

Virtual Learning in Neurosurgery during the COVID-19 Pandemic, a Systematic Literature Review

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BACKGROUND: The coronavirus disease 2019 (COVID-19) pandemic is considered one of our time's most significant global health crises, and its sequel is expected to be long-lasting. The shutdown of institutions, social distancing requirements, and decreased elective surgical exposure have disturbed neurosurgical training and education worldwide.

REVIEW: This review examines initiatives adopted to provide continued medical education for surgeons, trainees, and medical students during the pandemic. A systematic review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) protocol; quiring PubMed, Cochrane COVID-19 Study Register, Scopus, and Google Scholar for ("COVID-19" AND "Education" AND "Neurosurgery"). Out of 598 studies, 21 articles met the inclusion criteria. Studies showed that many institutions and societies worldwide adopted virtual learning for continuing medical education during the pandemic.

CONCLUSION: Data showed that online educational methods added educational value that can be considered an adjunct or replacement for traditional learning methods. It proved effective and carried a high satisfaction and engagement rate between surgeons, trainees, and medical students in neurosurgery.

KEYWORDS: Neurosurgical training, Online learning, Virtual learning.

INTRODUCTION

Since the onset of the novel coronavirus disease 2019 (Covid-19) pandemic and the imposition of restrictions on gathering, teaching-learning activities have been severely limited, and as we enter a post-pandemic era, it is reasonable to hope for a return to normalcy. However, dismissing the innovative teaching strategies that evolved as we survived the COVID-19 crisis would be remiss.

The primary intent of this review is to assess the feasibility of virtual learning worldwide for neurosurgical training and highlight initiatives that arose during the pandemic that reduced the burden on training programs. Secondly, we report perspectives regarding the pandemic's impact on medical education, evaluate online webinars as an alternative educational tool and explore the role that virtual medical education may play in the future of neurosurgical training.

MATERIALS AND METHODS

This systematic literature review was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA 2020). PubMed, Cochrane COVID-19 Study Register, Scopus, and Google

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Scholar were queried using the following search terms; "COVID-19" AND "Education" AND "Neurosurgery."

The search was limited to studies published during the pandemic (January 2020-July 12th, 2022). Studies were screened for inclusion and exclusion criteria. Briefly, we included studies reporting the extent of the influence of the COVID-19 pandemic on neurosurgery training and education, studies exploring changes in training program dynamics and adaptation, and studies mentioning the standpoint of neurosurgeons, spinal surgeons, trainees, and medical students on the impact of COVID-19 on their training and education. Studies published before January 2020, review articles, studies with mixed cohorts (not limited to neurosurgeons and spinal surgeons), letters to the editor, editorials, and abstracts were eliminated.

Studies were identified through a comprehensive and systematic search of databases between July 12, 2022, to July 18, 2022. The search encompassed terms related to "COVID-19" AND "Education" AND "Neurosurgery," limited to titles only in the google scholar database. Literature research results were imported into the Rayyan web for systematic reviews, article selection, and duplications. Titles and abstracts were screened based on eligibility criteria.

RESULTS

The screening and study selection process is shown in **Fig. 1**. A total of 598 articles were identified; following duplication removal of 181 articles, 417 titles and

abstracts were examined. Two hundred twenty-four articles were banned as they did not focus on desired cohorts. One hundred five were excluded for the weak level of evidence, e.g., letters to editors, editorials, and abstracts. Fifty-five were excluded as they did not report outcomes. Two were excluded because they were not accessible in English.

Ultimately, this systematic review collected data from 21 articles. twelve surveys from neurosurgical programs worldwide, two global surveys for surgeons' perspectives on virtual experience, three reporting virtual initiatives towards medical students' neurosurgery education, and the rest highlighting global educational activities.

Shift to virtual teaching

During the COVID-19 pandemic, many institutions worldwide were prompted to adopt virtual teaching and learning methods. As such, there has been a rapid transition and increased favor of virtual meeting platforms, including Zoom, Microsoft teams, Google Meet and Skype. Several cross-sectional studies have assessed the use of virtual learning methods among surgeons, surgical trainees, and medical students.

In Nepal, early restrictions and adherence to "social distancing" led to the use of virtual meetings at the Neurosurgery department of Tribhuvan University Teaching hospital. These monthly educational meetings included trainees and faculty from Nepal, the United States, and Sweden who were surveyed after one year of participation. All participants reported expansion of their knowledge with this form of education, and less than half reported issues with audio and visual connection during the meetings or challenges due to viewing from different time zones.¹

Turkey is among the countries that were most affected by the COVID-19 pandemic. There was a 37% COVID infection rate among the neurosurgical trainees on the front lines. Online teaching strategies were developed in approximately half of the institutions in response to high trainee COVID infection rates, reduced clinical training opportunities, and social distancing guidelines. Of the surveyed trainees, 29.4% received combined online/face-to-face education, 21.3% experienced a complete shift to online teaching, 11% continued with entirely in-person training, and a significant proportion (38.3%) received no academic sessions at all. More than half of the respondents (58.3%) indicated that the online sessions were at least as valuable as in-person educational experiences.²

Similarly, in Italy, the reduction in time spent in surgical practice was translated into increased educational and scientific activities. With the increasing availability of seminars and webinars, most trainees (64.4%) noted an increase in theoretical educational activity. Online educational activities were conducted primarily on a national and regional basis through a vast network of residency programs.³ In southern Asia, COVID-19 affected all aspects of neurosurgical training. Among the

Indonesian residents, webinars were most popular, with 91% of respondents reporting the use of online lectures twice weekly or more. However, 68% of the Thai residents had attended one or fewer webinars per month.⁴ In a survey of neurosurgical trainees in Europe, 92.5% reported participation in virtual education experiences, with 56.7% reporting a positive impact on their training, and nearly half (44%) agreed that these online activities could be incorporated into future training.⁵ In African countries, only 43.9% reported having received online departmental teaching. 12% received online national education and 59% logged onto international webinars.⁶ In five large university hospitals in Egypt, educational methods were changed to virtual by 88% compared to 30% pre-pandemic.⁷

In India, a significant shift was observed from classroom teaching (25.42%) to online video conferencing sessions (61.02%). Around 73.7% of respondents reported attending classes/webinars during the lockdown. and 84.6% of the residents were willing to participate in online activities and reported the advantage of communication with professional colleagues through virtual learning and webinars.^{8,9}

Almost all neurosurgery training programs in the United States shifted to online training strategies such as video conferencing. 87.5% of respondents indicated that their programs provided didactics online while 12.5% had combined in-person and online components. Half of respondents reported that the online format was better than in person, 12.5% felt it was comparable, and 37.5% thought the online didactics were worse than in-person training.¹⁰ Similarly, a median of participants strongly agreed that they would continue to use virtual conferences, even after the pandemic. Furthermore, the median respondents agreed that the virtual conference would partially replace traditional meetings.¹¹

More than 80% of AO Spine members (one of the eminent international societies of spine surgeons worldwide) were interested in online spine education and 93% utilized online communication platforms for communication with other surgeons¹²

Responders of a global survey from 96 countries reported a notable impact of virtual education, with 55.7% stating they would change aspects of their practice because of virtual learning. The majority acknowledged that virtual learning activities enhanced their knowledge of the best evidence-based practice (65.7%) and the level of care they delivered to their patients (62.1%). They would also consider alternative management strategies for their patients based on the knowledge they had received from virtual sessions (63.4%). Many pointed out that virtual learning had helped them improve patient outcomes (56.7%) and communicate better with professional colleagues (63.6%). Furthermore, most respondents found that virtual activities equipped them with networking opportunities (58.4%) and indicated

that their participation in future learning activities would likely grow (69.7%).¹³

Initiatives for medical students

The COVID-19 pandemic had an equivalent impact on medical students as surgical trainees. Most medical schools were forced to transition to virtual forms.

Martini et al. reported a virtual interactive neurosurgery course consisting of 16 biweekly one-hour sessions over two months in June and July 2020. Online seminars were well attended, with 595-course registrants and an average of 82 live student participants in each lecture. The mean post-course confidence was 7.79 ± 0.19 , denoting an improvement from 3.13 ± 0.38 ($P < 0.0001$). When queried about the usefulness of this learning method in the post-pandemic time, 96.9% believed that online virtual interactive courses would be useful.¹⁴

At the Irish medical school, National University of Ireland Galway (NUIG), two neurosurgical lecture days series were organized virtually to enrich their knowledge and exposure to the specialty. (62%) attendees agreed that they want to receive future teaching and clinical orientation in neurosurgery as part of their undergraduate medical education.¹⁴

Eight neurosurgery institutions offered an online training camp for medical students. There were 305 medical students registered for the event, with 107 being U.S medical students. (100%) of the post-camp survey, responders desired a future annual virtual training camp. (65%) reported improved neurosurgical knowledge, and (82.5%) reported increased enthusiasm toward neurosurgery as a specialty.¹⁵

The reason behind favoring this form of education is that it allows an increase in program varieties and increases participation with reduced costs for students.

The Saudi Association of Neurological Surgery (SANS) initiative:

The SANS academy of education produced twenty-six virtual education webinars through teleconferencing Zoom. These webinars were provided by board-certified neurosurgical faculty and covered most neurosurgical specialties, including spine, vascular, skull-base, oncology, pediatrics, and functional and epilepsy neurosurgery. Of the attendings and residents that participated, the overwhelming majority reported a high satisfaction rate with this learning experience (>80%), 81.2% of the residents were more comfortable attending and asking questions at online webinars than traditional lectures, while only 56.4% reported the same. Additionally, 75.4% of residents preferred online webinars to traditional classes, compared with 52.7%.¹⁷

2020 International Web-Based Neurosurgery Congress (2020 IWBNC)

The Center for Research and Training in Neurosurgery

(Centro de Investigación y Entre- Nacimiento en Neurocirugía [CIEN]) developed the 2020 International Web-Based Neurosurgery Congress (2020 IWBNC). The first 3-day international neurosurgery congress with a double-room method was carried out virtually, hosted 25 internationally well-known speakers and offered 30 top-of-the-line multidisciplinary conferences. Three thousand ninety-six people from 125 countries attended it, moreover, 22,266 live-stream views were registered. Around 92% of attendees agreed that participating in the 2020 IWBNC enhanced their neurosurgical practice, and 95.4% felt that it was highly likely (>50% chance) that they would participate in various virtual academic activities once the pandemic had ended. Around 69% perceived that their 2020 IWBNC experience was comparable to or better than in-person events in knowledge acquisition.¹⁸

Virtual Global Spine Conference

The Virtual Global Spine Conference (VGSC) is a multi-institutional, multidisciplinary, international collaboration of spine fellowship-trained neurosurgeons and a board-certified neuroradiologist. It was established in April 2020. It was made to facilitate access to spine education after the academic disruption created by the COVID-19 pandemic. During the early phase of the pandemic, lectures were launched in biweekly virtual meetings hosted through the Zoom teleconferencing platform. Lectures were provided by national and international neurosurgical and orthopedic spine surgeons and neuroradiologists by faculty invitation and self-volunteering. In a study, 92% of VGSC participants deemed the content as valuable, and 94% continued attending it post-pandemic. Since the establishment of VGSC to date (July 26, 2022), 1532 surgeons and trainees have registered with Zoom, a total of 1961 YouTube subscribers, with 47 new subscribers registered in the last 28 days. There are 65,498 YouTube views and 9700 hours watch time.¹⁹

DISCUSSION

The COVID-19 pandemic gathering restrictions have demanded the adoption of rapid alternation in the healthcare system and organizations. Surgical specialties, including neurosurgery and orthopedic surgery, were among the most affected as healthcare resources were preserved in fighting the pandemic.

Our systematic review of surveyed neurosurgery trainees globally showed alteration in elective surgical cases, reduced time spent in the neurosurgery department, limited real-time theater/operative experience, decreased variety of pathologies treated by trainees, residents being deployed to other departments, and being with the first-line fighters of the pandemic, which led to a significant change in their training and education structure of neurosurgery.

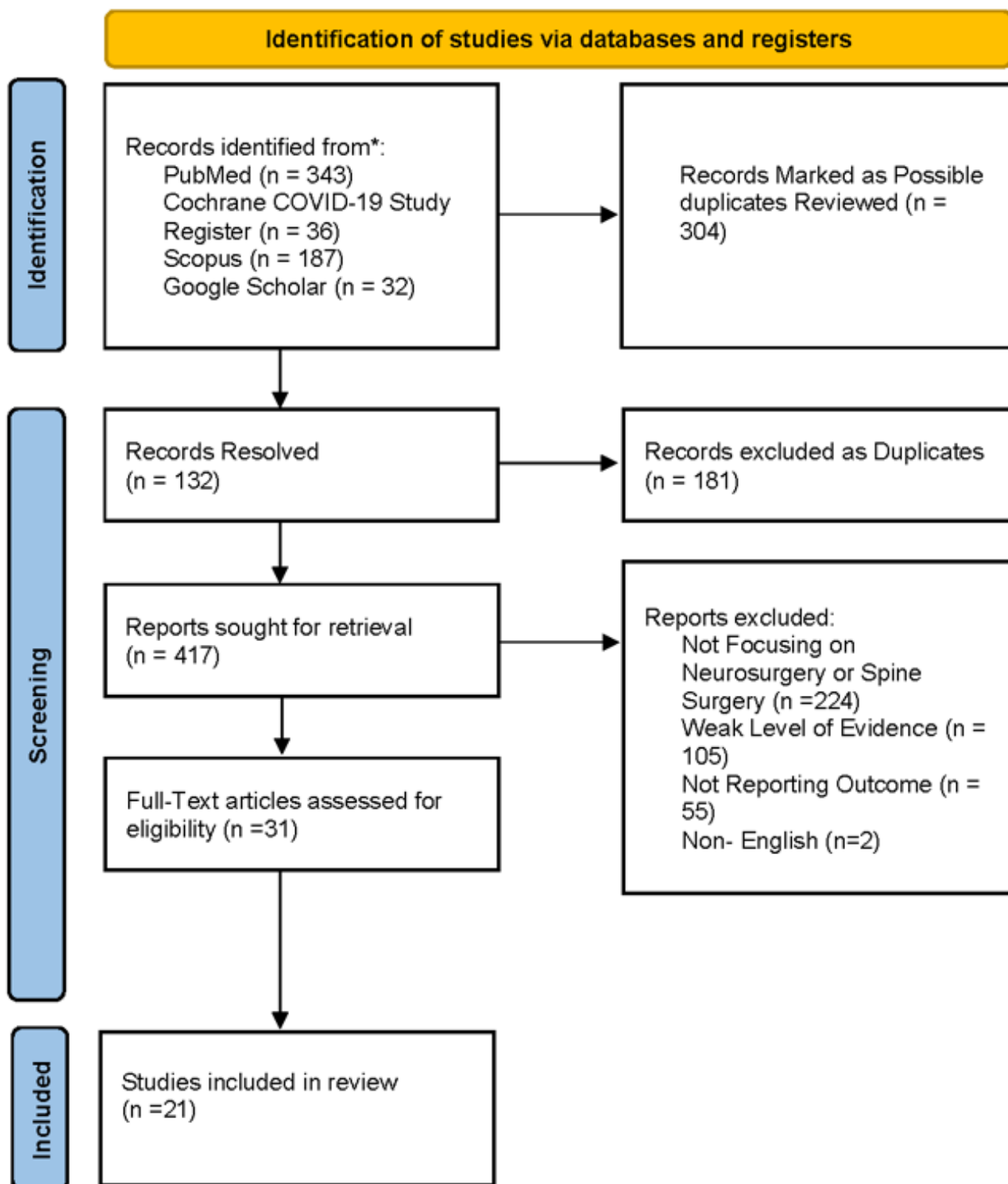


Fig 1: PRISMA flow diagram of the included searches of databases and registers only.

A need to enhance new technological solutions arose. Interestingly, virtual forms of education have been proposed as a possible solution. Virtual conferencing during the pandemic played a significant role as a preferred communication and education method.

This method has the advantages of widespread accessibility, reduced cost, and a variety of content for learning. Greater importance is that it encouraged teaching and learning activities more frequently. Our review showed that online resources are widely accepted by trainees and medical students who previously struggled to afford traveling for externships, conferences abroad, or joining teaching hospitals. One might also argue that most trainees were already students of digital medium use, which might have contributed to their easier transition and receptiveness to virtual learning. Adopting virtual learning in educating neurosurgery residents will enrich their experience and allow for more regional collaboration and communication.

A significant downside to virtual learning is the lack of physical operative experience, a vital part of any surgical training. Unfortunately, the psychological, mental, and social benefits of in-person relationships that contribute positively to learning experiences cannot be afforded online. Discrepancies in resources are also another limiting factor for virtual learning. This might be well explained by the fact that only 43.9% of Africans reported having received online departmental teaching and 12% received online national education.

CONCLUSION

The Covid-19 pandemic has significantly affected neurosurgical education and training during the last three years. Many institutions and societies, however, have adapted well with integrating either entirely virtual or hybrid opportunities into their curricula.

List Of Abbreviations

CIEN: Centro de Investigación y Entre- Nacimiento en Neurocirugía.

Covid-19: Coronavirus disease 2019.

IWBNC: International Web-Based Neurosurgery Congress.

NUIG: National University of Ireland Galway.

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analysis.

SANS: Saudi Association of Neurological Surgery.

VGSC: Virtual Global Spine Conference.

Disclosure

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