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Developing a Web-Based Congress: The 2020 International Web-Based Neurosurgery Congress Method

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■ **BACKGROUND:** Continuing medical education and continuing professional development have been affected by the ongoing 2019 novel coronavirus disease (COVID-19) pandemic. Therefore, we developed the 2020 International Web-Based Neurosurgery Congress (2020 IWBNC), which became the first successful virtual neurosurgical congress. The aim of this article was to describe the experience designing and organizing a web congress by the 2020 IWBNC method.

■ **METHODS:** The 2020 IWBNC was organized by the Center for Research and Training in Neurosurgery (Centro de Investigación y Entrenamiento en Neurocirugía [CIEN]) in a record time of 4 weeks. Eight committees were created and assigned a specific task. The event followed a strict protocol based on the double-room method, which consisted of 2 virtual rooms (A and B) hosted from 4 different physical locations to avoid lecture overlapping and connection drops. Quality and impact were measured by a videoconferencing platform and social media parameters as well as an audience perception survey.

■ **RESULTS:** High quality was achieved in academic standards, worldwide assistance, schedule adherence, and security. The 2020 IWBNC hosted 25 internationally

renowned speakers and offered 30 top-of-the-line multidisciplinary conferences. There were 3096 participants from 125 countries, and 22,266 live-stream views were registered. No technical or cybersecurity-related issues occurred.

■ **CONCLUSIONS:** Web-based academic meetings will continue to be a helpful educational tool for continuing medical education and continuing professional development. The 2020 IWBNC double-room method represents an alternative design that may be replicated by the academic community planning web congresses and similar events.

INTRODUCTION

Continuing medical education (CME) and continuing professional development have been affected as a result of the 2019 novel coronavirus disease (COVID-19) pandemic.¹⁻⁹ Consequently, medical education departments have tried to devise virtual-based solutions for this critical situation.^{3,4,10-14} Nonetheless, there has been an indisputable presence of design flaws in these web-based events, including low-quality recordings, tardiness, cancellations, connection drops, poor

Key words

- COVID-19
- Congress
- Continuing medical education
- Continuing professional development
- Medical education
- Professional education

Abbreviations and Acronyms

2020 IWBNC: 2020 International Web-Based Neurosurgery Congress
AANS: American Association of Neurological Surgeons
CIEN: Center for Research and Training in Neurosurgery (Centro de Investigación y Entrenamiento en Neurocirugía)
CME: Continuing medical education
CNS: Congress of Neurological Surgeons
COVID-19: 2019 novel coronavirus disease
CTC: Cybersecurity and technology committee
EANS: European Association of Neurosurgical Societies
GSC: Global Spine Congress

KASS: Korean American Spine Society

NASS: North American Spine Society

Q&A: Questions and answers

SWOT: Strengths, weaknesses, opportunities, and threats

WFNS: World Federation of Neurosurgical Societies

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Citation: *World Neurosurg.* (2021) 148:e415-e424.
<https://doi.org/10.1016/j.wneu.2020.12.174>

Journal homepage: www.journals.elsevier.com/world-neurosurgery

Available online: www.sciencedirect.com

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marketing strategies, as well as critical security breaches and cyber attacks.^{3,4,8,15,16}

Aiming to promote free and high-quality CME and continuing professional development opportunities, the Center for Research and Training in Neurosurgery (Centro de Investigación y Entrenamiento en Neurocirugía [CIEN]) developed the 2020 International Web-Based Neurosurgery Congress (2020 IWBNC). As a nonprofit organization affiliated with 3 leading university hospitals, CIEN has had previous experience organizing international hands-on courses, conferences, live surgery broadcasts, and webinars before the COVID-19 pandemic. Nonetheless, the 2020 IWBNC was the first event of its kind and became the first successful 3-day virtual world-class neurosurgery congress as well as the team's first congress. The 2020 IWBNC hosted 25 internationally renowned speakers, offered 30 top-of-the-line multidisciplinary conferences, reached 3096 participants from 125 countries, and registered 22,266 live stream views. The aim of this study was to present a methodological description of the 2020 IWBNC to highlight its success from technical, cybersecurity, academic, and scientific perspectives.

MATERIALS AND METHODS

How 2020 IWBNC Was Developed

Planning Stage. The planning stage, which began in April 2020, required an effective working time of approximately 280 hours per person distributed over 4 weeks. This stage started with the creation of 7 committees (Figure 1). Each committee was composed of various staff members, including neurosurgeons, neurosurgery residents, research fellows, engineers, volunteers, and marketing specialists (Supplemental Table 1). Committee objectives were created according to the SWOT (strengths, weaknesses, opportunities, and threats) matrix.¹⁷ These objectives arose from 5 key points (Supplemental Figure 1), which were used for the development of all the 2020 IWBNC protocols.

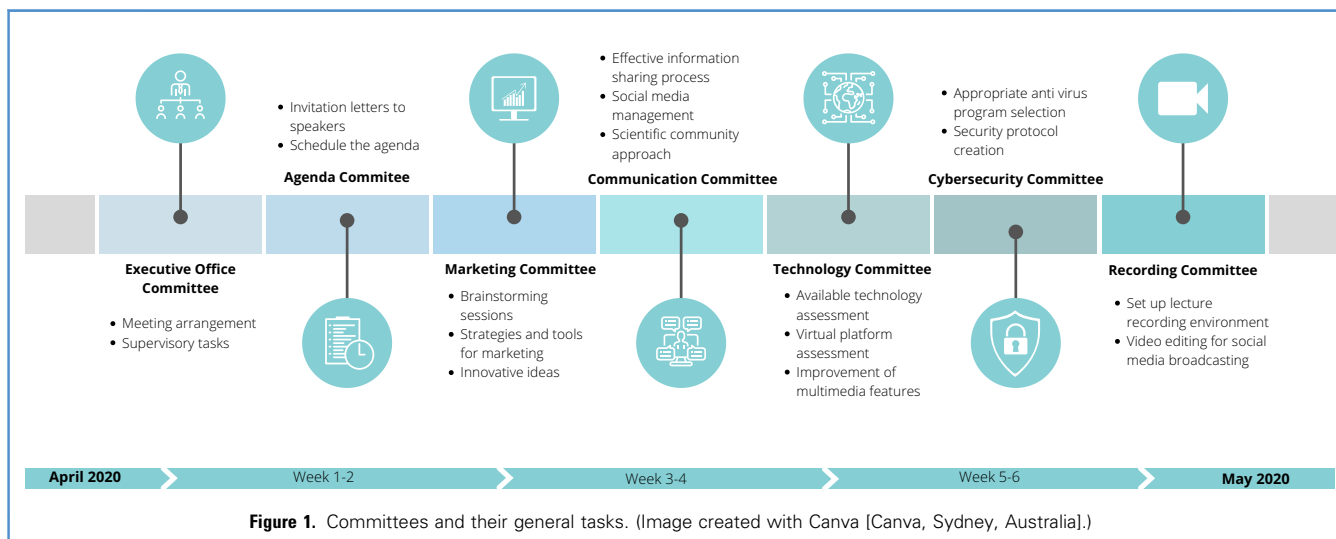
To standardize the execution of tasks and prevent situations caused by poor coordination between team members, the

following 8 protocols along with checklists were developed (Supplemental Table 2):

1. Setting a webinar: Standardizing webinar features to restrict interactions between the audience and the speakers beyond the questions and answers (Q&A) sessions.
2. Scheduling a webinar: Standardizing conference features that allow easy access to all participants.
3. Cybersecurity: Blocking access to any malicious software or person throughout the congress.
4. Aborting sabotage: Re-establishing control of the online meeting when sabotage is attempted.
5. Preconference training: Verifying conference credentials, defining the schedule, and instructing the speakers in the correct use of the chosen online platform.
6. Launch: Adjusting settings to ensure a correct webinar launch.
7. Prebroadcasting: Establishing a connection with the speaker and briefing the speaker about conference dynamics.
8. Connection protection: Maintaining control over the meeting in case of an unexpected host connection drop.

When defining the date and time of the 2020 IWBNC, the organizers considered the academic calendars from major neurosurgical scientific meetings to avoid overlapping, the time zone of the speakers, and the global distribution of previous registrants in the CIEN database. The duration of each presentation and Q&A section was set at 40 and 20 minutes, respectively.

A rigorous selection of speakers was conducted to include prominent and renowned personalities from 6 neurosurgical domains: vascular, oncological, spine, pediatric, functional, and education. The list included neurosurgeons, spine surgeons, neuroradiologists, neuropathologists, and neuro-oncologists from around the world. Career trajectory, academic and professional affiliations, and scientific contributions (published articles and book chapters) were the cornerstones of the selection process.



Combining the aforementioned requirements, 75 speakers were preselected. Invitations were sent in 3 consecutive stages, with a 10-day interval between stages. In the first stage, 30 speakers were invited, with an acceptance rate of 26.7%. In the second stage, 39 speakers were invited, with an acceptance rate of 28.2%. Finally, in the third stage, 6 speakers were invited, and the acceptance rate was 100%. A total of 25 speakers accepted the invitation to participate. The main reason for not participating was speaker unavailability.

After the invitation was accepted, each speaker received 3 potential slots for scheduling their lecture. The time slots were then assigned on a rolling basis. If 2 speakers selected the same time slot, an agreement was reached according to the availability of each lecturer.

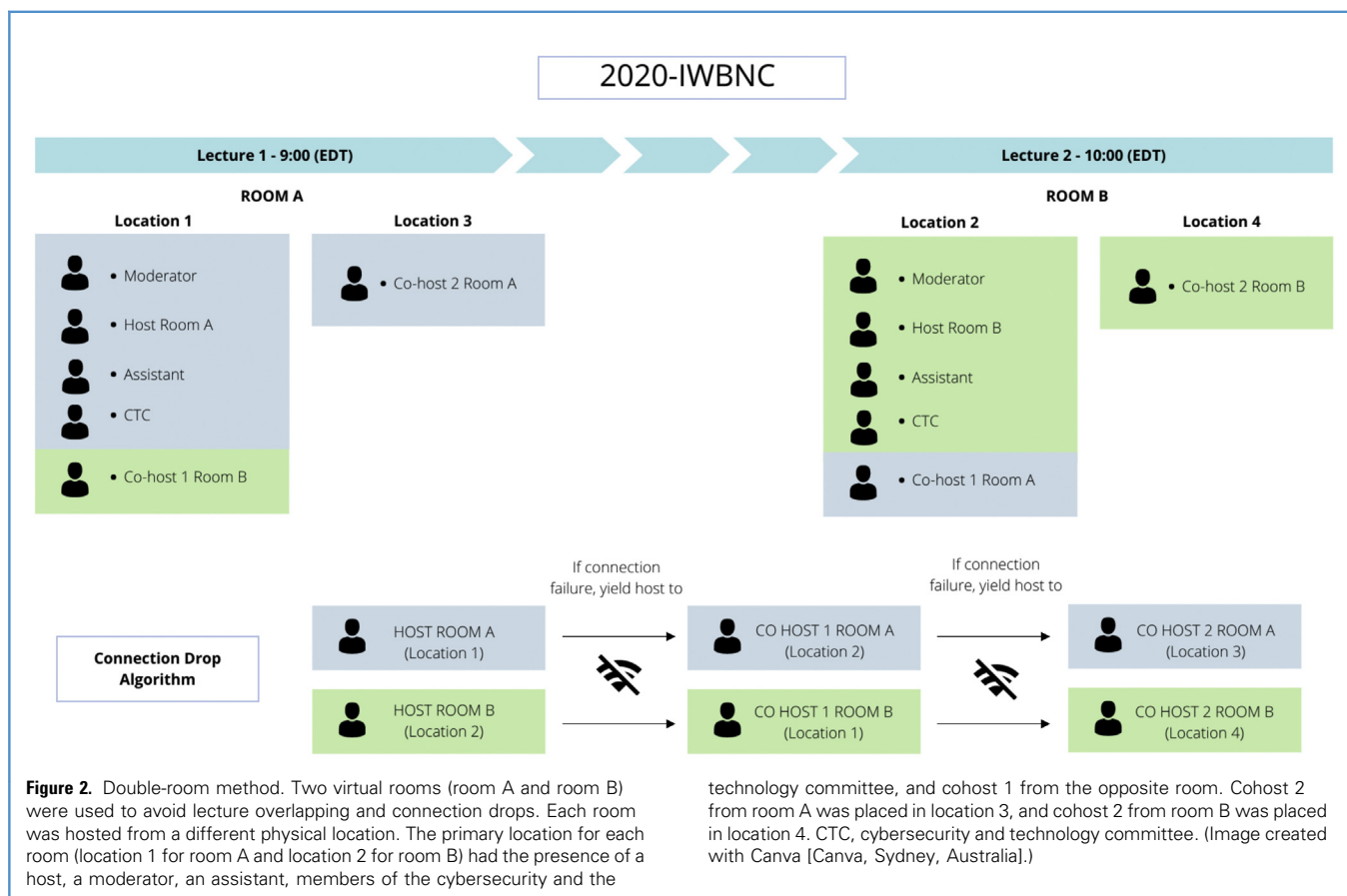
Using faculty information and assisted by a web-development company, the communication and marketing committees designed the schedule, brochure, invitations, e-mails, and website. Those elements were released 2 weeks before the congress started through a multistage marketing strategy (see Executive Stage).

Choosing a video conference platform was the responsibility of the cybersecurity and technology committee (CTC). A rigorous evaluation of 8 attributes (interaction, connectivity, security, accessibility, live streaming, prebroadcasting options, costs, and

previous experiences) from 5 different platforms was performed. A decision was made to use Zoom (Zoom Inc., San Jose, California, USA). These committees also examined and selected the best technological devices (e.g., laptops, modems, routers, and cables) to be used during the congress. A minimum requirement of an emergency power system and a broadband fiber-optic set with at least 200 Mbps streaming speed was set for each location. All computers were connected to the internet through a 1-Gbps shielded ethernet cable to guarantee a stable network connection. Finally, to avoid hazards or tripping accidents, safe transit corridors were delimited.

Executive Stage. The executive stage consisted of the development of activities related to the double-room organization method, simulations, training, marketing, and congress execution itself. Each activity had a corresponding checklist according to the previously established protocols (Supplemental Table 2). As in the planning stage, goals were analyzed under the SWOT matrix strategy (Supplemental Figure 2).¹⁷

The double-room method comprised 2 virtual rooms (room A and room B) hosted from 4 different physical locations to avoid lecture overlapping and connection drops. Both virtual rooms were controlled from 2 separate Zoom accounts. A total of 30



password-encrypted video conferences were hosted, distributed 15:15 in each room.

Each room was managed by 1 host and 2 cohosts whose central task was to maintain uninterrupted broadcasting. Each cohost was stationed in a different location to ensure permanent control over the meeting in case of connection failure. Furthermore, each room was permanently supported by a staff team composed of a moderator, who introduced the speaker and conducted the Q&A section; an assistant, who maintained communication between rooms; and members of the CTC (Figure 2). In a scenario of sudden host disconnection, the first cohost (placed in a second location) would automatically assume command of the meeting until it finished. The second cohost (placed in a third location) would remain alert in case the first cohost was disconnected. Moreover, if abrupt speaker disconnection occurred, the CTC members would be prepared to provide technical assistance immediately.

After establishing the rooms, preconference simulations were carried out testing possible normal and disruptive scenarios. Simulations of normal scenarios helped revise scripts, prepare moderators, check the standard conference dynamics, optimize room migration between lectures, and evaluate the ease of access to the conferences through the website. Meanwhile, turmoil simulations prepared staff in case of host or cohost disconnections, helped overcome potential hacker attacks, enabled staff to be prepared in case of speaker delays, and served as training to manage major technical failures.

Concerning cybersecurity and technical aspects, organizers implemented preventive measures, such as the use of an 8-core shield antivirus, the generation of ethical hacking simulations using Kali Linux (Offensive Security Services, LLC, New York, New York, USA), the development of the double-room method, and the restriction of audience interaction. This last constraint was achieved by disabling the annotation panel, remote control, chat, camera, microphone, raise-hand, anonymous questions, and rename options on Zoom.

Regarding preconference training, the committees arranged an initial appointment with each speaker. During each training session, the CTC members instructed speakers on the correct use of Zoom, verified conference credentials and schedule, requested an emergency phone contact from the speaker, confirmed the e-mail address of the speaker (to be included in the panelist invitation on Zoom website), and provided instructions about the conference specifics.

The multistage marketing process involved positioning, distribution, communication, and promotion strategies. The targeted audience encompassed medical students, physicians, neurology and neurosurgery residents and attending physicians, neuroscientists, neuropsychologists, spine surgeons, and orthopedists. E-mail campaigns were developed using an automation platform (Mailchimp; The Rocket Science Group, LLC, Atlanta, Georgia, USA). Concerning social media management, efforts focused on sharing information through neurosurgery interest groups on Facebook, Instagram, Twitter, Telegram, YouTube, LinkedIn, and WhatsApp. Simultaneously, some neurosurgical societies, including the American Association of Neurological Surgeons (AANS), North American Spine Society

(NASS), and Korean American Spine Society (KASS), among others, and speakers agreed to share the 2020 IWBNC details (brochure, agenda, schedule, and invitation) on their official websites and social media.

Although an uninterrupted conference list was displayed on our website, every consecutive lecture was hosted by a different virtual room (either room A or room B) (Figure 3). In each room, the prebroadcasting session took place 30 minutes before starting the lecture. During this session, all staff members and the speaker accessed the virtual room. Once the speaker joined, the moderator would explain the conference details and measures to be taken in case of a cyberattack or connection drop. The moderator would also assist the speaker in sharing their presentation. In the event the speaker had not joined the room 20 minutes before the starting time of their conference, a reminder e-mail would be sent. If the speaker failed to attend the meeting within the following 10 minutes, an emergency phone call would be placed to assist and solve any potential inconvenience. No attendees were allowed in the room during the prebroadcasting session.

Live broadcasting began 5 minutes before the official starting time of the conference. The CIEN website (<https://www.cienhus.com/english/iwbnc>) was the central hub for the audience. It offered a full congress schedule with separate links to join the corresponding room for each lecture. A “Join Now” button was activated once the live broadcasting started, granting the audience access to the room.

Each lecture started with a brief introduction by the moderator, and then the speaker would take the lead. Five minutes after the opening of the room, a welcome message explaining the dynamics of the conference to the audience was sent through the chat. The Q&A section started once the lecture concluded. This section usually lasted 20 minutes but could be extended according to the availability of the speaker to answer more questions.

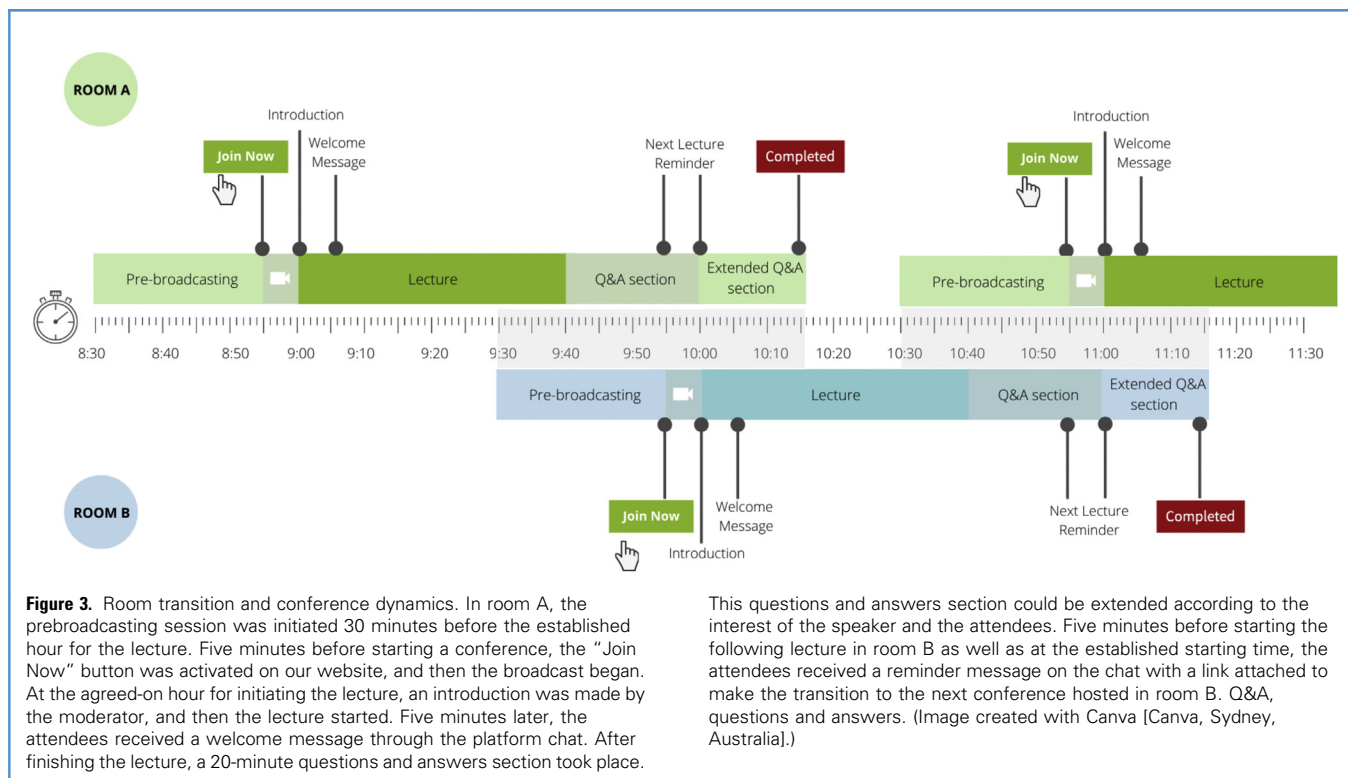
Furthermore, the transition from one lecture to the next was achieved as follows. In room A, for example, a reminder message was sent through the chat 5 minutes before the established starting time of the following lecture. This reminder included a link to room B, where the upcoming lecture would be held. After finishing the Q&A section in room A, a “Completed” notification was displayed on the CIEN website to indicate that the meeting in room A had concluded. No Q&A sections in room A could extend beyond an additional 15 minutes once the following conference in

room B had started. In room A, the host had at least 15 minutes to start the prebroadcasting session of the upcoming conference and repeat the cycle (Figure 3 and Video 1). The same process took place for the transitions from room B to room A.

Although no technical or cybersecurity-related issues occurred (including disconnections or Zoom bombing), members of the corresponding committees actively inspected all the conferences seeking irregular user credentials and intercepted abnormal connection patterns, anonymous attendees, and offensive messages sent via the Q&A panel. When any of these behaviors were identified, corrective actions were applied, such as removing and blocking some suspicious attendees connected through malicious networks.



Video available at
www.sciencedirect.com



How 2020 IWBNC Was Assessed

Quality assessment consisted of 2 main tools: an audience perception survey and a set of predetermined success parameters. Following the end of the congress, a survey was sent to all registered attendees (Supplemental Table 3). Fourteen questions assessing different areas were reviewed, including attendee position, congress opinion, virtual platform performance, participation in prior major neurosurgery in-person meetings, and COVID-19 pandemic impact in educational behavior, among others.

Furthermore, the following success parameters were evaluated: 1) proportion of lectures affected by cyber attacks, 2) proportion of lectures started on time, 3) proportion of lectures affected by technical problems including connection drop, 4) proportion of canceled or interrupted lectures, 5) proportion of lectures negatively affected by overlap, 6) overall reach, 7) peak views per talk, 8) average proportion of traffic between virtual rooms, and 9) number of countries reached.

RESULTS

2020 IWBNC World Impact

The 2020 IWBNC was attended by 3096 people from 125 countries. According to the survey results, most of the attendees were neurosurgeons (51%), followed by residents (26%), students (14%), and others (9%). The continent with the most significant participation was South America (33%), followed by Asia (19%), North America (17%), Europe (6.9%), Africa (4.6%), and Oceania (0.1%)

(Figure 4). According to Zoom and YouTube broadcast records, 22,266 live stream views were registered (Supplemental Figure 3). Seven weeks after the end of the congress, delayed streaming via YouTube upload had accounted for an additional 5279 views.

We assessed the engagement of the audience through attendance and interaction. Regarding attendance per day, the first day registered the largest number with 2209 participants. The second and third days hosted 1685 and 1055 attendees, respectively. When reviewing the daily participation per attendee, 553 participants attended all 3 days of the congress, 737 attended 2 days, and 1801 attended 1 day. The number of lectures per attendee showed that 81% of participants viewed up to 8 lectures. The interaction was assessed through the Q&A section parameters: 358 questions were answered during the congress, with an average of 12 questions per lecture.

The 2020 IWBNC time frame was 7:00 AM to 8:00 PM (GMT−5). After controlling for different time zones, the global peak attendance was from 8:00 AM to 2:00 PM (GMT−5), accounting for 74% of the overall attendance (Figure 5A). The attendance pattern registered in lectures was similar all over the world throughout the entire congress independent of the local time of each country. Figure 5B depicts audience behavior by continent on their time frame. Attendees from South America accounted for the majority of live stream views with 6024 attendees and a mean of 481 attendees per hour, followed by participants from Asia and Oceania (260 attendees per hour), North America (206 attendees per hour), Europe (107 attendees per hour), and Africa

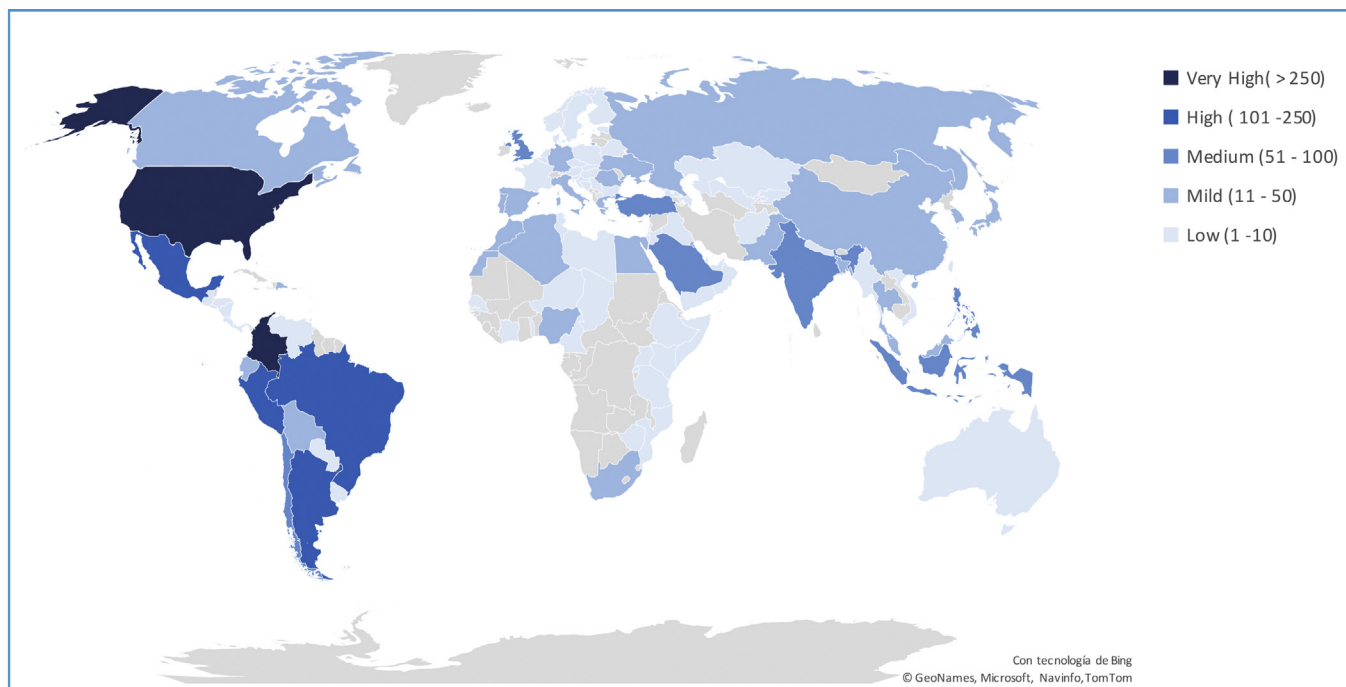


Figure 4. Demographic distribution of Zoom attendees across countries. (Image created with Microsoft Excel [Microsoft Corporation, Redmond, Washington, USA].)

(84 attendees per hour). It is noteworthy that the Asian audience reached a peak pattern attendance (375 attendees per hour from 9:00 PM to 3:00 AM GMT+9) similar to South America despite the late-night time frame (Figure 5B).

Quality Assessment

Regarding the success parameters established during the planning stage, 76.6% of lectures extended beyond the established schedule. Although this extended period could have meant a detriment to the quality of the event owing to lectures overlapping, the double-room method allowed 100% of lectures to start on time. The congress weathered 7 sabotage attempts; however, no lectures were affected by cyber attacks or security gaps. The proportion of lectures affected by technical issues, host connection drops, interruptions, and cancellations was 0%. The marketing campaign on social media reached 54,156 people around the world. Organizers sent 17,756 e-mails, with an e-mail opening rate of 45.8%. The peak average audience per talk was 420 attendees (goal: 300 people). The average proportion of traffic between rooms was 61% (goal: 50%). Finally, the number of countries reached was 125 (goal: >100).

The quality survey obtained 451 responses. The general academic mean rating level for the 2020 IWBNC was 4.6 points on a 1–5 scale (where 1 equals poor and 5 equals perfect). A total of 91.8% of attendees agreed that taking part in the 2020 IWBNC improved their neurosurgical practice, and 95.4% felt that it was highly likely (>50% chance) that they would participate in further virtual academic activities once the pandemic has ended. When assessing participants' perceptions

of in-person and virtual educational events, 66.7% of respondents said they had previously attended in-person neurosurgical events, and 68.7% perceived that their 2020 IWBNC experience was equal or better than in-person events in terms of knowledge acquisition.

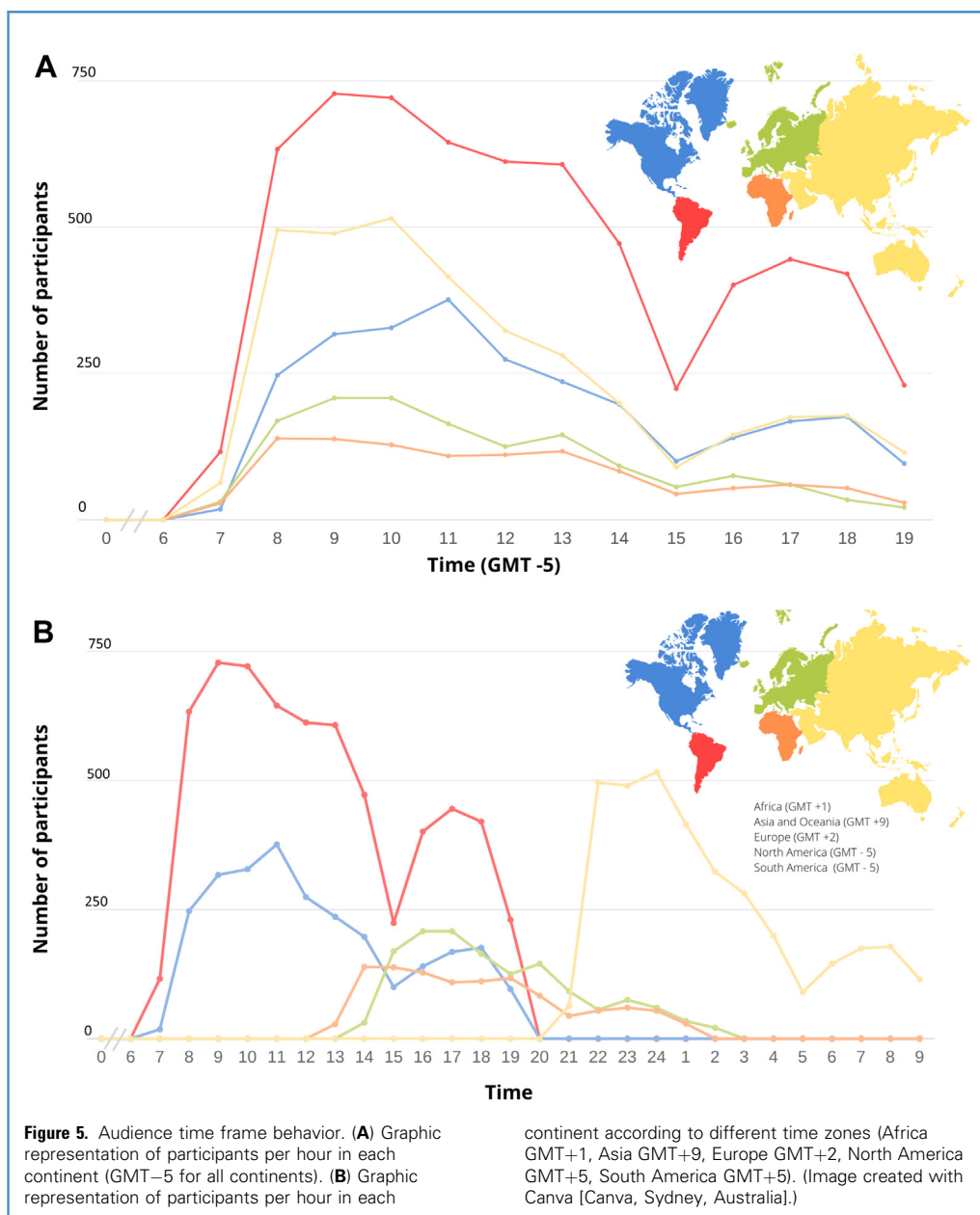
Concerning the lecture length, 49% agreed that 20–40 minutes was the ideal duration for a lecture. Q&A sections were assessed from 2 main perspectives: interaction and duration. Regarding duration, 76.5% felt that it was either “good” or “perfect”; the remainder gave a “fair” rating. Regarding interaction, 77.4% considered it to be “good” or “perfect.” Only 4.2% of the respondents perceived that the transition between rooms was “difficult/very difficult.”

Expenses

Even though there were no accommodation and travel expenses for lecturers, the 2020 IWBNC required an assigned budget for the different committees. As the congress had no income from registration fees or industry donations, the costs were self-funded by the Executive Committee. The total expenditure for the live stream and mailing platforms, CTC, communication and marketing services, high-speed internet, and complementary souvenirs gifted to the lecturers was USD \$7542.65 USD (Supplemental Table 4).

Other Neurosurgery Web-Based Events During the COVID-19 Pandemic

Owing to the COVID-19 pandemic, there has been an increasing number of webinars. Aiming to identify the number of



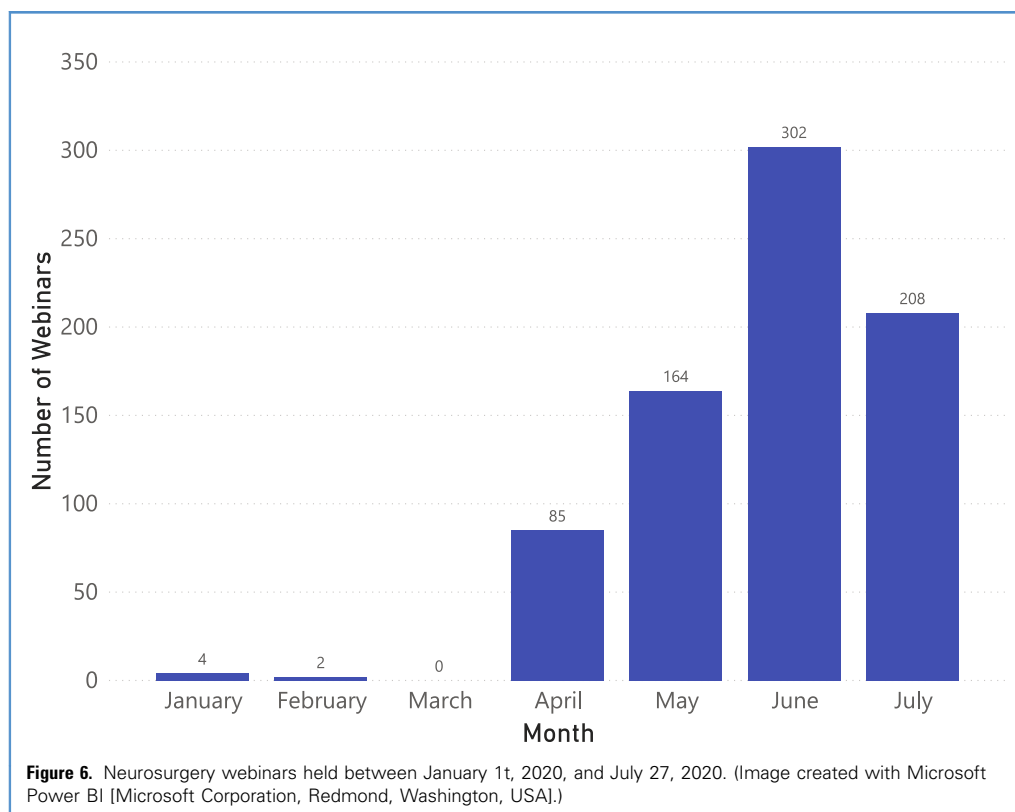
neurosurgery webinars performed from January 1, 2020, to July 27, 2020, we investigated 3 areas: 1) neurosurgery virtual meetings broadcasted through social media and meeting platforms, 2) websites of major neurosurgical societies, and 3) other neurosurgical scientific societies from our database. We found 765 webinars (Figure 6 and Supplemental Table 5). According to our search, the increasing webinar tendency started in April 2020.

DISCUSSION

The 2020 IWBNC arose as a response to concerns of the neurosurgical community regarding their professional development,

education, and research activities, all of which were affected by the COVID-19 pandemic.^{7,10,18-20} The audience and the faculty team widely welcomed the 2020 IWBNC. High quality was achieved in all domains.

The 2020 IWBNC had a larger and more diverse audience compared with in-person congresses; the 2019 World Federation of Neurosurgical Societies (WFNS) international meeting took place in Belgrade and had 773 participants from 73 countries,²¹ while the 2019 Congress of Neurological Surgeons (CNS) meeting in San Francisco had participants from 40 different countries.²² The smaller and less diverse audience might be a result of high registration fees (fees for international meetings



in neurosurgery range from USD \$300 to USD \$1000) and the traveling, accommodation, and daily maintenance costs.^{23,24} Regarding audience reach goals, the event surpassed the established target audience numbers by 19.2% and the target for countries by 20%. We believe that this larger audience was due in part to the fact that this congress was free and easily accessible from every place and every device with an internet connection. Additionally, real-time and delayed streaming enabled attendees to choose the best time to watch the lectures, offering a solution for different time zones across countries.

Estimating the total organizing cost of an in-person congress is challenging, especially when it is planned for a large number of people, and it varies depending on the host country. According to some websites that offer calculators to estimate the general costs for organizing large events,²⁵ the overhead of an in-person congress for >3000 attendees, 25 invited speakers, and 31 staff members is extremely high. This includes the venue (USD \$1000 per hour), travel expenses and hotel accommodation for speakers (USD \$1500 per speaker), staff costs (USD \$200 per member), and branded items such as printed banners and programs (USD \$600).²⁵ Therefore, if the 2020 IWBNC had been held in person, it would have cost approximately USD \$74,300, not including travel expenses for international attendees. A study by Sarabipour et al.²⁶ reviewing a broad database for scientific conferences and their key features estimated an overall cost of about USD \$1.2 billion during 270 in-person conferences held between 2018 and 2020.

Results from the survey showed that the 2020 IWBNC had a high acceptance from the audience. The most important points

were its high academic quality, its capacity to improve neurosurgical performance of its attendees, adequate lecture length and overall duration, and interaction indicators. It is noteworthy that attendees gave an exceptionally good rating for this web-based congress compared with in-person events, such as WFNS, European Association of Neurosurgical Societies (EANS), CNS, and Global Spine Congress (GSC), according to collected data and supported by their evident willingness to continue attending web-based congresses. The execution of the 2020 IWBNC also received good ratings in terms of technology and a user-friendly system.

Concerning success parameters, the double-room method was pivotal to the high quality achieved. It was designed to allow overlapping without delaying lectures, provide opportunities for interaction, and decrease the risk of cyber attacks. In a classic single-room model, achieving the proposed schedule without delaying or canceling conferences or interrupting speakers whose lectures ran overtime would have been challenging. If the 2020 IWBNC had been held in a single room, 76.6% of the conferences would have been delayed. Moreover, the double-room method allowed a transition rate between rooms 11% higher than predicted. Regarding other success parameters, the 2020 IWBNC had excellent cybersecurity. There were no significant safety issues despite some sabotage attempts. Concerning engagement, participants from South America and North America accounted for 50% of the total audience. The schedule of the 2020 IWBNC was favorable to them because of their shared time zones. Interestingly, attendance from countries with different time zones, such as Asia, remained constant regardless of their local time.

Therefore, the peak number of attendees might be related to the interest in the speaker or the lecture topic, rather than the time zone.

Given the wide acceptance of the 2020 IWBNC in terms of knowledge acquisition compared with in-person meetings, we firmly believe that this scientific meeting modality has the potential to become common practice, even after the COVID-19 pandemic subsides. As depicted by the research conducted, the frequency and relevance of virtual CME encounters have increased. Admittedly, the conducted inquiry has limitations owing to the absence of an international repository of virtual meeting data; therefore, it is difficult to make a comparison between webinars conducted in previous years. Creation of a referencing, indexing, and repository system similar to that used for journal articles is required to gain proper visibility for these essential academic meetings. Additionally, it might be beneficial to offer CME credits for attendance and participation in these events.

Finally, there are still some obstacles stemming from virtual teleconferencing that are yet to be overcome. Besides technological issues, such as unstable internet connection, hardware malfunction, and Zoom bombing, there are social interaction limitations inherent to the platform that constitute new challenges. Among these, networking, empathy, and human contact are difficult to reproduce on online platforms. Future web congresses will have to address these issues to improve their performance in an ever-increasing virtual academic environment.

CONCLUSIONS

The 2020 IWBNC was the first successful 3-day international neurosurgery congress carried out entirely virtually. It provided a convenient, cost-effective, and accessible alternative for achieving top-quality CME. Web-based events will continue to be a helpful educational tool in the future; the double-room method represents an alternative design that may be replicated by the academic community planning web congresses and similar events.

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ACKNOWLEDGMENTS

The authors thank the Neurosurgery residents and staff members of Hospital Universitario de la Samaritana and Hospital Universitario Mayor Méderi for their essential contribution to the development of the 2020 IWBNC.

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Conflict of interest statement: The authors declare that the article content was composed in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received 12 September 2020; accepted 31 December 2020

*Citation: World Neurosurg. (2021) 148:e415-e424.
<https://doi.org/10.1016/j.wneu.2020.12.174>*

Journal homepage: www.journals.elsevier.com/world-neurosurgery

Available online: www.sciencedirect.com

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