channels for instructional purposes, the quality of this content and the pedagogical soundness of the videos can be improved. When using existing YouTube video, educators must review the quality of the content and credibility of the authorship source before adopting for teaching and learning purposes.

Recommendations

1. Medical educators should adopt evidence-based criteria and standards when reviewing and selecting existing YouTube videos for learners. Learners need to be aware that engagement parameters, such as number of viewers, "Likes," "Dislikes," comments, or share, do not provide an accurate indication of the quality or usefulness of YouTube videos [36].

2. Medical educators should consider potential logistical barriers when integrating YouTube videos into lectures including the following: ensuring that Internet access will be available during the presentation; audio devices are available to broadcast sound to your audience; having access to the Internet URL for the video; knowing how to insert or link a video to relevant presentation software and/or hyperlink to the video's online location and play it from the Internet during the presentation; and that YouTube may often be a "blocked" website in medical

education centers and this regulation of access could be a major limitation to its use [28, 44, 53].

3. Medical educators who have created educational videos should consider collaborating with their institutional licensing librarian to apply Creative Commons license to such work and publishing all videos publicly. YouTube supports Creative Commons licenses that require others to provide attribution to authors should they use any part of the video or content. Authors may license work only for non-commercial purposes, meaning that it can be used freely for research or teaching, and that others cannot profit from these materials.

4. As a community, medical educators should explore practical means to promote peer review processes by which experts or reviewers could elicit corrections or verify content before publishing videos as a means to improve the overall accuracy, validity, and reliability of available resources. Standardized criteria and external validation of available materials would assist educators in assessing and selecting materials to integrate into health professional education.

5. Future research is needed to evaluate modification of learners' attitudes or perceptions, behavioral change, change in practice, or benefits to patients resulting from using YouTube as an educational recourse in medical education.

Conclusions

This scoping review revealed the paucity of research and evaluative work surrounding the use of YouTube as an educational resource across the medical education continuum. The small number of studies in which YouTube was evaluated as an educational intervention suggests learners find the use of this social networking application useful and instructive. However, the quality of the medical education content on YouTube, particularly publicly accessible video content, is highly variable due to a lack of peer review to critique misleading and/or incorrect information. Medical learners and educators must ensure the source of the video resource is credible and trustworthy, and also cross-check the accuracy of information conveyed with other peer-reviewed resources (e.g., guidelines). Despite these limitations, YouTube, as with other social media, is growing in usage and adoption in medical education. Advancing evaluation of the effective integration of this application in medical education would inform further understanding and future practice.

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Data Availability A supplementary table on characteristics of video review articles was submitted along with the article.

Compliance with Ethical Standards

Conflict of Interest The authors declare that there is no conflict of interest.

Ethics Approval This is a scoping review of literature. No ethical approval is required.

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