

DESCRIPTIVE ARTICLE

Anatomical societies find new ways to come together in a post-Covid world

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Abstract

The world has been turned upside down by a global health emergency caused by the Covid-19. Given the high contagiousness of the virus and the need to contain its spread, social distancing rules, self-isolation policies, and geographical lockdowns have been enforced globally. Over the pandemic emergency the majority of the planned in-person meetings and congresses of national and international anatomical societies have been postponed or canceled. It is unclear what the future holds, but times of crisis often present possibilities for re-thinking old ways to achieve a more critical approach. It has become increasingly clear that traditional in-person congress formats of scientific societies need to be reevaluated. Over the past year and a half, two types of congressional modalities have been trialed to address the challenge of the pandemic as far as scientific meetings are concerned: the fully virtual congress, in which case the conference program is live streamed to all of the attendees, and the hybrid congress, in which case some of the attendees physically participate at the congress's venue while others interact via a virtual platform. The current study set out to investigate the technical difficulties, social challenges, costs and sustainability, logistics and management issues linked to holding various types of congresses in the post-Covid world. Anatomical societies throughout the world are actively striving to reshape their response to the current global emergency and to uncover new types of conference modalities in the effort to keep scientific exchange alive and flourishing in the post-Covid era.

KEYWORDS

anatomy conferences, anatomy meetings, anatomy congresses, Covid-19, pandemic, SARS-CoV-2, symposium, webinars

INTRODUCTION

The world is still whirling under the effects of a global health emergency caused by the uncontrollable spread of the highly contagious

SARS-CoV-2, which was initially identified in Wuhan city, Hubei province, China, and reported in late December 2019 (WHO, 2020a; Zhu et al., 2020). As announced by the World Health Organization (WHO) on February 11, 2020, the disease associated with the virus

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is "Covid-19," which stands for COrona Vlrus Disease identified in 2019 (WHO, 2020a). Covid-19 is often characterized by pneumonia, which may progress to severe acute respiratory syndrome, kidney failure, and even death (Argenziano et al., 2020; Evans et al., 2020). On March 11, 2020, the WHO declared COVID-19 a pandemic (WHO, 2020b), which has been defined as "an epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people" (Last, 2001). Alongside its dramatic effects on health and health systems, the Covid-19 pandemic has also had salient economic consequences affecting practically all human activities worldwide, including scientific events (Ayittey et al., 2020; Russell et al., 2021). It is well established that the coronavirus disease is transmitted through contact with droplets from an infected person's cough or sneeze, and/or by touching objects or surfaces that have been contaminated (Pascarella et al., 2020). As crowded communities are particularly exposed to viral contagion, social distancing rules, self-isolation policies, and complete lockdowns have been imposed in many regions and countries to reduce exposure, prevent infections, and limit the spread (Velavan & Meyer 2020; Cucinotta et al., 2021; Russell et al., 2021).

In the wake of the first pandemic waves, air travel has gradually resumed as it became clear that stringent travel restrictions can help to prevent the spread of the virus only in the event that there are no or few cases in the destination country (Russell et al., 2021). At the same time, some studies have demonstrated that individual and community surveillance measures can be used to gradually reopen following stay-at-home and business closure protocols (Pernice et al., 2020; Bendavid et al., 2021). It has nevertheless also become clear that it is impossible to return to life as it was in the pre-Covid world, especially with regard to large gatherings (Korbelt & Stegle, 2020; Pung et al., 2020). As second and third pandemic waves of new variants arise and spread throughout Europe and other continents, government and healthcare officials are striving to investigate, plan, and implement strategies to control the pandemic's spread (Cacciapaglia et al., 2020; Callaway, 2021; WHO, 2021b).

As the pandemic's effects reverberate, internet and technology have helped the world to communicate in unthinkable ways. In fact, an enormous amount of information including videos, power-point presentations, and large documents can be shared almost instantly, even from portable devices (Lecueder & Manyari, 2000). In the field of medicine, partial or entire online events have become commonplace. At first, even before the Covid-19 emergency, they were used for small specialistic continuing medical education courses but they have become ever more important parts of large, complex national and international medical conferences (Zucconi, 1986; Cucinotta et al., 2021; Ng et al., 2021). Just as dedicated infrastructures and specialized organizing agencies have been created to assist the organizing committees of medical societies to address the many technical, logistic, legislative, financial, and social details that the organization of mega medical congresses entail, numerous online features such as web pages, video conferencing, chat sessions, and mailing lists have become available. The Covid-19 pandemic has abruptly challenged the traditional modality of organizing medical congresses and forced

scientific societies to rethink how they can accomplish the goals of their meetings in virtual formats.

During 2020 when only a few in-person medical conferences were held, two new types of remote congress modalities were trialed: the fully virtual congress and the hybrid congress (in the former case, all aspects are carried out online; in the latter some of the registrants participate in person while others are connected via video conferencing software). These new directions reflect not only technological advancements but also the ever-greater needs for education and scientific dissemination (Fawcett et al., 2021) and have opened the way to more accessible conferences (Viglione, 2020). Needless to say, there are positive and negative implications linked to the many aspects of the traditional and novel virtual congress modalities.

This article intends to evaluate the technical issues, social aspects, costs and sustainability, logistics and management, feasibility, and future of these congress modalities both in a general sense and specifically in connection to congresses of anatomical societies. Some tables were prepared to evaluate the real situation of the most significant anatomical societies of the world. Data on national (Table 1) and international (Table 2) congresses of anatomical societies planned before the Covid-19 emergency arose were collected using the following criteria. Only national anatomical societies belonging to the International Federation of Associations of Anatomists (IFAA) or the European Federation for Experimental Morphology (EFEM) were considered provided the congress of interest was not planned for a time preceding the Covid-19 emergency outbreak. For example, the congress of the Dutch Anatomical Society, which was held in January 2020, was not considered here. Only the society's main annual congress and not minor events such as symposia, masterclasses etc. were considered. Data regarding societies for which it was impossible to find online information about their congress were not included. Data were retrieved on July 10, 2021 (last update) via the official website of each anatomical society or the link to the conference website contained therein. In those cases the information reported on the websites was not up-to-date about the event, an inquiry message was sent to the contact e-mail provided.

The English translation of the name of each society as registered by the IFAA, EFEM, or found in the society's official website appears here. The congress of a national anatomical society hosted within an international congress was not considered a standing alone event but a part of the international congress, unless it was held in the host country. In that case, the event was registered as both an international and a national event. Local conferences of anatomical societies were not taken into consideration.

The authors classified the congresses as follows. Online: the congress maintained its complex organization with minimal adjustments but changed its nature from traditional to online. Hybrid: the congress was held in a mixed form, with an in part onsite and online faculty (e.g., connected via video conferencing software). The classification "canceled" refers to a planned face-to-face conference that has been moved to a later date or has been abandoned. Those cases in which the anatomical society had not planned any event for 2020

TABLE 1 National congresses of anatomical societies planned before the outbreak of the Covid-19 emergency

Country	National scientific societies	Main face-to-face event originally planned in 2020	Adaptation due to the Covid-19 emergency ^a
Argentina	Argentine Association of Anatomy	57° Congreso Argentino de Anatomía	Canceled
Australia and New Zealand	Australia and New Zealand Association of Clinical Anatomy	Annual Conference of the Australia and New Zealand Association of Clinical Anatomy	Canceled In its place, a half-day "e-conference" will be held in December
Brazil	Brazilian Society of Anatomy	Congresso de Anatomia Clínica	Online
Chile	Chilean Society of Anatomy	XIII Jornada Chilena de Anatomía	Online
China	Chinese Society of Anatomical Sciences	9th Asia Pacific International Congress of Anatomists	Supposedly none (unanswered mail)
Czech Republic	Czech Anatomical Society	Morphology 2020–52nd International Congress of Czech Anatomical Society and 57th Lojda Symposium on Histochemistry	Canceled. In its place, a one-day online symposium was held in September
France	Association des Morphologistes	25es Journées du Collège des Histologistes, Embryologistes et Cytogénéticiens et le 102e Congrès de l'Association des Morphologistes	Canceled
Germany	Anatomische Gesellschaft	115th Anatomische Gesellschaft Annual Meeting	Canceled
Ghana	Anatomical Society of Ghana	Anatomical Society 4th Annual Scientific Conference	Canceled
India	Anatomical Society of India	68th National Conference of the Anatomical Society of India	Canceled
Italy	Italian Society of Anatomy and Histology	74° Congresso Nazionale della Società Italiana di Anatomia e Istologia	Canceled
Malaysia	Malaysian Anatomical Association	Not planned for 2020	Not applicable
Poland	Polish Society of Anatomy	XXXIV Międzynarodowy Kongres Polskiego Towarzystwa Anatomicznego	Canceled
Portugal	Portuguese Society of Anatomy	12th International Symposium of Clinical and Applied Anatomy	Canceled ^b
Serbia	Serbian Anatomical Society	VII Congress of Serbian Anatomical Society of Serbia	Canceled
South Africa	Anatomical Society of Southern Africa	48th Annual Anatomical Society of Southern Africa Conference	Canceled In its place, a one-day online symposium was held in October ^b
Spain	Spanish Society of Anatomy	Not planned for 2020	Not applicable
Sri Lanka	Anatomical Society of Sri Lanka	National Congress of the Anatomical Society of Sri Lanka	Canceled ^b
Switzerland	Swiss Society for Anatomy, Histology, and Embryology	82nd Annual Meeting of the Swiss Society for Anatomy, Histology, and Embryology	Canceled
Thailand	Anatomy Association of Thailand	43rd Annual Conference of the Anatomy Association of Thailand	Canceled
Turkey	Turkish Association of Anatomy and Clinical Anatomy	XXI Ulusal Anatomi Kongresi	Online
United Kingdom and Republic of Ireland	Anatomical Society (Great Britain and Ireland)	Anatomical Society Summer Meeting Anatomical Society Winter Meeting	Canceled Online
United States	American Association for Anatomy	Annual Meeting of the American Association for Anatomy at Experimental Biology Annual Meeting Week	Canceled Online

(Continues)

TABLE 1 (Continued)

Country	National scientific societies	Main face-to-face event originally planned in 2020	Adaptation due to the Covid-19 emergency ^a
United States	American Association of Clinical Anatomists	American Association of Clinical Anatomists Virtual Annual Conference 2020	Online

^aOnline, the congress maintained its complex organization with minimal changes, but was held in an online format; Canceled, the planned face-to-face conference was or will be moved forward to 2021/2022 or annulled; Not planned, no congress had been scheduled in 2020.

^bInformation retrieved by email. "Supposedly" refers to those cases in which the information reported on the websites was not up-to-date and our inquiry went unanswered.

are marked as "not planned." Those cases in which the information on the website was not up-to-date and the inquiry message to the contact address was unanswered were listed as "supposedly."

DESCRIPTION

One of the three Covid-19 clusters detected early in Singapore in February 2020 referred to a company congress attended by 111 participants working at the branches of a worldwide corporation located in 19 countries (Pung et al., 2020). That cluster of disease probably arose from the circumscribed local transmission during that convention or, in other words, the handshaking, physical contact, meal sharing, participation at presentations and discussions, workshops, and social events typical of that sort of conference (Pung et al., 2020). That particular cluster referred to a business meeting, but the same dynamics occur at a medical congress. Prior to 2020 and the Covid-19 pandemic, scientific conferences and meetings played an important role in scientific exchange and progress as it was the medium whereby researchers presented their latest results to the rest of the scientific community. They also represented an opportunity for training sessions, debates, discussions, round tables, and workshops. At the same time, while knowledge was shared,

collaborative networks were formed and friendships were cultivated (Achakulvisut et al., 2020; Weissgerber et al., 2020).

When the emergency first began, many national and international anatomical societies postponed and then canceled their in-person congresses scheduled for 2020 (Tables 1 and 2). Complying with the directives of the Centers for Disease Control and Prevention (CDC) and the WHO (CDC, 2020; WHO, 2020c, d) many scientific societies did likewise (Hermieu et al., 2020; Poriglia et al., 2020; Soriano Sánchez et al., 2020; Weissgerber et al., 2020). But after the first uncertain response to the emergency, the scientific community set out to find new avenues and formats for scientific exchange that could minimize or prevent the consequences of in-person congresses. The arrangement of any conference, convention, seminar, meeting, symposium, forum, or consultation involving even minimal participation must face several critical issues that risk jeopardizing its scientific success if carried out as physical meetings, that is the classically way they were planned up to now (Table 3).

Factors related to the epidemiology of pandemic

It is well established that Covid-19 spreads mainly through close contact (typically less than a meter) with an infected person. An individual

TABLE 2 International congresses of anatomical societies planned before the outbreak of the Covid-19 emergency

International scientific societies	Main face-to-face event originally planned in 2020	Measures taken up-to-date for the Covid-19 emergency ^a
Asia Pacific International Congress of Anatomists (A.P.I.C.A.)	9th Asia Pacific International Congress of Anatomists	Supposedly None (unanswered mail)
European Association of Clinical Anatomy (E.A.C.A.)	Not planned for 2020	Not applicable
European Federation for Experimental Morphology (E.F.E.M.)	Not planned (It does not run independent congresses)	Not applicable
International Congress of Anatomists (I.C.A.)	International Congress of Anatomists	Canceled
International Federation of Associations of Anatomists (I.F.A.A.)	Not planned for 2020	Not applicable
International Symposium Clinical and Applied Anatomy (I.S.C.A.A.)	12th International Symposium of Clinical and Applied Anatomy	Canceled
Pan-American Association of Anatomy (P.A.A.A.)	XXII Congreso de Anatomía del Cono Sur	Online
Trans European Pedagogic Research Group (T.E.P.A.R.G.)	16th Annual Meeting	Hybrid

^aOnline, the congress maintained its complex organization with minimal changes, but was held in an online format; Hybrid, the congress was held in a hybrid form with some participating in person and some participating via video conferencing software; Canceled, the planned face to face conference was moved forward to 2021/2022 or skipped; Not planned, no congress had been scheduled in 2020. Please note that the wording "supposedly" indicates situations in which the information reported on the websites was not up-to-date and the mailed inquiry was unanswered.

TABLE 3 Educational event-related risk assessment table during the Covid-19 pandemic

Stakeholder	Critical issues	Mitigating response		
		Restrict in-person participation	Arrange for hybrid events	Arrange for online events
Scientific Societies and Organizers	Events with an expected high number of attendees could discourage participation	x	x	x
	Social distancing requires additional larger spaces, extended congress timing, and a stringent level of hygiene and sanitation of the common areas	x	x	x
	Lockdown of the hosting country			x
	Lockdown of participating countries or travel restrictions for speakers or attendees	x	x	x
	Contagion among the participants during the event	x	x	x
	Uncertainty about the measures adopted by the local health-political authorities			x
	Increased costs linked to the distancing rules and the need for cleaning and sanitation between scientific sessions organizing staggered meals to avoid self-service solutions	x	x	x
Exhibitors	Increased management costs due to social distancing and hygiene requisites	x	x	x
	Basic costs to cover setting up stands, dedicated staff, transport of exhibition material, gadgets	x	x	x
Speakers and attendees	Possible extension of their stay away from home beyond that which was planned		x	x
	Additional costs for accommodation, airline tickets, transfers		x	x
	Movement restrictions because of the pandemic or religious and political issues		x	x
	Professional and family obligations		x	x
	Limitations for researchers from countries with limited funding		x	x
	Limited spending budget for pre-graduated students, graduate students, and post-doctoral researchers		x	x
	Logistic limitations for attendees affected by disabilities		x	x
	Outstanding scientists with numerous commitments may be discouraged from participating in onsite events		x	x
Impossibility of following parallel sessions	x	x	x	

becomes infected when aerosol particles or fine droplets are inhaled or come into contact with the mouth, nose, or eyes particularly in crowded, indoor, and poorly ventilated settings (WHO, 2020e). Events foreseeing large groups of individuals coming from multiple countries including those with less stringent viral containment policies, can thus become important hubs for the transmission of infectious diseases (Alirol et al., 2011; Desai & Patel, 2020). Just as it is difficult to predict the pandemic's evolution (WHO, 2020a), it is expensive, time consuming, and risk-laden to organize a global event in which hundreds or thousands will be participating, just think to the arrangement of locations and rooms, devoted personnel, materials, and facilities that are challenging considering the differences in epidemic curves between and within continents as well as between and within countries. This is particularly critical for events involving faculty and attendees from all over the world (Porpiglia et al., 2020). Moreover, the time and expense involved in organizing an in-person scientific congress could be jeopardized by rapid changes in local conditions and precipitous

lockdowns of a region or country or new peaks linked to seasonal changes (Margolis et al., 2020; Fawcett et al., 2021; WHO, 2020a).

The epidemiological picture continues to change rapidly, and from one moment to the next countries with no access limits can and have introduced restrictions (EU, 2021; UNECE, 2021). There are other complications to international travel such as the European Union (EU) Digital Covid Certificate, which went into effect on June 1, 2021 providing digital proof that a traveler has either been vaccinated, has received a negative test result or recovered from the virus, thus allowing Europeans to move freely within the union (EC, 2021). At the moment, it is difficult to predict the future evolution of the pandemic, nor its duration (Cucinotta et al., 2021). It is unknown if the waves that may come will be similar to those of the past, nor if environmental factors could worsen the viral effects in some regions or cities (Coccia, 2021; WHO, 2021b).

Evidence has been emerging that strict travel restrictions are probably unjustified in countries that have good international travel

connections and a very low local COVID-19 incidence (Russell et al., 2021). This is true for the viral forms that are currently widespread, but it may not be valid for the emerging, worrisome variants (Callaway, 2021; Chung et al., 2021; Gobeil et al., 2021; WHO, 2021b). Other variables that are unpredictable are the immunization coverage that each country will achieve over time, the effectiveness of the different vaccines to the virus and the contagiousness and lethality of new variants (WHO, 2020a; Soleimanpour and Yaghoubi, 2021; WHO, 2021b).

Factors related to the educational event

There are also important critical factors concerning the educational events themselves. Crowded, confined, or enclosed settings where people are in close proximity for prolonged periods, in particular if there is poor ventilation, facilitate the circulation of Covid-19 (WHO, 2020e). In order to be able to ensure safety and guarantee social distancing, the organizers need to arrange for larger spaces, increased hygiene practices, sanitization and cleaning protocols, as well as safe food service and personal hygiene products (WHO, 2020e), all representing extra expenses to the congress budget.

Moreover, sponsors and exhibitors that generally cover part of the cost of large-scale events have the following variables to take into consideration. First of all, management costs, as explained, will be higher. Second, the global economic recession may lead to lower profits for companies investing in conference events. On the other hand, it is also true that some companies specializing in educational technologies are experiencing phenomenal economic growth due to restrictions imposed by the pandemic on travel and in-person attendance. Third, it has been hypothesized that Covid-19-related topics will probably absorb a significant portion of funds allocated to scientific research (Martelletti, 2020), meaning that there will probably be less funding for research in other fields as well as less availability for educational events. Finally, few sponsors or scientific committees will be willing to take the risk connected to finding the funding necessary to organize an in-presence event knowing that an infected participant could unknowingly infect others leading to unforeseeable consequences.

Probably no medium or large congress can be classified as an event whose risk is acceptable and consciously accepted. Not every conference organizer and scientific society would be willing to take the hazard.

Factors related to the speakers/attendees

There are also considerations regarding the speakers/attendees who play a central role in the success of an educational event. Laboratory data suggest that infected persons appear to be most infectious 2 days before they develop symptoms and early in their illness (WHO, 2020e). An attendee who becomes symptomatic during a congress, or resulting positive to a swab test or who has had contact with a positive person would need to quarantine as required by the

host country's protocol (McDowell et al., 2020). Moreover, it remains to be seen how the local health-political authorities would react to an outbreak within the context of a medical conference. Restrictive measures, including quarantining the participants, canceling the rest of the event and even blocking attendees at the airport are all possible measures that public officials could implement (Russell et al., 2021).

The probable consequence of such a scenario would be that the contaminated person(s) would be required to remain in the host country longer than planned with all the personal, professional, and financial inconvenience that such a necessity would imply. Apart from these extraordinary and unpredictable circumstances, there may be increased costs due to the complicated logistics necessary for the event. This can be due to distancing rules and moving delay among rooms, the need for cleaning between scientific sessions or presentations, or the management of staggered meals avoiding the self-service model. The increased accommodation cost will probably add up to more expensive airline tickets and transfers, as transport companies have to reduce the passengers carried on to respect distances. Everything would weigh on the institutional funds assigned to researchers, which will predictably diminish due to the economic crisis, or worse, take resources away from research. According to a recent study, countries can expect Covid-19 infected travelers to arrive in the absence of travel restrictions (Russell et al., 2021). However, such restrictions should be implemented only after the analysis of local incidence, epidemic growth and travel volumes (Russell et al., 2021). In any case, undeniably, large international medical congresses could be a vehicle for virus transmission and need to be reevaluated not only for the sake of international travelers but also for that of the local community hosting an in-person conference.

Is there a future for in-person congresses of anatomical societies in the post-Covid world?

Anatomical societies organize congresses of and for their members to promote and facilitate research, collaboration, and scientific exchange and discussion. At the same time, congresses are an opportunity for policy-making decisions and for organizing workshops and specialized training sessions. No less important, professional and personal networks are formed and reinforced. Congresses and conferences can also be a vehicle for further funding and academic recognition. Scientists at all stages of their careers consider meetings as opportunities to gain recognition and receive a feedback regarding their research studies as well as to establish networks with other colleagues and collaborators (Weissgerber et al., 2020). All of the above considerations continue to be valid despite the ongoing pandemic.

As far as mitigating the impact of conference and travel cancellations of planned meetings on researchers is concerned, several recommendations have been formulated including that of transforming conferences into virtual events and hosting poster sessions online

(Weissgerber et al., 2020). Others have proposed acknowledging the contribution of speakers' accepted presentations and making abstracts, posters, and other conference materials freely available online (SOT, 2020; Weissgerber et al., 2020).

While these proposals can be applied to planned congresses/meetings, new alternatives need to be formulated to address the challenges anatomical societies are facing as far as future events are concerned. Fortunately, online possibilities seem to be able to fill the gap between old and new solutions, and the digital revolution that is already underway as far as online education and virtual events are concerned seems to be ready for the challenge (Fawns et al., 2020). Now, it would seem, is the time to further develop the possibility of virtual educational events.

DISCUSSION

Every systemic crisis can represent an opportunity to rethink positions and strategies and to implement new solutions. Indeed, a crisis or emergency can be an unrepeatable opportunity to kick-start the reevaluation process, and this is true for the traditional congresses of national and international societies of anatomy during the coronavirus pandemic. Many anatomical societies have been working to find new avenues for congresses by organizing online seminars commonly known as webinars, that is, seminars on the web. Independently of health considerations, webinars can accommodate more participants than a normal conference room can. The chance to manage a virtual congress using ready-to-go online technology seems to be at one time attractive and safe, as experienced with webinars (Fadlelmola et al., 2019). Two types of congressional alternatives can be used instead of the traditional ones, the fully virtual and hybrid congresses which can be held partially or entirely online. In the former case, *all* of the scientific content of the congress is transmitted to *all* of the participants via real-time or delayed streaming. In the latter case, *some* of the participants attend in person, with all the travel, risk, and inconvenience that it entails, while *some* participate entirely online via video conference. The residential part of the event has to comply with the local health authority regulatory framework, considering the WHO recommendations. These will encompass the cardinal principles of the fight against transmission: to reinforce frequent handwashing and sanitation, procure needed supplies, regular cleaning and disinfection of buildings, rooms, surfaces, as well as the implementation of social distancing practices and use of personal protective equipment (WHO, 2020e). Both the fully virtual and hybrid alternatives can use live and delayed streaming or a combination of the two and can offer differing degrees of interaction between the attendees and the speakers/moderators. These approaches have already been tested at some conferences that have streamed plenary lectures or selected presentations (Porpiglia et al., 2020). It is only a matter of extending this option across the full conference content.

There are in any case positive and negative implications linked to the transition to (at least partial) online congresses (Table 4).

Obviously, they are more accentuated for the fully virtual mode than for the hybrid one.

Positive implications of the transition to online events

A traditional congress can last as long as a week or more, and travel time and jet lag also need to be taken into consideration. Indeed, participating in a traditional offline congress is typically time and money consuming due to the costs of flights, airport transfers, hotel accommodations, conference registration fees, and may cause a disruption in professional or family obligations at home (Longhurst et al., 2020; Viglione, 2020). Travel can also prevent scientists from participating, as some countries might introduce movement restrictions because of the pandemic or religious and political issues (Weissgerber et al., 2020). In many cases these costs and the others linked to congress participation may be absorbed by the scientific system, the university administration, or the scientist him/herself (Achakulvisut et al., 2020). Researchers from countries with limited funding, graduate students, and post-doctoral researchers, or individuals with disabilities are the ones who would benefit the most from a fully virtual approach (Weissgerber et al., 2020), and they are also the ones who are less likely to participate in a traditional offline congress (Viglione, 2020; Cucinotta et al., 2021).

The costs of a virtual event are generally lower than those of a traditional congress, and its carbon footprint is reduced since no flights are involved (Li et al., 2020). At the same time, the commitment of organizing an online congress is in many ways less demanding (Lecueder & Manyari, 2000) as no venue needs to be found months or years in advance, no onsite secretariat or hotel booking, catering or sanitation services or incoming/outgoing transportation or specialized onsite technical assistance, or social programs for accompanying people need to be arranged (Achakulvisut et al., 2020). Most importantly, a virtual format would open the congress to a wider number of participants who could participate with greater ease, less cost, and no risk with respect to a traditional in-person congress. A virtual congress modality would allow participants to attend at reduced or even canceled congress fees. In fact, some societies have chosen to abolish registration fees to virtual events in order to give more members the possibility to benefit from the educational opportunity a congress represents (Lecueder & Manyari, 2000). Graduate students or post-doc fellows could in particular benefit from the stimulating atmosphere of the congress at minimal or no expense (Weissgerber et al., 2020), likewise for individuals with disabilities or communication limitations (Li et al., 2020).

At the same time, outstanding scientists could accept invitations to online congresses with greater ease because the time commitment and impact on professional/personal commitments would be significantly reduced (Achakulvisut et al., 2020). Likewise, researchers from institutions or countries with fewer opportunities could benefit from online events and the possibility to interact with senior scientists (Cucinotta et al., 2021).

TABLE 4 Pros and cons of virtual alternatives with respect to face-to-face traditional congresses during the Covid-19 pandemic

Positive implications	Negative implications
<ul style="list-style-type: none"> • Ease and comfort of visualizing the event from anywhere 	<ul style="list-style-type: none"> • Scientific socialization opportunities are limited and atypical
<ul style="list-style-type: none"> • Reduction of the time and money required to participate 	<ul style="list-style-type: none"> • Convivial moments (e.g., gala dinner) would be severely compromised or even prevented.
<ul style="list-style-type: none"> • Recorded speeches can be made available for participants living in different time zones or with professional or family obligations 	<ul style="list-style-type: none"> • The digital divide regarding information technology may be an issue for less supported attendees and speakers
<ul style="list-style-type: none"> • Researchers and students with limited funding can participate in an event at a reasonable price 	<ul style="list-style-type: none"> • Sponsors and exhibitors may exaggerate with their advertising requests.
<ul style="list-style-type: none"> • No limits of accessibility for individuals with disabilities 	<ul style="list-style-type: none"> • Sharing digital images of bodies, dissections or body parts pose significant ethical and legal issues
<ul style="list-style-type: none"> • Reduced costs for organizing an event so congress fees can be reduced 	<ul style="list-style-type: none"> • Access to conference material and the printed abstract book could be restricted to participants in person
<ul style="list-style-type: none"> • Communication limitations (e.g., hearing loss) can be overcome at one's computer station 	<ul style="list-style-type: none"> • Speakers/attendees living in different time zones or those with personal obligations may be prevented from participating in live-streaming sessions
<ul style="list-style-type: none"> • Outstanding scientists are more likely to accept invitations because of the reduced time commitment 	<ul style="list-style-type: none"> • Hackers could interfere with an online system
<ul style="list-style-type: none"> • Attendees from institutes/countries rarely frequented by well-established scientists can benefit from interaction with senior scientists 	<ul style="list-style-type: none"> • The congress activity of attendees may not be easily traceable as it is during a traditional event through use of the badge
<ul style="list-style-type: none"> • A higher number of scientific posters and short presentations can be accepted 	<ul style="list-style-type: none"> • The easy multiplication of poster oral communication sessions can be distracting
<ul style="list-style-type: none"> • Speakers can be seen and heard more clearly at one's computer station 	<ul style="list-style-type: none"> • Activities planned in hands-on mode would be limited
<ul style="list-style-type: none"> • Greater freedom of interaction, and peers can provide instant feedback to each presentation and ask questions 	<ul style="list-style-type: none"> • The transmission of high-quality images and content can overload personal audio-video and connection systems
<ul style="list-style-type: none"> • Automatic simultaneous translation of dozens of languages without paying for dozens of translators 	<ul style="list-style-type: none"> • Shared chats can generate background confusion causing multitasking participants to be distracted
<ul style="list-style-type: none"> • The auditorium can choose which of the pending questions the moderator should submit to the speaker 	<ul style="list-style-type: none"> • The message bombing could occur at events with many simultaneous activities in different sessions
<ul style="list-style-type: none"> • Lower costs and larger spaces for sponsors and exhibitors 	<ul style="list-style-type: none"> • Senior scientists may be mobbed by participants wishing to interact personally through their devices, and prioritizing interaction can require complex algorithms

There was always a limit to the number of rooms that were available for traditional onsite conferences (Lecueder & Manyari, 2000), which meant that only a limited number of speakers could be invited, and whatever space that was left over was dedicated to poster presentations. More scientists could present their findings at an online congress and posters, could be converted into short presentations, and it is possible to manage a high number of parallel sessions (Achakulvisut et al., 2020; Price, 2020).

Participants' time management is improved at virtual meetings, and more time can be dedicated to question/answer sessions and discussions as well as to keynote addresses, or plenary sessions (Price, 2020). What is more, all the oral presentations can be recorded for the attendees' convenience. Participants who live in different time zones or those with professional or personal obligations can view recordings of presentations of interest at their convenience, without missing out on simultaneously presented lectures (Longhurst et al., 2020; CROI, 2021; Cucinotta et al., 2021). Recordings make it possible to view a lecture as many times as desired, in particular, those sections that are more complicated or difficult to understand.

In addition, in a virtual modality all the participants can see and hear the speaker clearly (Achakulvisut et al., 2020) and, in some cases, can ask the speaker questions with greater freedom while avoiding all risk of contagion (McBrien et al., 2009; Martin-Gorgojo et al., 2020).

Virtual congresses can usually offer better and wider translation facilities to overcome language barriers (Lecueder & Manyari, 2000; Margolis et al., 2020). Those who have language difficulties or need to listen to a presentation several times to grasp its full meaning would be facilitated. As many online solutions can allow participants to pose questions or comments, this would certainly enhance his/her interest and participation (O'Flaherty and Laws, 2014; Achakulvisut et al., 2020; McDowell et al., 2020; Price, 2020). The only technical requirement to participate in a virtual congress is a computer and an internet connection; more sophisticated, up-to-date software and/or hardware may nevertheless be necessary for some sessions.

Another appealing aspect relates to sponsors and exhibitors roles, which could be encouraged to participate because of the

lower cost. Online congresses would lack physical stands to be set up, dedicated staff, transport of exhibition material, and the cost of gadgets. At the same time, they could use information material prepared for other media campaigns at a not renewed cost. Furthermore, on online platforms, there are no problems of space to be granted to sponsors and exhibitors, nor is there the need to rent broader and more expensive venues to satisfy all requests (Lecueder & Manyari, 2000).

Negative implications of the transition to online events

Despite the appeal of virtual events, they do have some important limitations (Table 4). Human contact and the possibility to socialize and discuss common interests with members of the scientific committee, other attendees, and representatives of pharmaceutical companies cannot be reproduced on an online platform. Many formal and informal interactions between the participants of a congress would no longer be possible, and there would be fewer opportunities for networking (Achakulvisut et al., 2020). Understandably, some will miss the in-person get togethers and the fortuitous collaborations that can arise over coffee (Price, 2020). This is a clear

limit to human relations development in all contexts, especially in those where even non-verbal communication takes on importance. In the scientific field, one can compare on specific issues by giving the conversation a different tone and a different approach based on the interlocutor who is faced with. Sometimes, personal feelings about the speaker or listener's feedback can make the difference between collaborating and avoiding each other. This can only be understood in person (Lecueder & Manyari, 2000).

It is nevertheless possible to provide some level of interaction between attendees, moderators, and speakers (Table 5). Chat rooms and forums, and break-in rooms can be created, and algorithms can be used to match participants' interests, skills, and attitudes and thus foster contacts that paradoxically could be more focused and effective than trying to meet an expert in the crowd of a large congress (AHE and APH, 2018; Achakulvisut et al., 2020; Mackenzie and Gulati, 2020; Martin-Gorgojo et al., 2020; Sayre et al., 2020). While attendees who live in different time zones or who have family obligations may not be able to participate in live-streaming sessions (Longhurst et al., 2020), lectures can be made available in a recorded mode (Fawns et al., 2020).

From a technical point of view, the uneven distribution in access to communications technologies, that is, the so-called digital divide, is something to consider as a large percentage of the world's

TABLE 5 Drawbacks related to remote participation in hybrid or online events by speakers/attendees

Critical issue	Mitigation response	Examples
Socialization opportunities and convivial moments would be severely compromised	<ul style="list-style-type: none"> • Arranging of virtual squares, rooms dedicated to breaks, or informal talks can be created • Algorithms can be introduced to match interests, skills, and attitudes • Integration of social media in congress activity has to be strengthened 	<ul style="list-style-type: none"> • American College of Cardiology Annual Scientific Session 2020 (Mackenzie and Gulati, 2020) • Neuroscience Conference—Neuromatch (Achakulvisut et al., 2020) • Librarians building Momentum for Reproducibility 2020 (Sayre et al., 2020) • Congresso de Herpetologia Português-Espanhol 2018 (AHE & APH, 2018)
Speakers/attendees living in different time zones or those with parental and caregiving obligations may not be able to participate in live-streaming sessions	<ul style="list-style-type: none"> • Recording of the scientific sessions, keeping them active online well beyond the end of the educational event 	<ul style="list-style-type: none"> • Conference on Retroviruses and Opportunistic Infections 2020 (CROI, 2021)
The digital divide regarding information technology (e.g., personal computer or an internet connection with appropriate bandwidth and steadiness of data transmission) may be an issue	<ul style="list-style-type: none"> • Recording of scientific sessions and their availability online for extended times can facilitate the attendants in searching for a local solution to access the contents at convenient times (e.g., public libraries, universities) 	<ul style="list-style-type: none"> • Conference on Retroviruses and Opportunistic Infections 2020 (CROI, 2021)
Sponsors and exhibitors may introduce invasive or distracting advertising material	<ul style="list-style-type: none"> • Set up of sponsored sessions, clearly stated as funded by sponsors • Permission of sole static advertising not distracting the attendees 	<ul style="list-style-type: none"> • European Association of Urology Congress 2020 (EAU, 2021) • Virtual Society of Laparoscopic and Robotic Surgeons Annual Meeting 2020 (VSLRS, 2020)
Potential disclosure and share of digital images of bodies, prosected human bodies, or body parts, with significant ethical and legal issues	<ul style="list-style-type: none"> • Checking the access and identity of those who use the online platform • Signing a specific agreement and a shared ethics code 	<ul style="list-style-type: none"> • International Federation of Automatic Control, Annual Meeting 2020 (IFAC, 2020)
Access to conference material and the abstract book restricted to participants in person	<ul style="list-style-type: none"> • Conference materials freely available online for anyone 	<ul style="list-style-type: none"> • Society of Toxicology (SOT) Annual Meeting (SOT, 2020)

population does not have access to internet (Fawns et al., 2020). Those without one will be unable to benefit from a virtual format (but they were also unable to travel to a traditional congress) (Wimpenny and Savin-Baden 2013, Ilgaz and Gülbahar 2015). The problem could be minimized by recording scientific sessions and keeping them active online well beyond the event so interested individuals could seek access to internet at a later date (Fawns et al., 2020). It would seem that many of individuals in this type of situation manage to access internet if not immediately or in their homes but via the institutions they attend (Lecueder & Manyari, 2000).

The roles sponsors and exhibitors play in reducing the costs of medical congresses have always been relevant. How will their function change? Hypothetically, they could put pressure on the organizers to place distracting advertising material in live streamed sessions. The problem could be partially solved by agreeing to sponsored sessions with only static advertising (VSLRS, 2020; EAU, 2021). In this regard, it must be remembered, of course, that as stated by the International Academy for Continuing Professional Development Accreditation (IACPDA, 2018), commercial support must be based on fairness, transparency, and the precise separation of promotion/advertising from education.

Another aspect that needs to be considered are the companies offering technical assistance to develop events (Evans et al., 2020). Alongside long-term professionals, new firms will probably appear. While the former may be expensive, the latter may not produce satisfying results. This will probably be a short-lived problem, as there will be a natural selection among competitors, and in the end, the most reliable and qualified professionals will prevail. In addition, event management platform software could also be used to simplify the planning process (Mackenzie & Gulati, 2020; McDowell et al., 2020).

Finally, and most importantly, there are the regulatory and ethical constraints that need to be considered with regard to online events of the anatomical sciences. Digital images of human cadaveric dissections could hypothetically be disclosed and shared to sources beyond congress participants. Tailored agreements and shared ethics code involving both the speakers and attendants need to be formulated. A system of access control to an online platform would make it possible to verify the participants' identities and prevent others from viewing anatomical material and thwart hacker attacks (Artibani et al., 2014; IFAC, 2020; Pather et al., 2020).

During this time of crisis some schools of anatomy have been streaming anatomical dissections in collaboration with nearby universities, generally as training sessions for medical students (Fawns et al., 2020). The Institute of Human Anatomy at the University of Padova has long collaborated with some Institutes of Surgery streaming cadaveric dissection laboratories during which professors of anatomy interact with professors of surgery for teaching purposes. Addressing a few hundred online attendees is, however, quite different from managing an international event. As it was said, some anatomical societies have attempted to produce alternative hybrid or fully virtual online events (Tables 1 and 2), and the international anatomical community has been examining these experiments with great attention. Virtual congresses are generally appreciated by most participants,

even hypothesizing that they must remain in the current format in the immediate future due to the effects of the pandemic (Martin-Gorgojo et al., 2020; McDowell et al., 2020; Cucinotta et al., 2021).

Innovative communication solutions and ever greater academic cooperation could be unexpected but very positive outcomes of the current crisis. Reinforcing these collaborations by developing an online anatomical network could create an important resource for the entire anatomical community and provide an opportunity for integrating new technologies and social media into congressional events (Mackenzie & Gulati, 2020; McDowell et al., 2020; Price, 2020). In an ambient of collaboration and exchange, the digital competencies that some institutions develop would benefit those centers with limited resources.

As the *Anatomical Science Education* journal has reported, the anatomical community is energetically striving to find solutions to Covid-19-related issues such as online and near-peer teaching formats. As many of the world's people are vaccinated, there could be a light at the end of the tunnel, although new viral variants have cast some shadows. In any case, the anatomical community will need to meet the challenges that continue to arise.

Study limitations

This study has some limitations. First, this review of educational events organized by anatomical societies was restricted to members of the IFAA or the EFEM societies, although the authors think it provides the information they proposed to disclose. Second, despite the efforts, some data regarding planned congresses are missing as many of the websites were not up-to-date and some of authors' inquiries were unanswered. Third, the global situation is continuing to evolve even now, making it difficult for us to draw generalizations.

CONCLUSIONS

The measures that have been implemented to protect public health and reduce the impact of the Covid-19 pandemic have had a critical effect on the daily lives of most of the world's people. As far as anatomical congresses are concerned, it is improbable that it will be possible to go back to the traditional format when the pandemic is over. The adjustments that anatomical societies been forced to make in order to be able to continue to provide a vehicle for scientific development and exchange have accelerated a digital revolution that was already in progress.

While there are some limitations to the two online congress modalities treated here, they undeniably have many advantages and benefits. At the same time, the hybrid format does give the participant the choice about how he/she wants to participate. Perhaps other congress forms will be developed and evolve, but in any case virtual scientific meetings are here to stay. All medical societies and in particular anatomical ones are searching for innovative ways to continue to promote the education and advancement of its members through scientific exchange and to provide guidelines for educational, technological, and scientific purposes.

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