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On the advantages and disadvantages of virtual continuing medical education: a scoping review

Avantages et inconvénients de la formation médicale continue virtuelle : une revue exploratoire

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Abstract

Introduction: With the COVID-19 pandemic, most continuing medical education activities became virtual (VCME). The authors conducted a scoping review to synthesize the advantages and disadvantages of VCME to establish the impact of this approach on inequities that physicians face along the intersections of gender, race, and location of practice.

Methods: Guided by the methodological framework of Arksey and O'Malley, the search included six databases and was limited to studies published between January 1991 to April 2021. Eligible studies included those related to accredited/non-accredited post-certification medical education, conferences, or meetings in a virtual setting focused on physicians. Numeric and inductive thematic analyses were performed.

Results: 282 studies were included in the review. Salient advantages identified were convenience, favourable learning formats, collaboration opportunities, effectiveness at improving knowledge and clinical practices, and cost-effectiveness. Prominent disadvantages included technological barriers, poor design, cost, lack of sufficient technological skill, and time. Analysis of the studies showed that VCME was most common in the general/family practice specialty, in suburban settings, and held by countries in the Global North. A minority of studies reported on gender (35%) and race (4%).

Discussion: Most studies report advantages of VCME, but disadvantages and barriers exist that are contextual to the location of practice and medical subspecialty. VCME events are largely organized by Global North countries with suboptimized accessibility for Global South attendees. A lack of reported data on gender and race reveals a limited understanding of how VCME affects vulnerable populations, prompting potential future considerations as it evolves.

Résumé

Introduction : Par suite de la pandémie de la COVID-19, la plupart des activités de formation médicale continue ont été offertes en ligne. Les auteurs ont effectué une revue exploratoire de la littérature visant à faire la synthèse des avantages et des inconvénients de la formation médicale continue en mode virtuel (FMCV) et à évaluer les effets de cette approche sur les inégalités qui affectent les médecins en fonction du sexe, de la race et du lieu d'exercice.

Méthodes : Suivant le cadre méthodologique d'Arksey et O'Malley, nous avons effectué une recherche dans six banques de données, que nous avons limitée aux études publiées entre janvier 1991 et avril 2021. Les études incluses étaient celles relatives à la formation médicale post-certification, accréditée ou non, aux conférences et aux réunions destinées aux médecins qui se sont déroulées dans un cadre virtuel. Une analyse numérique et une analyse thématique inductive ont été réalisées.

Résultats : Au total, 282 articles ont été inclus dans l'étude. Les principaux avantages identifiés sont la commodité, les formats favorables à l'apprentissage, les possibilités de collaboration, l'efficacité pour l'amélioration des connaissances et des pratiques cliniques et le rapport coût-efficacité. Les principaux inconvénients sont les obstacles technologiques, les défauts de conception, le coût, les compétences technologiques insuffisantes et le manque de temps. L'analyse des études a montré que la FMCV était plus courante dans la spécialité de la médecine générale/familiale, dans les banlieues et dans les pays du Nord. Quelques études prennent en compte sexe (35 %) et race (4 %).

Discussion : La plupart des études évoquent les avantages de la FMCV, mais il existe des inconvénients et des obstacles liés au lieu de pratique et à la surspécialité médicale. La plupart des activités de FMCV sont organisées dans les pays du Nord et leur accessibilité n'est pas optimale pour les participants provenant des pays du Sud. Le manque de données sur e sexe et la race des participants limite à notre compréhension de la façon dont la FMCV affecte les populations vulnérables. Ces facteurs seraient à prendre en considération dans les recherches futures sur le sujet au fur et à mesure que la FMCV évolue.

Introduction

Continuing medical education (CME) is defined as "educational activities which serve to maintain, develop, or increase the knowledge, skills, and professional performance and relationships that a physician uses to provide services to patients, the public, or the profession."[1,2] Traditional CME activities include in-person lectures and conferences that may require travel to attend.[3] With technological advances, there has been increased opportunity to deliver CME using virtual modalities that eliminate the need for travel and offer greater flexibility to participants.[3] Since 2005, virtual CME (VCME) with Internet enduring materials (online activities that do not have a designated time or location for participation), has seen the greatest growth in participant engagement and accounted for 43% of all physician CME learning in 2017.[4] In 2019, providers accredited in the Accreditation Council for Continuing Medical Education (ACCME) system offered 49,431 Internet enduring materials, for which there were over 5.6 million physician participants.[5] Moreover, compared to other CME activity types, Internet-based offerings, such as Internet (live) and Internet enduring materials, constituted more than 45% of total physician engagement in 2019.[5] The interactive nature and multimedia capabilities of the Web offers opportunities for practical problem-solving, performing tasks in authentic clinical learning settings, and participating in social dialogue. The literature also suggests online CME activities have the potential to improve physician knowledge,[6,7] clinical care,[8,9] and patient health outcomes,[10] with larger effects for online forms compared to traditional activities.[11-13]

Physicians face various barriers to obtaining CME, depending on personal factors as well as practice-specific contexts. With time and cost reported as the most significant barriers to physician participation in traditional in-person didactic formats,[14,15] VCME is a promising approach as it can offer greater scheduling flexibility, reduce travel time, and expenses.[16] However, equity data on the rise of VCME is limited and, at times, conflicting. In the context of VCME, equity entails ensuring fairness in opportunity by removing barriers to participation.[17] Research indicates that physicians prefer CME delivered in the format of in-person lectures compared to other modalities including Web-based training.[18] This finding is consistent across gender, location, race, and physician specialty.[18] More recent findings however, show that rural physicians prefer videoconferencing as the mode of delivery of CME compared to urban physicians,[19] and physicians in rural practice locations are more likely to enrol in Web-delivered CME compared to those practicing in urban areas.[20] This data suggests that VCME may be more accessible to geographically dispersed health professionals in comparison to in-person delivery. However, the latter study only sampled a small number of rural physicians, which limits generalizability, and greater program interest may not reflect participation. Regarding gender, one study found that male physicians were more likely to use the Internet for CME compared to female physicians[21] but another study found that female physicians were more likely to use online CME programs than male counterparts, and that these physicians were also younger.[22] VCME may provide greater accessibility for health professionals with young families to overcome barriers associated with travel and childcare expenses. A better understanding of how virtual delivery impacts access to CME is crucial for informing those who develop and implement online CME programs to meet the needs of all learners.

Given the recent COVID-19 pandemic, a greater reliance on virtual methods has resulted in a massive upheaval in CME. Various CME events, including in-person lecture series and large meetings, converted to online teaching and e-conferences, which explored different approaches for delivery of material and audience engagement. Organizers looking to make decisions about which of these innovative virtual methods should be retained post-pandemic,[23,24] presenting an ideal opportunity to re-evaluate CME standards and explore the possibilities of the future state of VCME. Additionally, it is important to understand whether VCME contributes positively or negatively to learning disparities, such that future restructuring avoids reproducing or exacerbating existing inequities. Therefore, the aims of this review is to first synthesize the advantages and disadvantages of VCME and then establish the impact of this approach on inequities that physicians face along the intersections of gender, race, location of practice, and medical sub-specialty.

Methods

A scoping review[25] methodology was selected as the focus of this work has not been thoroughly investigated in the literature to date. We sought to identify knowledge gaps and to scope the body of literature. Our approach was guided by the methodological framework articulated by Arksey and O'Malley.[25]

Data sources and article identification

A comprehensive literature search was performed on VCME in the following databases: Medline ALL, Cochrane Central Register of Controlled Trial, Cochrane Database of Systematic Reviews, and Embase, all from the OvidSP platform; ERIC from EBSCOhost, and Global Index Medicus (AIM, LILACS, IMEMR, IMSEAR, WRRIM) from the World Health Organization. There were no language restrictions. The search was limited to studies published between January 1991 to April 2021, as 1991 marks the advent of commercial Internet exchange and is not so long ago that the technology discussed in these articles is no longer relevant.[26] Where provided, both controlled vocabulary terms and text words were used in the subject component blocks. There were three subject blocks in the search strategies. The first subject block contained medical/surgical professionals and educators, such as physicians, surgeons, and faculty. The second subject block included continuing medical education, such as education, medical education, in-service-training, professional development, and clinical competency. The third subject block contained virtual learning, such as distance education, educational technology, virtual reality, online learning, and e-learning (see Appendix A).

Article selection and eligibility

Included publications were restricted to those focused on physicians and related to accredited/non-accredited post-certification medical education (e.g., continuing education, faculty development, maintenance of certification and/or professional development). Publications were focused on virtual education (e.g., e-learning, virtual space with avatars, video-based, app-based, SMS based) related to conferences and/or annual meetings in any virtual format. Study populations that encompass physicians with other health care professionals were included. Publications were excluded if they were intended solely for non-health professions, non-clinical health professionals, non-medical health professionals, focused on undergraduate learning or post-graduate training, focused on patient or caregiver education, involved clinical telemedicine or were conference proceedings, dissertations, or news articles.

Data abstraction

Citations for screening were managed and stored in Endnote, a citation management software, and Covidence,[27] an online systematic review manager and screening tool. Procedures applicable to scoping reviews for study appraisal, as outlined in the Joanna Briggs Institute methods,[28] were followed. Three reviewers (CC, MG, BU) performed data abstraction and appraisal independently with an a priori study protocol as a guide. Title and abstract screens were conducted, and the full text of all articles that met inclusion criteria were reviewed. Discrepancies between reviewers were resolved by a fourth reviewer (JP). The data abstraction form was pilot tested on a random sample of four articles by CC and BU before data were extracted from the remaining articles and charted.

Data analysis

Numeric analysis was used to summarize the characteristics of included studies. Inductive thematic analysis was conducted to categorize findings.

Results

The literature search yielded 38,465 studies, of which 12,324 duplicates were removed. The remaining 26,141 articles underwent title and abstract screening and 25,477 were excluded. Six-hundred and sixty-four articles remained for full-text review. Following full text review, 282 articles met eligibility criteria and are summarized in this review (see Figure 1 for PRISMA flow chart and Appendix B for a list of included articles).

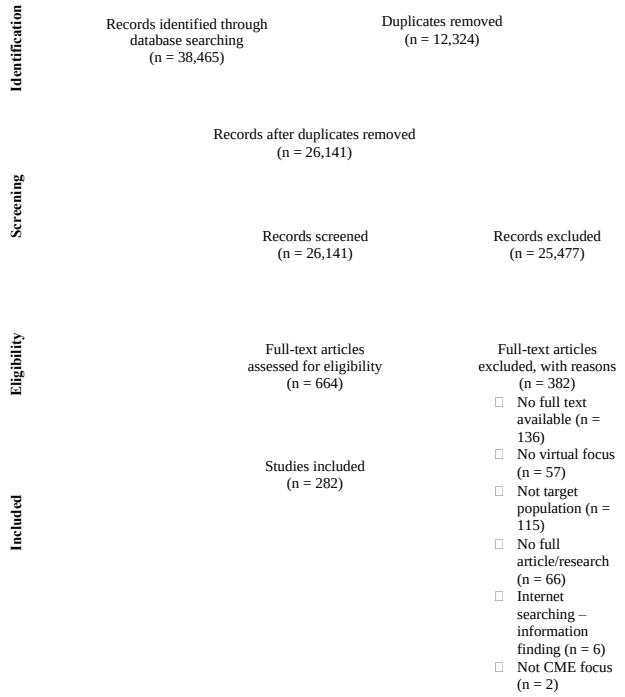

Figure 1. PRISMA flow diagram

Numeric analysis

Of articles that reported the country of origin, the predominant country was the United States (29%, *n* = 83), followed by Canada (11%, *n* = 30), Australia (6%, *n* = 16), the United Kingdom (3%, *n* = 9), and France (2%, *n* = 6). By continent, most VCME programs originated from North America (41%, *n* = 115), followed by Europe (17%, *n* = 47), Asia (8%, *n* = 24), Australia/Oceania (7%, *n* = 19), South America (4%, *n* = 12), and Africa (1%, *n* = 3), respectively. For the remaining VCME programs, the continent of origin was not applicable (10%, *n* = 29), not reported (9%, *n* = 25) or had a multi-continental origin (3%, *n* = 8). Among the 282 included articles, 155 (55%) were empirical studies, 43 (15%) were editorials/commentaries, and 30 (11%) were case studies. Of the empirical studies, 79 (51%) were pre-post studies, 38 (25%) were cross sectional surveys, 31 (20%) were randomized controlled trials, and 5 (3%) were prospective cohort studies. Among the included studies, 122 (43%) were published between 2010 to 2019, 99 (35%) were published between 2000 to 2009, 42 (15%) were published from 2020 to the present year, and 19 (7%) were published between 1991 to 1999. Nearly all included studies were published in English (93%, *n* = 265), followed by German (2%, *n* = 6), French (1%, *n* = 3), Portuguese (1%, *n* = 3), and Spanish (1%, *n* = 3). Less than 1% (*n* = 1) of articles were published in the following languages: Danish, Korean, Norwegian, Polish, and English and French.

VCME launch year was defined as the year in which the VCME activity was made available to participants. Among the included studies, 11 (4%) had VCME launch years between 1991 to 1999, 53 (19%) had VCME launch years between 2000 to 2009, 53 (19%) had VCME launch years between 2010 to 2019, and 12 (4%) had VCME launch years from 2020 to the present year.

The modality of VCME used in the included studies was mostly websites and/or discussion boards (27%, *n* = 77), followed by e-learning modules (20%, *n* = 57), videoconferences (18%, *n* = 50), webinars (3%, *n* = 7), simulations (2%, *n* = 6), CD-ROM (1%, *n* = 4), social media (1%, *n* = 4), SMS text messaging (1%, *n* = 3), applications (1%, *n* = 4), video games (<1%, *n* = 1,), and podcasts (<1%, *n* = 1). The remaining studies use multiple modalities (16%, *n* = 44), did not report the modality of VCME (6%, *n* = 16), or the modality of VCME was not applicable (e.g., letter to the editor broadly describing the need for virtual learning) (3%, *n* = 7). Refer to Appendix A for a detailed breakdown.

The majority of articles did not report the age, race, nationality nor ethnicity of participants. Of the articles that reported age (28%, *n* = 79), most participants were between the ages of 41 and 50 years old. In articles that specified the race of participants (4%, *n* = 11), White Hispanic and/or other non-White racial groups (e.g., Black, Asian/Pacific Islander, Latino) were included. Of the included articles, seven (3%) mentioned the nationality of participants consisting of Chinese and Japanese, Dutch, Vietnamese, predominantly Italian, predominantly Chilean, predominantly non-Saudi Arabian, and multi-national. In terms of the language of VCME, the majority (39%, *n* = 109) of VCME programs were in English (see Table 1).

Table 1. Article characteristics

Variables	*N* (%)
Language of VCME	
English	109 (39)
French	7 (3)
Spanish	7 (3)
Italian	4 (1)
Portuguese	4 (1)
German	3 (1)
Vietnamese	3 (1)
Dutch	2 (<1)
Japanese	1 (<1)
Norwegian	1 (<1)
Polish	1 (<1)
Persian	1 (<1)
Turkish	1 (<1)
Multiple	15 (5)
Medical Speciality	
General/Family Practice	70 (25)
Multiple Specialities	56 (20)
General Surgery	14 (5)
Paediatrics	9 (3)
Radiology	9 (3)
Emergency Medicine	7 (2)
Ophthalmology	7 (2)
Obstetrics and Gynaecology	4 (1)
Anesthesiology	4 (1)
Dermatology	4 (1)
Psychiatry	4 (1)
Urology	3 (1)
Internal Medicine	2 (<1)
Neurosurgery	2 (<1)
Oncology	2 (<1)
Orthopaedics	2 (<1)
Pathology	2 (<1)
Plastic Surgery	2 (<1)
Sports Medicine	1 (<1)

Among the included articles, 100 (35%) included discernible information regarding the gender of participants. Among these, 57 had more male than female participants, 40 had more female than male participants, and three had an equal proportion of male and female participants. No other gender identities were reported. In articles that specified the location of participants, the

majority of articles included participants from semi-rural/suburban (8%, *n* = 23) regions followed by rural (5%, *n* = 15) and urban (7%, *n* = 19) regions. Refer to Appendix A for further details on study characteristics.

Thematic analysis

The advantages and disadvantages were analyzed thematically using an inductive approach. Five main categories of advantages were identified: convenience (*n* = 107); favourable learning formats (*n* = 92); opportunities for collaboration (*n* = 79); effectiveness at improving (short-term) knowledge and clinical practices of participants (*n* = 70); and cost-effectiveness (*n* = 59). Five main categories of disadvantages were also identified: technological barriers (*n* = 73); poor design (*n* = 53); cost (*n* = 20); lack of sufficient technological skill (*n* = 18); and lack of time (*n* = 16). Other disadvantages included privacy concerns (*n* = 8); lack of familiarity with VCME (*n* = 7); difficulty with evaluation (*n* = 5); country-specific differences (*n* = 5); learner isolation (*n* = 4); and the need for in-person training (*n* = 4).

Advantages

A majority of articles reported an advantage of VCME being convenience[29-31] (38%, *n* = 107), including ease of access (e.g., ability to access the program anywhere with an enabled device, regardless of geographic location),[10,15,23,32-93] reduced travel (time, distance),[10,15,33,34,39,53,54,58,70,82,91,94-113] and scheduling flexibility.[32-34,39,40,44-46,49,51,52,61,63,64,69,75,81,83,88,92,94,97,98,106,113-132] This data was gathered through surveys (e.g., questionnaires, evaluation forms) (*n* = 57); focus groups (*n* = 1); interviews (*n* = 5); a combination of surveys, focus groups and/or interviews, (*n* = 6); general feedback (e.g., comments from participants) (*n* = 3); data analysis (e.g., using analytics to measure participation and engagement) (*n* = 1); or feedback from VCME organizers (*n* = 5).

Of the 107 studies that reported convenience as an advantage of VCME, 17 had more male than female participants, 11 had more female than male participants, and one had an equal proportion of male and female participants. The remaining 78 studies did not report the gender of participants. Of those studies that had a greater proportion of female participants (*n* = 11);[31,44,49,75,79,80,93,98,115,126,133] three had female participants less than 40 years of age[31,49,79]; five had female participants between the ages of 41 and 55;[75,80,115,126,133] and two included participants over 30 years.[44,98] Archibald et al. did not report participant age.[93]

The second most reported advantage was favourable learning formats[94] (33%, *n* = 92), including the qualities of being self-directed/self-paced;[33,34,48,59,61,64,72,73,85,92,97,113,115,125,130,134-142,120,122,123,143,144] interactive;[6,10,29,32,39,41,43-45,57,69,72,88,94,97,99,101,102,105,106,115,118,130,136,142,145-152] engaging;[10,32,93,102,143,153] user-friendly;[44,59-61,95,99,114,115,137,139,149,151,154-169] easy to follow/understand (e.g. rehearsed, refined presentation);[59,60,114,137,170] well-designed;[33,40,41,43,54,59-61,88,93,135,167,171,172] providing immediate feedback;[76,93,147,173-175] and enabling active participation.[56,130,174,176-180]

The next most cited advantage was opportunities for collaboration[180] (28%, *n* = 79), including greater communication and interaction with doctors from different geographic locations (e.g., international experts),[39-41,43,47-49,55,56,58,63,65,66,69,71,75,82,85,92,96,99-101,103,105-107,109,110,112,113,118,125,128,130,131,136,140,146,149,151,159,161,165,167,176-179,181-196] allowing for greater diversity of learners and disciplines;[8,41,43,63,65,76,84,90,95,103,105,119,123,124,144,145,159,161,165,171,176,195,197] reduced feelings of professional isolation,[55,85,101,113,146,151,193,198] and possible benefits for physician recruitment and retention in remote areas.[55,146]

Subsequent advantages were effectiveness at improving the (short-term) knowledge and clinical practices of participants[6-8,32-34,42-44,49,61,66,68,69,76,85,88,93,95,107,115,117,128,131,133,134,137,139,142-144,147,150,153,155,158,159,169,181,186,197,199-227] (25%, *n* = 70); and cost-effectiveness[107,112,130,144,188,192,219,225] (21%, *n* = 59), such as low costs to implement the program,[29,39,45,56,90,98,104,106,113,119,120,128,129,151,156,159,163,173,174,195,202,228-230] as well as reduced costs to attend with respect to travel[10,15,29,33-35,39,44,49,50,52,53,58,70,82,83,85,100,102,103,107-109,114,116,120,122,150,162,163,195,210,231] and accommodation expenses.[29,34,44,52,82,83,85,150,163,195]

Disadvantages

Most articles reported that a disadvantage was related to technological barriers (26%, *n* = 73), including structural barriers (e.g., limited bandwidth, poor audio quality);[29,31,36,44-46,50,56,58-60,62,69,70,76,82-86,88,91,95,100,108,112,115,118,126,130,143,147,150,153,155,157,161,174,178,180,181,185,187,193,195,208,224,228,230-247] lack of functioning and availability of equipment (e.g., computer, device);[45,70,72,115,123,174,233,237] software problems (e.g., system crashes);[75,117,197,248] and lack of access (e.g., no Twitter[249]). Of these articles, seven had participants from low-income countries;[44,56,82,118,178,245,247] 10 studies had participants from lower-middle income

countries;[31,44,82,85,115,118,143,155,239,242] six studies had participants from upper-middle income countries;[31,44,112,117,118,243] and 22 studies had participants from high-income countries, of which nine had participants from rural areas of high-income countries.[36,58,70,126,193,228,244,246,250] Of the remaining articles, two mentioned participants from over 50 different countries and 32 did not report the location of participants. Overall, the majority of those who reported technological barriers were located in Global South countries.

The second most reported disadvantage was poor design (19%, *n* = 53), including lack of interaction (between learner and facilitator or between learners);[34,51,59,67,70,77,79,84,88,90,104,112,123,135,142,168,208,216,224,239,243,251-256] lack of active participation;[33,125,159,232,237,257,258] logistical issues (e.g., microphone and camera placement, unmuted microphones)[36,58,59,110,174,232,236,259] and technology-related logistical issues (e.g., site blocked by institution);[31,33,59,60,108,117,149,177,187,202,228,259] not user-friendly;[34,59,66,149,208,248,251] poor delivery format;[193,216,260] and lack of coordination (e.g., with audio visual department).[232]

The next most reported disadvantage was related to cost[40,46,70,97,105,112,116,118,130,146,155,178,180,183,184,194,198,228,231,240,261] (7%, *n* = 21), of which *n* = 12 articles mentioned high costs to develop, implement, and/or sustain the VCME program,[40,70,97,105,112,130,178,180,184,194,198,228] with participants located in rural areas of high-income countries,[40,70,184,198,228] low-income countries,[178,194] and less developed areas of upper-middle-income countries.[112] The other nine articles mentioned high costs to participate (e.g., monthly subscription cost),[46,116,118,146,155,183,231,240,261] with participants mostly located in lower-middle income countries.[118,146,155,231,261] Lack of funding and support was reported by participants located in rural U.S.,[184] less developed provinces in China,[112] and developing countries.[194] An article by Geissbuhler et al. mentioned a lack of international support for reducing costs associated with satellite connectivity in Mali.[146]

Other reported disadvantages were lack of sufficient technological (e.g., computer, Internet) skill[34,45,51,59,60,70,72,73,106,125,148,150,155,178,208,243,261,262] (6%, *n* = 18) and lack of time[59,60,70,72,75,118,125,150,155,161,193,208,224,240,257,261,263] (6%, *n* = 16). In one of these studies in which there were more female than male general practitioners, many participants reported being able to access VCME from home but finding it difficult to find time while balancing family responsibilities.[75] Moreover, in the study by Curran et al.,[59] the majority of those who did not use the web-based aspect were mostly female and reported that personal commitments were a time-limiting factor that made accessing the web-based VCME challenging. Similar findings were reported by and Curran et al.[60] where personal activities left little time to participate in VCME. The remaining studies did not provide discernible information regarding the gender of participants or further details regarding physicians' reasons for reporting lack of time as a barrier.

Several articles also mentioned disadvantages associated with privacy concerns (e.g., online payment, Internet security)[34,48,72,105,114,149,190,249] (3%, *n* = 8); lack of familiarity with VCME (e.g., more experience and success with traditional CME)[36,57,106,135,264] (2%, *n* = 7), including educators' lack of familiarity;[123,244] difficulty with participant evaluation (e.g., lack of integrity in completing VCME)[44,74,114,159,248] (2%, *n* = 5); country-specific differences (2%, *n* = 5) (e.g., misunderstanding of lab results, differences in treatment, language barriers)[43,69,154,237,241]; learner isolation (*n* = 4, 1%) (e.g., impersonal interactions);[130,132,195,253] and the need for in-person training.[45,51,98,265]

Discussion

Structural barriers

This scoping review has highlighted the importance of VCME as a tool. However, the widespread delivery is still restricted by structural barriers, including limited bandwidth and slow Internet connectivity. A large proportion of participants who reported these barriers were located in low and lower-middle income countries, which may be associated with a lack of funding, and unaffordable, often higher costs of Internet connectivity, compared to high income countries.[146,231,233] Likewise, a significant proportion of participants located in high-income countries, notably those in rural areas, face similar technological difficulties.[231] The limited provision of reliable high-speed Internet in high-income countries may also be attributed to some degree to a lack of financial support. For example, although Canada is considered a high-income country, with $6 billion in funding in 2019 to provide Canadians with reliable high-speed Internet,[266] there are still areas that are satellite dependent, communities without fibre transport technologies, and areas where less than one quarter of households have access to broadband services of 50 Mbps download and 10

Mbps upload speeds or greater.[267] Furthermore, although 87.4% of households in Canada have access to broadband speeds of at least 50/10 Mbps, only 45.6% of households in rural communities have access to these services.[267] These statistics indicate that physicians located in rural areas may have different technology requirements compared to their urban counterparts. Thus, without an emphasis on the need for funding to support VCME projects in low/lower-middle income countries and rural regions of high-income countries, physicians in these areas may be left behind while the field of VCME advances, therefore further widening the technological and social gap that exists between and within countries.

Country of origin of VCME

Another important aspect to consider is the temporality of VCME, as live sessions are usually held at more suitable times for physicians living in the host country of the VCME event. This synchronous nature of VCME may limit attendance and participation for those living in other countries due to differences in time zones.[171,249] To provide a more supportive environment for all learners, live sessions could be recorded and viewed by participants at a more convenient time.[268] Presenters in different time zones could be invited to pre-record their presentations, which may have the additional benefit of avoiding technical or Internet connectivity issues at the scheduled time of the VCME event.[82] Online discussion forums for learners to leave questions for presenters to answer on their own time could also be included.[123] This solution may not provide the same sense of interaction associated with live or in-person CME discussion forums, but it is a useful initial consideration to keep in mind as the use of VCME continues to expand.

The country of origin of VCME is also important when considering cross-country cultural differences that may exist between the VCME host and its recipients, such as differences in communication style, disease management, and healthcare systems.[154] Several ways in which VCME programs can provide information that better reflects the local context include incorporating local information and treatment guidelines,[154] using locally-based case presentations,[56] and including local experts as co-organizers.[82] In one study, a VCME program originating in Canada that was adapted to a Uruguayan context specifically had translations performed by Uruguayan experts in order to encapsulate disease management practices that aligned with Uruguayan culture.[241] This example highlights the need for culturally appropriate translations rather than simply obtaining literal translations from English,[269] which is often the VCME source language. Moreover, it demonstrates the importance of addressing the needs of participants from Global South countries, particularly in the context of VCME in which a majority of interventions, as shown in our analyses, are created by Global North countries. Therefore, as VCME seeks to open opportunities for collaboration by eliminating temporal and geographical constraints, VCME organizers must consider language and cultural differences to increase VCME access and use, reduce misinterpretation, and enhance the effectiveness of VCME in improving physicians' knowledge.

Duality of VCME

VCME is perceived to save time, minimize costs, and eliminate travel, therefore increasing the accessibility of CME to marginalized groups, including women and physicians with young children.[102,126,240,270] However, travelling away from home to attend in-person conferences and CME programs may have been an opportunity for physicians to take protected time off from domestic responsibilities.[59,60,75,271] Prior to the pandemic, female physicians were already devoting more hours to household and child-care duties than their male counterparts.[272,273] Along with the pandemic and consequent increase in VCME that can be accessed from home, this disparity has likely intensified, negatively impacting the ability of female physicians to balance their work and personal lives. There is also a common assumption that female physicians will make sacrifices in their professional lives to accommodate their home and family care responsibilities.[271] With CME programs being delivered virtually and allowing physicians to access them from home, the expectation for female physicians to make time for domestic responsibilities amidst their work life may be further exacerbated. As a result, VCME may be reinforcing gender stereotypes and undermining the career development of female physicians in the process of attempting to address a need. This unintended consequence is a crucial aspect of VCME that CME providers must take into account.

Cost of VCME

A prominent advantage of VCME is its cost-effective nature due to the elimination of travel[116] and accommodation expenses, therefore improving the accessibility of CME to a wider physician audience.[64,82,274] It has also shown to be cost-effective when built upon existing platforms and

resources[120,228] and may even offset the initial costs of investment over time as these virtual modalities are used more frequently. However, a reduction in the cost of participation may have important implications, such as a greater reliance on commercial sponsors, a decrease in the perceived value and worth of presenters' expertise, and a reduction in participants' commitment to the VCME program. Since registration fees are often needed to support the host platform and provide remuneration to speakers, providing CME courses free-of-charge may require greater financial support from commercial organizations, which can lead to biased practice-transforming information and techniques,[275] as well as greater scepticism among participants regarding the credibility of the information provided virtually.[227,257] Additionally, with VCME being perceived as less financially demanding, organizers may decide to divert funds away from VCME and re-allocate it towards other educational activities.[82] Consequently, there may be a reduction in the quantity of presenters that can be invited to speak at VCME events, as well as a decrease in the perceived value and worth of presenters' expertise,[256] which can further decrease participants' motivation to participate and complete the CME course.[166]

Future of VCME

Since the beginning of the COVID-19 pandemic, there has been a significant increase in the number and frequency of VCME activities.[276] Not only has VCME allowed specialty medical training to endure during the pandemic, but it has also served as a means of communicating up-to-date information on COVID-19, as well as providing peer support and reducing feelings of isolation among medical professionals.[277] It has also led to record attendance numbers in participants and experts that were not previously possible with in-person conferences.[179] Although most VCME activities were focused on general/family practitioners, VCME focused on specialties such as oncology, sports medicine, and plastic surgery have also been positively received,[77,174,236] suggesting that the benefits of VCME may not be limited by medical specialty. Although we did not detect meaningful differences in gender regarding the convenience of VCME, it should be noted that only fewer than one-third of articles that mentioned convenience as an advantage of CME reported on participants' gender. Thus, more data is needed in order to determine whether there are differences in VCME access based on participant gender.

In the post-pandemic phase, VCME may continue to be a highly demanded modality for CME delivery, particularly in Global South countries, with a recent online survey showing that physicians located in sub-Saharan Africa were more receptive to the transition to VCME compared to those from North America.[231] VCME may reduce cost and travel distance for physicians located in these regions, the latter of which is particularly pronounced in low-income countries as most CME events tend to occur in North America. This finding may provide another reason to retain VCME in the post-pandemic era, especially for those located in low-income countries. However, as most VCME interventions are created by Global North countries, an emphasis must be placed on addressing the specific needs of those located in the Global South to ensure equitable access among all participants.

Study limitations

Our scoping review has several limitations. First, our searches were limited to physicians, as the inclusion of all health professionals generated an unfeasible number of records. Second, we excluded conference proceedings, dissertations, and news articles, given their less detailed and low information yield. As breadth of evidence is the focus of this scoping review, methodological quality and critical appraisal of the included studies was not assessed.

Conclusion

To our knowledge, this is the first literature review that attempts to synthesize the advantages and disadvantages of VCME with an equity lens. While most studies reported advantages of VCME, disadvantages and barriers to VCME were also mentioned. However, few articles reported the age, race, nationality, and ethnicity of participants, and only a minority of articles reported the gender of participants. Thus, our analysis on the implications of VCME on vulnerable populations is limited. Additionally, as VCME events are largely organized by North American and European countries, a lack of attention towards factors such as distance, time zone, and Internet accessibility means that VCME events will not be optimized for all attendees. The increase in published data on the topic of VCME in the last decade is a trend which will likely continue into the post-pandemic phase. We therefore hope that our review will prompt further research in this area with particular attention to age, race, nationality, ethnicity, and gender of participants, as VCME continues to be increasingly used to update physicians' knowledge and optimize delivery of care.

See Appendix B for list of all articles included in the review with asterisks to denote those that were not directly referenced in the manuscript.

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Appendix A. Ovid MEDLINE(R) ALL 1991 to April 15, 2021

#	Searches	Results	Type
1	exp Medicine/	1155540	Advanced
2	exp Physicians/	148772	Advanced
3	Faculty/	10128	Advanced
4	Faculty, Medical/	13707	Advanced
5	physician?.tw,kf.	410178	Advanced
6	doctor?.tw,kf.	128332	Advanced
7	surgeon?.tw,kf.	214553	Advanced
8	(medical adj2 staff?).tw,kf.	14698	Advanced
9	(medical adj2 personnel?).tw,kf.	7321	Advanced
10	(medical adj2 profession?).tw,kf.	7726	Advanced
11	(medical adj2 facult*).tw,kf.	4886	Advanced
12	(medical adj2 educator?).tw,kf.	2523	Advanced
13	(medical adj2 trainee*).tw,kf.	1538	Advanced
14	(medical adj2 instructor*).tw,kf.	83	Advanced
15	(surgical adj2 staff?).tw,kf.	767	Advanced
16	(surgical adj2 personnel?).tw,kf.	282	Advanced
17	(surgical adj2 profession?).tw,kf.	126	Advanced
18	(surgical adj2 facult*).tw,kf.	320	Advanced
19	(surgical adj2 educator?).tw,kf.	235	Advanced
20	(surgical adj2 trainee?).tw,kf.	1897	Advanced
21	(surgical adj2 instructor*).tw,kf.	17	Advanced
22	(clinical adj2 train*).tw,kf.	8882	Advanced
23	specialist?.tw,kf.	103641	Advanced
24	specialti*.tw,kf.	21519	Advanced
25	or/1-24	1916488	Advanced
26	Education/	21201	Advanced
27	Education, Medical/	57966	Advanced
28	Education, Medical, Continuing/	25093	Advanced
29	Education, Professional, Retraining/	1246	Advanced
30	exp Inservice Training/	29490	Advanced
31	Models, Educational/	10308	Advanced
32	exp Professional Competence/	120048	Advanced
33	Clinical Competence/	96230	Advanced
34	Schools, Medical/	26078	Advanced
35	exp Hospitals, Teaching/	52582	Advanced
36	Hospital Medicine/	226	Advanced
37	exp Teaching/	87776	Advanced
38	Learning/	68021	Advanced
39	(continu* adj5 educat*).tw,kf.	28449	Advanced
40	(medical adj5 educat*).tw,kf.	69502	Advanced
41	(surgical adj5 educat*).tw,kf.	5038	Advanced
42	(model? adj2 educat*).tw,kf.	3279	Advanced
43	(module? adj2 educat*).tw,kf.	1145	Advanced
44	(medical adj2 (retrain* or re-train*)).tw,kf.	16	Advanced
45	(surgical adj2 (retrain* or re-train*)).tw,kf.	6	Advanced
46	(specialist? adj2 (retrain* or re-train*)).tw,kf.	13	Advanced
47	(medical adj2 (recertificat* or re-certificat*)).mp,kw.	16	Advanced
48	(surgical adj2 (recertificat* or re-certificat*)).mp,kw.	3	Advanced
49	(specialist? adj2 (recertificat* or re-certificat*)).mp,kw.	16	Advanced
50	((inservice? or in-service?) adj2 train*).tw,kf.	1846	Advanced
51	(staff? adj2 development?).tw,kf.	2099	Advanced
52	(profession* adj2 development?).tw,kf.	12030	Advanced
53	(profession* adj2 competen*).tw,kf.	3150	Advanced
54	(clinical* adj2 competen*).tw,kf.	4635	Advanced
55	((medical or medicine) adj2 (school? or universit* or institut* or college?)).tw,kf.	117949	Advanced
56	((surgical or surgery) adj2 (school? or universit* or institut* or college?)).tw,kf.	5217	Advanced
57	(hospital? adj2 teaching*).tw,kf.	49098	Advanced

58	(hospital? adj2 (medical or medicine)).tw,kf.	22830	Advanced
59	(continu* adj5 teaching*).tw,kf.	773	Advanced
60	(medical adj5 teaching*).tw,kf.	10793	Advanced
61	(surgical adj5 teaching*).tw,kf.	1977	Advanced
62	(model? adj2 teaching*).tw,kf.	1578	Advanced
63	(module? adj2 teaching*).tw,kf.	555	Advanced
64	(continu* adj5 learning*).tw,kf.	3097	Advanced
65	(medical adj5 learning*).tw,kf.	6428	Advanced
66	(surgical adj5 learning*).tw,kf.	1675	Advanced
67	(model? adj2 learning*).tw,kf.	12055	Advanced
68	(module? adj2 learning*).tw,kf.	1547	Advanced
69	or/26-68	627399	Advanced
70	Education, Distance/	4813	Advanced
71	Educational Technology/	1557	Advanced
72	Virtual Reality/	2666	Advanced
73	Computer-Assisted Instruction/	12077	Advanced
74	Computer User Training/	2034	Advanced
75	Computer Communication Networks/	13655	Advanced
76	Online Systems/	8430	Advanced
77	Internet/	75355	Advanced
78	exp Self-Directed Learning as Topic/	14555	Advanced
79	(educat* adj2 technolog*).tw,kf.	2213	Advanced
80	(distance adj2 educat*).tw,kf.	1198	Advanced
81	(distance adj2 learn*).tw,kf.	1776	Advanced
82	(distance adj2 teach*).tw,kf.	91	Advanced
83	(distance adj2 course?).tw,kf.	261	Advanced
84	(distance adj2 lectur*).tw,kf.	2	Advanced
85	(distance adj2 session?).tw,kf.	51	Advanced
86	(distance adj2 seminar?).tw,kf.	3	Advanced
87	(distance adj2 class*).tw,kf.	600	Advanced
88	(distance adj2 (workshop? or work-shop?)).tw,kf.	9	Advanced
89	(distance adj2 curricul*).tw,kf.	18	Advanced
90	(distance adj2 train*).tw,kf.	612	Advanced
91	((online or on-line) adj2 educat*).tw,kf.	2162	Advanced
92	((online or on-line) adj2 learn*).tw,kf.	2834	Advanced
93	((online or on-line) adj2 teach*).tw,kf.	655	Advanced
94	((online or on-line) adj2 course?).tw,kf.	1564	Advanced
95	((online or on-line) adj2 lectur*).tw,kf.	238	Advanced
96	((online or on-line) adj2 session?).tw,kf.	441	Advanced
97	((online or on-line) adj2 seminar?).tw,kf.	46	Advanced
98	((online or on-line) adj2 class*).tw,kf.	615	Advanced
99	((online or on-line) adj2 (workshop? or work-shop?)).tw,kf.	107	Advanced
100	((online or on-line) adj2 curricul*).tw,kf.	311	Advanced
101	((online or on-line) adj2 train*).tw,kf.	1354	Advanced
102	(computer? adj2 educat*).tw,kf.	622	Advanced
103	(computer? adj2 learn*).tw,kf.	1296	Advanced
104	(computer? adj2 teach*).tw,kf.	311	Advanced
105	(computer? adj2 course?).tw,kf.	169	Advanced
106	(computer? adj2 lectur*).tw,kf.	46	Advanced
107	(computer? adj2 session?).tw,kf.	155	Advanced
108	(computer? adj2 seminar?).tw,kf.	8	Advanced
109	(computer? adj2 class*).tw,kf.	825	Advanced
110	(computer? adj2 (workshop? or work-shop?)).tw,kf.	38	Advanced
111	(computer? adj2 curricul*).tw,kf.	49	Advanced
112	(computer? adj2 train*).tw,kf.	1141	Advanced
113	(digital adj2 educat*).tw,kf.	285	Advanced
114	(digital adj2 learn*).tw,kf.	345	Advanced
115	(digital adj2 teach*).tw,kf.	174	Advanced
116	(digital adj2 course?).tw,kf.	44	Advanced
117	(digital adj2 lectur*).tw,kf.	23	Advanced

118	(digital adj2 session?).tw,kf.	34	Advanced
119	(digital adj2 seminar?).tw,kf.	7	Advanced
120	(digital adj2 class*).tw,kf.	215	Advanced
121	(digital adj2 (workshop? or work-shop?)).tw,kf.	23	Advanced
122	(digital adj2 curricul*).tw,kf.	21	Advanced
123	(digital adj2 train*).tw,kf.	191	Advanced
124	(internet? adj2 educat*).tw,kf.	410	Advanced
125	(internet? adj2 teach*).tw,kf.	78	Advanced
126	(internet? adj2 learn*).tw,kf.	177	Advanced
127	(internet? adj2 course?).tw,kf.	102	Advanced
128	(internet? adj2 lectur*).tw,kf.	24	Advanced
129	(internet? adj2 session?).tw,kf.	52	Advanced
130	(internet? adj2 seminar?).tw,kf.	3	Advanced
131	(internet? adj2 class*).tw,kf.	84	Advanced
132	(internet? adj2 (workshop? or work-shop?)).tw,kf.	20	Advanced
133	(internet? adj2 curricul*).tw,kf.	16	Advanced
134	(internet? adj2 train*).tw,kf.	196	Advanced
135	(web adj2 educat*).tw,kf.	691	Advanced
136	(web adj2 teach*).tw,kf.	191	Advanced
137	(web adj2 learn*).tw,kf.	584	Advanced
138	(web adj2 course?).tw,kf.	250	Advanced
139	(web adj2 lectur*).tw,kf.	41	Advanced
140	(web adj2 session?).tw,kf.	92	Advanced
141	(web adj2 seminar?).tw,kf.	20	Advanced
142	(web adj2 class*).tw,kf.	130	Advanced
143	(web adj2 (workshop? or work-shop?)).tw,kf.	29	Advanced
144	(web adj2 curricul*).tw,kf.	132	Advanced
145	(web adj2 train*).tw,kf.	402	Advanced
146	(video* adj2 educat*).tw,kf.	1781	Advanced
147	(video* adj2 teach*).tw,kf.	708	Advanced
148	(video* adj2 learn*).tw,kf.	420	Advanced
149	(video* adj2 course?).tw,kf.	118	Advanced
150	(video* adj2 lectur*).tw,kf.	404	Advanced
151	(video* adj2 session?).tw,kf.	967	Advanced
152	(video* adj2 seminar?).tw,kf.	24	Advanced
153	(video* adj2 class*).tw,kf.	416	Advanced
154	(video* adj2 (workshop? or work-shop?)).tw,kf.	57	Advanced
155	(video* adj2 curricul*).tw,kf.	56	Advanced
156	(video* adj2 train*).tw,kf.	1217	Advanced
157	(recorded adj2 course?).tw,kf.	325	Advanced
158	(recorded adj2 lectur*).tw,kf.	118	Advanced
159	(recorded adj2 session?).tw,kf.	764	Advanced
160	(recorded adj2 seminar?).tw,kf.	14	Advanced
161	(recorded adj2 class*).tw,kf.	687	Advanced
162	(recorded adj2 (workshop? or work-shop?)).tw,kf.	15	Advanced
163	(recorded adj2 curricul*).tw,kf.	4	Advanced
164	(electronic adj2 educat*).tw,kf.	261	Advanced
165	e-educat*.tw,kf.	52	Advanced
166	(electronic adj2 teach*).tw,kf.	90	Advanced
167	(eteach* or e-teach*).tw,kf.	33	Advanced
168	(electronic adj2 learn*).tw,kf.	340	Advanced
169	(elearn* or e-learn*).tw,kf.	3386	Advanced
170	(electronic adj2 course?).tw,kf.	50	Advanced
171	(ecourse? or e-course?).tw,kf.	47	Advanced
172	(electronic adj2 lectur*).tw,kf.	13	Advanced
173	(electur* or e-lectur*).tw,kf.	15	Advanced
174	(electronic adj2 session?).tw,kf.	34	Advanced
175	(esession? or e-session?).tw,kf.	8	Advanced
176	(electronic adj2 seminar?).tw,kf.	6	Advanced
177	(eseminar? or e-seminar?).tw,kf.	1	Advanced

178	(electronic adj2 class*).tw,kf.	192	Advanced
179	(eclass* or e-class*).tw,kf.	313	Advanced
180	(electronic adj2 (workshop? or work-shop?)).tw,kf.	29	Advanced
181	(eworkshop? or e-workshop?).tw,kf.	5	Advanced
182	(ework-shop? or e-work-shop?).tw,kf.	0	Advanced
183	(electronic adj2 curricul*).tw,kf.	36	Advanced
184	(ecurricul* or e-curricul*).tw,kf.	16	Advanced
185	(electronic adj2 train*).tw,kf.	153	Advanced
186	(etrain* or e-train*).tw,kf.	99	Advanced
187	mobile educat*.tw,kf.	40	Advanced
188	(meducat* or m-educat*).tw,kf.	46	Advanced
189	mobile teach*.tw,kf.	7	Advanced
190	(mteach* or m-teach*).tw,kf.	5	Advanced
191	mobile learn*.tw,kf.	214	Advanced
192	(mlearn* or m-learn*).tw,kf.	82	Advanced
193	mobile course?.tw,kf.	1	Advanced
194	(mcourse? or m-course?).tw,kf.	78	Advanced
195	mobile lectur*.tw,kf.	0	Advanced
196	(mlectur* or m-lectur*).tw,kf.	0	Advanced
197	mobile session?.tw,kf.	9	Advanced
198	(msession? or m-session?).tw,kf.	10	Advanced
199	mobile seminar?.tw,kf.	2	Advanced
200	(mseminar? or m-seminar?).tw,kf.	1	Advanced
201	mobile class*.tw,kf.	18	Advanced
202	(mcalss* or m-class*).tw,kf.	466	Advanced
203	(mobile adj2 (workshop? or work-shop?)).tw,kf.	11	Advanced
204	(mworkshop? or m-workshop?).tw,kf.	0	Advanced
205	(mwork-shop? or m-work-shop?).tw,kf.	0	Advanced
206	mobile curricul*.tw,kf.	1	Advanced
207	(mcurricul* or m-curricul*).tw,kf.	0	Advanced
208	mobile train*.tw,kf.	31	Advanced
209	(mtrain* or m-train*).tw,kf.	55	Advanced
210	(teleeducat* or tele-educat*).tw,kf.	197	Advanced
211	(teleteach* or tele-teach*).tw,kf.	47	Advanced
212	(telelearn* or tele-learn*).tw,kf.	19	Advanced
213	(telecourse? or tele-course?).tw,kf.	8	Advanced
214	(telelectur* or tele-lectur*).tw,kf.	18	Advanced
215	(telesession? or tele-session?).tw,kf.	8	Advanced
216	(teleseminar? or tele-seminar?).tw,kf.	0	Advanced
217	(teleclass* or tele-class*).tw,kf.	3	Advanced
218	(teleworkshop? or tele-workshop?).tw,kf.	0	Advanced
219	(telework-shop? or tele-work-shop?).tw,kf.	0	Advanced
220	(telecurricul* or tele-curricul*).tw,kf.	0	Advanced
221	(teletrain* or tele-train*).tw,kf.	21	Advanced
222	(self-directed adj2 educat*).tw,kf.	203	Advanced
223	(self-directed adj2 teach*).tw,kf.	47	Advanced
224	(self-directed adj2 learn*).tw,kf.	1853	Advanced
225	(self-directed adj2 course?).tw,kf.	28	Advanced
226	(self-directed adj2 lectur*).tw,kf.	12	Advanced
227	(self-directed adj2 session?).tw,kf.	42	Advanced
228	(self-directed adj2 seminar?).tw,kf.	3	Advanced
229	(self-directed adj2 class*).tw,kf.	10	Advanced
230	(self-directed adj2 (workshop? or work-shop?)).tw,kf.	6	Advanced
231	(self-directed adj2 curricul*).tw,kf.	43	Advanced
232	(self-directed adj2 train*).tw,kf.	112	Advanced
233	(non-classroom? or non-classroom?).tw,kf.	14	Advanced
234	webinar?.tw,kf.	872	Advanced
235	virtual*.tw,kf.	138414	Advanced
236	(VR adj2 simulation?).tw,kf.	357	Advanced
237	(technolog* adj2 simulation?).tw,kf.	741	Advanced

238	avatar*.tw,kf.	1437	Advanced
239	second-life?.tw,kf.	279	Advanced
240	or/70-239	270982	Advanced
241	25 and 69 and 240	14257	Advanced
242	(physician? adj3 profession* develop*).tw,kf.	120	Advanced
243	(surgeon? adj3 profession* develop*).tw,kf.	31	Advanced
244	PCPD.tw,kf.	43	Advanced
245	CME-CPD.tw,kf.	48	Advanced
246	(CME adj10 certificat*).tw,kf.	71	Advanced
247	(CME adj10 simulation?).tw,kf.	41	Advanced
248	((online or on-line) adj2 CME).tw,kf.	125	Advanced
249	(computer? adj2 CME).tw,kf.	11	Advanced
250	(digital adj2 CME).tw,kf.	1	Advanced
251	(internet? adj2 CME).tw,kf.	22	Advanced
252	(web adj2 CME).tw,kf.	18	Advanced
253	(teleCME or tele-CME).tw,kf.	0	Advanced
254	(mCME or m-CME).tw,kf.	30	Advanced
255	(eCME or e-CME).tw,kf.	45	Advanced
256	or/241-255	14718	Advanced
257	exp animals/ not (exp animals/ and exp humans/)	4813301	Advanced
258	256 not 257	14677	Advanced
259	limit 258 to (clinical conference or consensus development conference or consensus development conference, nih or news or newspaper article or patient education handout or personal narrative)	81	Advanced
260	258 not 259	14596	Advanced
261	limit 260 to yr="1991 -Current"	13771	Advanced

Appendix B. Alphabetical list of included articles

*Indicates articles not referenced in the body of the manuscript	
Citation	Publication year
[44]Abawi K, Gertiser L, Idris R, et al. A large-scale Internet/computer-based, training module: dissemination of evidence-based management of postpartum hemorrhage to front-line health care workers. *IJEL*. 2017;16(4)317-328.	2017
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Bashook PG, Parboosingh J. Recertification and the maintenance of competence. *BMJ*. 1998;316(7130):545-8.	1998
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