1 Planning virtual and hybrid events: steps to improve inclusion and

2 accessibility

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18 **Abstract.**

19 The past decade has seen a global transformation in how we communicate and connect with one another, making it easier to
20 network and collaborate with colleagues worldwide. The COVID-19 pandemic led to a rapid and unplanned shift toward virtual
21 platforms, resulting in several accessibility challenges that have excluded many people during virtual events. Virtual and hybrid
22 conferences have the potential to present opportunities and collaborations to groups previously excluded from purely in-person
23 conference formats. This can only be achieved through thoughtful and careful planning with inclusion and accessibility in
24 mind, learning lessons from previous events' successes and failures. Without effective planning, virtual and hybrid events will
25 replicate many biases and exclusions inherent to in-person events. This article provides guidance on best practices for making
26 online/virtual and hybrid events more accessible based on the combined experiences of diverse groups and individuals who
27 have planned and run such events.

28 Our suggestions focus on the accessibility considerations of three event planning stages: 1) Pre-event planning, 2) on the
29 day/during the event, and 3) after the event. Ensuring accessibility and inclusivity in designing and running virtual events can
30 help everyone engage more meaningfully, resulting in more impactful discussions that will more fully include contributions
31 from the many groups with limited access to in-person events. However, while this article is intended to act as a starting place

32 for inclusion and accessibility in online and hybrid event planning, it is not a fully comprehensive guide. As more events are

33 run, it is expected that new insights and experiences will be gained, helping to continually update standards.

34 **1 Introduction**

35 Geoscience has long been considered one of the least diverse scientific fields (Dowey et al., 2021; Huntoon et al., 2015; Marin-

36 Spiotta et al., 2020). Many barriers to inclusion exist for researchers from historically marginalized groups, including fieldwork

37 accessibility (Giles et al., 2020; Stokes et al., 2019; Greene et al., 2021; Pickering and Khosa, 2023), financial barriers (Abeyta

38 et al., 2021), and parachute science (where international scientists typically from higher-income countries conduct research

39 without meaningfully engaging local communities and researchers (Ekandjo and Belgrano, 2022; Stefanoudis et al., 2021). A

40 significant challenge for many marginalised researchers has been accessing and attending international in-person conferences,

41 which are fundamental opportunities to network and connect with other researchers from beyond typical geographic and

42 disciplinary boundaries (Fleming, 2020). As such, the recent evolution in virtual, online, and hybrid (events with both in-

43 person and online elements) conferencing, and its impact upon accessibility and inclusivity in geoscience, merits renewed

44 discussion.

45   The dominance of purely in-person events has often resulted in the exclusion of historically marginalized groups from

46 these spaces. Traditional conferences often present physical and mental challenges to participation for a wide range of people,

47 including those who are neurodivergent, have disabilities or chronic conditions, or caring responsibilities/family commitments

48 (Chautard, 2019). For many researchers, events are too expensive to attend in-person when registration fees and

49 accommodation, transport and other costs are taken into consideration (Sang, 2017; Vasquez, 2021; Wu et al., 2022). The

50 predominance of in-person events to be held in the Global North also increases the costs for many and reduces opportunities

51 and career progression options for many marginalized groups (Talavera-Soza, 2023). Researchers from the Global South often

52 require visas to attend in-person conferences, which are often difficult and costly to obtain and require significant time in

53 advance to arrange. Indeed, there have been numerous reported cases of researchers who were unable to attend in-person

54 conferences to present their work simply because a request for a visa was either rejected or ignored completely (Chatterjee,

55 2022). Furthermore, cultural and political factors can also act to make in-person conferences inaccessible for minoritized

56 researchers. Transgender and gender non-binary researchers may have problems traveling with a passport that does not align

57 with their gender-expression (Savage and Banerji, 2022). Additionally, using a passport with a neutral gender-marker (e.g.,

58 'X' on U.S. passports) may cause issues if they are not accepted in the conference host country (Quinan, 2022). The political

59 and cultural climate of many countries is not one of inclusion for LGBTQIA+ members, with lack of legal support creating

60 unsafe environments for the community (Gibson, 2021; Olcott and Downen, 2020). In-person events may also lead to

61 experiences of isolation, discrimination, and sexual harassment (EDIG, 2020). Alcohol-focused social events may further

62 exclude people from full participation and cause increased occurrences of sexual harassment and other inappropriate

63 behaviours in professional settings (GRL, 2020). Consequently, virtual/hybrid events can provide advantages to foster more

64   inclusive and accessible environments, encouraging participation from more diverse audiences and promoting a greater sense
65   of belonging for all (Foramitti, 2021; Wu et al., 2022). Further, as many geoscientists are striving to travel less for
66   environmental reasons, virtual options offer a potential alternative to reduce carbon footprints associated with in-person
67   attendance (Allen, 1996; Tao et al., 2021; Periyasamy et al., 2022).

68   In the last 10 years or so, but especially since the forced virtualisation of many research activities during the COVID-
69   19 pandemic, the number of virtual academic events has increased very rapidly (Graham, 2023), yet equity, diversity,
70   inclusivity and accessibility have to a large extent not featured in discussions around this virtualisation. Indeed, many events
71   previously hosted online (as a result of the pandemic) are now returning to fully in-person, often resulting in the exclusion of
72   historically marginalized groups who benefited from the previous change (Fraser, 2017; Niner, 2021). It is our view that for
73   global, interconnected networks to continue to grow, and to provide a more inclusive and accessible experience for a wider
74   audience, virtual or hybrid events must continue to play a role in geoscience. Including virtual access to events makes them
75   more inclusive and accessible, helping to share the content with more people, including those who are unable or unwilling to
76   travel or are otherwise unavailable to attend physically. However, while virtual alternatives can be very positive, several
77   challenges remain, with common technological fatigue, a lack of networking opportunities, poor inclusion of the online
78   audience in hybrid events, or a lack of access to a reliable internet connection (due to remote locations, poor infrastructure or
79   a lack of finances to purchase internet services). To counter these challenges, advanced discussion and consideration of
80   accessibility during the pre-event, event, and post-event planning stages is crucial to avoid the inadvertent exclusion of people.
81   It is not sufficient to simply include a virtual component as an add-on at the end. If we wish to make sure that online and hybrid
82   events are truly inclusive and accessible, structures should be put in place early to ensure equitable experiences between virtual
83   and in-person participants.

84   Here, we outline suggestions to help make online and hybrid events more accessible to a wider audience, based on
85   the experiences of several groups and people involved with event planning for the virtual landscape, as well as from a wider
86   search of the literature surrounding virtual events. This article is structured as follows: we first provide a summary of the
87   existing literature surrounding accessibility, inclusion and online or hybrid conferences, and then provide some guidance for
88   each stage of running an accessible and equitable event including Stage 1 (pre-event), Stage 2 (during the event) and Stage 3
89   (after the event). Some of these suggestions will depend on the size and type of event being organised, but they have been
90   merged here to ensure that all elements are considered. While this article focuses on virtual and hybrid conferences specifically,
91   our suggestions may be applicable to other events like seminars, workshops and panel discussions. Many of us will be involved
92   in organising a virtual or hybrid event at some point in our careers, and ensuring it is accessible and inclusive for all requires
93   some thought and planning. We acknowledge that this paper cannot give a full and finite description of making online and
94   hybrid events more accessible and inclusive, as new techniques and strategies will evolve. Let's remember that we are all
95   learning and striving to continually improve accessibility and inclusion, so let's be patient, listen, learn and act together to
96   ensure equitable experiences for all participants.

2 Review of previous literature

When did the shift to virtual events begin, and how has this change manifested over time?

To quantitatively demonstrate the increased academic interest in virtual conferences as of 2020, we analysed records of literature indexed by Web of Science (https://www.webofscience.com/wos/). We chose to limit our search to articles with the words 'virtual', 'online' and 'conference' specifically in the title rather than in the abstract text, as these articles are more likely to deal with the specifics of virtual conferencing. We constructed searches by using the 'NEAR' query term to eliminate articles which do not directly relate to virtual conferences (see supplementary Table 1). This strategy was not entirely successful: for example, several papers were found concerning a 'virtual geoscience conference' which was an in-person event whose subject matter was photogrammetry and other virtual techniques for collecting and presenting geoscience data (Chandler, 2016); these data were removed manually from the analysis. Nevertheless, the search yielded a total of 452 unique publications, which when plotted by year (*Fig. 1*) clearly show an increase in publications as of March 2020: a total of 312 articles within the search were published in 2020 - 2023, almost 70% of the total dataset. We additionally performed searches of the Directory of Open Access Journals (https://doaj.org/), which allows less detailed search queries to be constructed and does not allow article metadata to be easily downloaded. A search for the words 'virtual' and 'conference' in the title of articles produced 71 results, of which 63 (89%) were published since March 2020, while a search for 'online conference' yielded 56 results, of which 46 (82%) were published since March 2020. Indeed, many articles published from 2020 onwards explicitly state that their rationale for considering virtual event organisation was driven by the pandemic (e.g., Busse, 2020: Fulcher, 2020; Gottlieb, 2020; Jain, 2022). In line with this change in interest, there has also been a huge shift in the type of literature published, with grey literature (blogs, social media, websites, etc) becoming an important body of work for several academic fields during the pandemic (Kousha et al., 2022).

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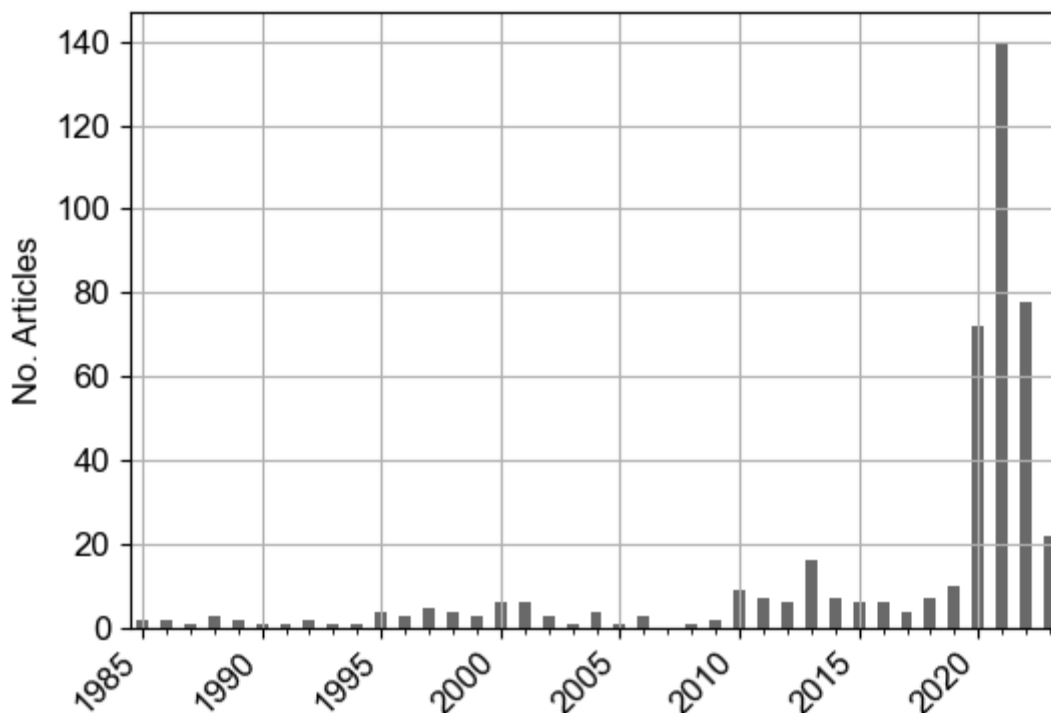
Figure 1: Plot of Web of Science search results for articles with the words 'virtual' or 'online' and 'conference' in their title,
within two words of each other (total dataset = 452). A very sharp uptick in publications is visible from 2020 (312 were
published from 2020 onwards), coincident with the onset of the COVID-19 pandemic which precipitated a necessary rise in
virtual conferencing.

To assess the interest in virtual conferencing outside of a purely academic sphere, we analysed search data from Google Trends
(https://trends.google.com/), aggregating hits for searches for six terms related to virtual conferencing from the last five years
(*Fig. 2; see Supplementary Table 2 for a list of all aggregated search terms*). These data demonstrate a very sharp increase
during the first wave of the COVID-19 pandemic, with interest tailing off from the summer of 2020 to the present, albeit the
interest remains higher than before the start of the pandemic.

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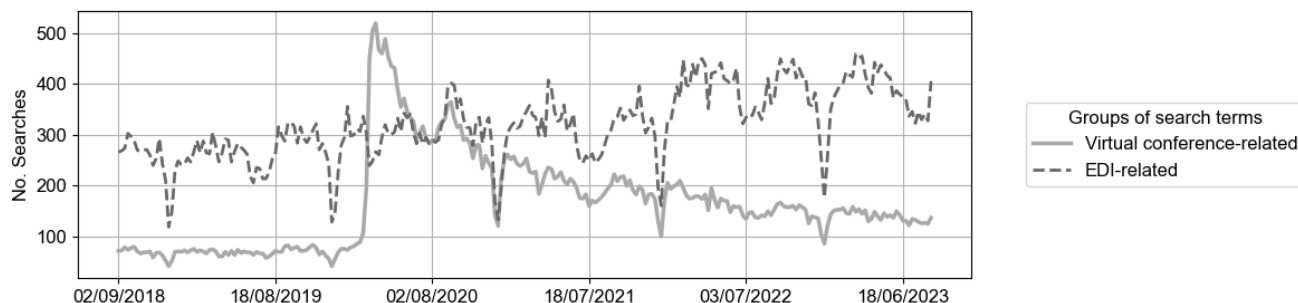
Figure 2: *Plot of Google Trends data, across all search categories over the 5-year period 02/09/2018 - 29/08/2023, for search terms related to (a) virtual academic conferences and (b) related to equity, diversity, and inclusion (EDI). There is a lack of correlation between the two datasets: interest in EDI is, on average, gently increasing with time, whereas that in virtual conferencing spiked during the COVID-19 pandemic but declined shortly after.*

What motivations were given for increased 'virtualisation' of conferences at the time?

Conferences are efficient tools for facilitating academic discussion, career development, networking and collaboration, but present several inherent inaccessibility and inequality challenges. While traditional conferences have typically been held in-person, the existence of virtual alternatives have long been recognised: the concept of virtual conferences and the use of virtual spaces to network has been discussed in the literature as early as 1986 (Heim). Much of the earlier literature is primarily concerned with addressing technological developments in virtual conferencing, which facilitate increased opportunities for networking and professional development if an appropriate physical meeting is not feasible (e.g., Anderson, 1996; Blow, 2011; Thatcher, 2006).

As the virtual conference management and participation landscape developed further, articles began to identify communities for whom traditional, in-person conferences fail to cater, and to suggest innovative virtual solutions to these specific hurdles. For example, Gichora (2010) described a series of conferences run virtually via regional hubs across Africa, facilitating access to a conference without the need for the time and money required for travel. Black et al. (2020) outlined the benefits of virtual interactions over in-person conferences from a feminist perspective, drawing on the experiences of organising a fully virtual, interdisciplinary conference (Lewis et al., 2019). Although the urgency of the COVID-19 pandemic led to comparatively little questioning of the status quo, pre-pandemic literature identified numerous ethical and EDI issues with in-person conferences (Spinellis and Louridas, 2013; Fraser, 2017), and reported results and surveys of virtual conference participation (Gunawardena et al., 2001; Gichora, 2010; Erickson, 2011). It should further be noted that many smaller-scale conferences and seminars have been run virtually in previous decades without a published record of having occurred and would therefore have been missed here.

6

153 *What challenges are associated with virtual conferences and how have these been addressed?*

154 The appropriate use of time zones is a common issue faced by virtual meetings, with significant planning required to ensure
155 time zones are accessible to as many people as possible. Clear communication (e.g., time zone specific programs) is vital to
156 ensure full inclusion (Gichora, 2010; Niner, 2020; Gibson, 2021). Virtual events often use a range of technologies, with many
157 of these rapidly changing or being replaced. Consequently, it is vital to provide extra time in the schedule to account for
158 technical glitches and to give presenters time to practice, and ideally to have pre-recorded videos as a fall back if using live
159 talks (Gichora, 2010; Raby and Madden, 2021). Communication through other platforms (such as running social media
160 campaigns or the use of mailing lists) prior to and during the event will also help ensure the smooth running of a meeting, as
161 will having clear information on an online form such as a website (Gottlieb, 2020; Raby and Madden, 2021). The use of
162 conference apps as the main communication form may not be fully accessible as they may not be compatible with all phones
163 (Niner, 2021), and digital accessibility (colour palettes, font, ease of reading etc.) may not be considered. Providing clear
164 instructions on how to submit questions or how to attend any virtual activities or networking opportunities, with detailed
165 explanations or access to help pages for any new technologies being implemented is crucial to avoid inadvertent exclusion
166 (Raby and Madden, 2021).

167 Many event reviews discuss the challenges in creating effective networking environments and fostering participant engagement
168 during online meetings (e.g., Fulcher, 2020; Correia, 2021; Gibson, 2021; Raby and Madden, 2021). In particular, virtual
169 poster sessions have often been difficult to design with limited success in promoting engaging networking, but introducing the
170 inclusion of other media (e.g., videos, QR codes) could enhance engagement (Raby and Madden, 2021). There may be multiple
171 reasons why online engagement is hindered, with some people finding it more difficult to interpret social cues in virtual spaces
172 making communication more challenging, or with people experiencing or expecting to experience more hostile interactions
173 online than in person (Niner, 2021). While more structured virtual activities have been used to make online networking more
174 successful (Fulcher, 2020), other reports suggest using alternative ways to engage that allow flexibility (Raby and Madden,
175 2021). The use of engagement platforms will depend on the scale of the event, with break-out rooms often working well in
176 small meetings to promote participant engagement (Gottlieb, 2020), but including features such as networking pages could
177 help participants engage more easily (Raby and Madden, 2021). Experimenting with different types of platforms and
178 engagement methods will help in future event planning for specific events (Niner, 2020).

179 The financial barriers that in-person events may create for people, often enhanced by geography, is commonly discussed (e.g.,
180 Sarabipour, 2020; Raby and Madden, 2021; Rowe, 2019). Many international conferences are hosted in the global north,
181 creating additional barriers to participation such as difficulty obtaining visas, leading to biased demographics of attendees
182 (Waruru, 2018). While there are still several challenges to overcome for virtual events (as discussed herein), online conferences
183 often reduce financial and geographical barriers to attendance (Wu et al., 2022). This can lead to an increase in representation
184 from traditionally underrepresented groups and foster new innovation and networking opportunities between new groups

185 (Sarabipour, 2020). The potential accessibility of virtual events for low-income attendees is hindered if the conference fees are

186 high, and adds another barrier to inclusion (Niner, 2020; Raby and Madden, 2021).

187 *Despite the increasing awareness of the benefits and challenges of virtual conferences, there is a need to better incorporate*

188 *EDI issues into virtual conference design.*

189 Our literature review shows that the shift to virtual events was not specifically motivated by EDI issues, and that to better cater

190 to these issues we should frame an appraisal of virtual conferences by their considerable potential EDI benefits. This is borne

191 out in the data analysed in Fig. 1. Of the 452 articles in the dataset, only three titles (<1%) contained the strings *'inclusiv'*

192 (contained in *'inclusive'* and *'inclusivity'*) or *'accessib'* (contained in *'accessible'* and *'accessibility'*). This quantitatively

193 demonstrates that inclusivity and accessibility are not at the forefront of discussions around virtual conferencing, despite the

194 increasing public interest in EDI issues, shown in Fig. 2.

195 The need for virtual conferences to actively create space and opportunities for minoritized groups of researchers to participate

196 was highlighted by a recent study examining the effects of gender on participation in an online conference from 2021 (Zhang

197 et al., 2023). The authors demonstrated that, even though women composed an equal number of participants to men, they asked

198 half as many questions as their male colleagues. A study of a different virtual conference from 2021 (de las Heras et al., 2023)

199 provided an example of what can be achieved when the needs of minoritized groups, in this case women and early-career

200 researchers, are kept in mind during the planning stages of a conference. By curating an event which centred the inclusion of

201 these groups in the design of the conference (such as round-table events with quotas for the participation of these groups), the

202 organisers received very positive feedback from the researchers involved.

203 Many people prefer in-person events for a variety of reasons including technology fatigue during online events and better

204 social cues when meeting in person. Thus, hybrid events seem to be a good way to incorporate the needs of a broad spectrum

205 of people. However, organizing hybrid events needs to carefully consider the needs of both in-person and virtual attendees, in

206 order to be inclusive.

207 Historically, EDI initiatives have not been the central theme of the published virtual conference literature, meaning that the

208 implications of these types of events for EDI have often been overlooked. Many of these publications are reports of an

209 individual virtual conference or series of conferences, written by the organisers of said conference, and therefore are not framed

210 by an EDI agenda despite indirectly addressing many issues related to EDI (e.g., cost of travel, adhering to social distancing

211 regulations). Reviews of virtual conferences are often but not always evaluated using feedback from participants, usually in

212 the form of a post-event survey (e.g., Fulcher, 2020; Erickson, 2011; Busse, 2020; Moreira et al., 2022), and often but not

213 always give practical advice for the future running of online conferences (e.g., Achalkulvisut, 2021; Reshef, 2020; Gottlieb,

214 2020; Harabor and Vallati, 2020; Li et al., 2021; Fu and Mahony, 2023; Margetis et al., 2007). Specific advice given can apply

215 both to running an online conference smoothly, without specific consideration of EDI (e.g., Pedaste and Kasemats, 2021; Seery
216 and Flaharty, 2020; Reshef, 2020) and give advice specifically tailored toward increasing EDI (e.g., Fraser, 2017; Gichora,
217 2010). While review articles cover a wide range of topics (such as survey feedback, online engagement, communication), it is
218 important to note that these reviews are not fully representative of everyone and may not capture all perspectives, especially
219 if someone is not able to attend in the first place due to lack of accessibility. Similarly, having a virtual component does not
220 automatically result in equitable inclusion (Niner, 2020). Virtual events may still present barriers to inclusion. These include
221 socio-economic challenges, with the cost of internet access varying widely across countries (Raby and Madden, 2021).
222 Additionally, not all people can engage with virtual events in the same way, with some attendees including many
223 neurodivergent or disabled participants often facing additional focus and fatigue challenges (e.g., Nahass, 2022; Kukoyi, 2023),
224 resulting in lower engagement and their inadvertent exclusion.

225 Often, inclusion of accessibility considerations for virtual events is not a priority of review articles, with many elements
226 missing from the current literature. For example, live closed captions or subtitles for virtual events are rarely mentioned, as
227 these may not have been considered far enough in advance for effective implementation (Gibson et al., 2021) but, these are
228 crucial for inclusion of those with certain disabilities and participants with different first languages to the conference (Seery
229 and Flaharty, 2020; Wu et al., 2022). The benefits of effective subtitles and transcriptions in online environments are clear,
230 with higher engagement from people with hearing and motion impairments in online lessons (Federico and Furini, 2012). In
231 order to produce effective subtitles or closed captions, a clear audio connection is required, which may be restricted by poor
232 microphones or acoustic environments, which may generate additional costs that should be considered early (Federico and
233 Furini, 2012).

234 In-person academic conferences have existed for over a century but have often lacked meaningful consideration of EDI in their
235 planning. In recent years, virtual conferences have increased in popularity, with the COVID-19 pandemic showing that
236 increased use of virtual and online platforms leads to a huge increase in collective experiences, regardless of the limited
237 experience hosting virtual events many people had prior to the pandemic (Eventcube, 2023). As virtual and hybrid conferences
238 continue to be utilized, it is vital that the academic community incorporates accessibility and inclusion into planning. With this
239 in mind, in the section below we collate and combine recommendations from across both the literature and the authors'
240 experiences running and participating in virtual/hybrid conferences and give concrete advice in the running of future events.
241 As the breadth of the literature shows, each online conference will have different audiences, goals, and ways of planning (e.g.,
242 Gichora, 2010; Niner, 2020; Gibson, 2021; Raby and Madden, 2021). However, by utilizing diverse mechanisms for running
243 conferences, novel and inclusive experiences can be had by all participants of a virtual or hybrid conference, both
244 technologically and socially. As virtual conferences continue to take place, with hybrid-events becoming more frequent, the
245 ways of ensuring inclusion and accessibility will grow, with new ideas and technologies always emerging. Therefore, the
246 below guidance should be taken as advice rather than as rules.

3 Stages in event planning

3.1 Stage 1: Pre-event planning and event design

3.1.1 Who?

Often an event will start before any official planning begins, when several people come together to discuss ideas. During these early discussions, several steps should be thought about (e.g., target audience(s), title/theme, organisational roles, timelines, communication strategies). Early decision on the precise event theme and target audience is important for every other step, and will be used as a foundation for communication and accessibility planning. During these early stages, ensuring diversity and inclusivity of those involved is crucial. Be proactive in inviting early-career colleagues and those from historically marginalized groups who might not otherwise become involved, and provide opportunities for individuals to suggest themselves as volunteers. It is important that volunteers are valued and not invited to tick a diversity box. Everyone's opinions and ideas need to be listened to and discussed. Furthermore, involving a broad range of people means that specific considerations for different marginalized groups are less likely to be overlooked. In the presence of a team of organisers from a diverse range of backgrounds who are treated equitably, organisers and attendees alike will feel more able to raise any foreseen issues before the event, thus reducing the likelihood of negative experiences.

Target audience: Work out who the target audience(s) is for your event and how best to reach them. Different audiences may be more familiar with different platforms or have different needs or expectations of an event. Different approaches or structures of an event (or event series) may be required depending on your audience because people engage in different ways.

Presenters: If inviting/reviewing applications for speakers or other event roles, try and ensure a broad and diverse range of presenters to ensure wide representation. Inclusion statements and codes of conduct can help, but still many events fail to provide a diverse line up, reducing the diversity of conversation. If running an event with invited speakers, consider covering expenses for speakers at your event. This is particularly important for EDI-related events, where many speakers often carry out their work on a voluntary basis. Depending on the scope of your event, it can be a good idea to give people the opportunity to talk about both their research and EDI-related concepts.

Avoiding tokenism and ensuring the most appropriate people are selected for the event you are organizing is crucial. Inviting someone because of their gender, socio-economic status, ethnic background or other characteristic to meet quotas does more harm than good to EDI work (Kamalnath, 2020). Tokenism undermines equity movements and reduces the benefits of a truly diverse community in terms of diverse perspectives and ideas (Kamalnath, 2020). If it proves difficult to identify diverse experts or speakers, rather than assuming there are none, re-evaluate it from a different perspective and consider alternative ways (e.g., connecting with specialized groups) to reach people outside of the committee's network. This may require more pre-planning in order to find the best people for a topic or talk, but meaningful diversity and inclusion take time and effort from everyone.

279   When potential speakers for an event have been decided upon, make sure to email and communicate clearly with
280 them at an early stage. The exact format, purpose and length of a talk should be shared, along with any due dates (e.g., for pre-
281 recorded talks) as soon as is feasible. Similarly, if inviting a speaker, it can be a good idea to explain why you feel they would
282 be a good fit for the talk, and ask for alternative speakers to try and reach new networks. Share any accessibility information
283 (see Section 3.1.6) and format requirements with speakers and panellists early in order to help them with the preparation of
284 talks. If a panel discussion is planned, communicating any planned questions before the event can ensure the event is more
285 accessible to many people, including neurodiverse participants (Nocon, 2021). A pre-event session or 'dress rehearsal' can
286 give volunteers, invited speakers or panellists the opportunity to familiarise themselves with the platform, ask any questions
287 and reduce uncertainty of how the event will run on the day (Nocon, 2021).

288

3.1.2 When?

290 During this stage, there are several decisions that need to be made to help streamline the rest of the event planning: When
291 should we run the event? Is there a cycle for events like this? What permissions need to be sought? Can we tag onto a larger
292 event which will increase our audience or should we do it alone?

293

294 *Time zones:* In which time zones are your target audience and speakers? Will you need to rerun certain sessions to facilitate
295 reaching a wider audience? If you are working across multiple time zones, what steps can be taken to ensure accessibility?
296 Providing pre-recorded talks before the event can allow people to submit questions and become more involved, while providing
297 a recording of the event afterwards can allow it to be shared with people who could not attend live.
298 *Dates for the event:* When choosing dates for the event, researching possible time clashes early is important to avoid any issues
299 later. This should include identification of national holidays, religious and holy days or times, and any other events that may
300 restrict attendance for some people. Avoid clashing with other conferences in similar or adjacent fields. The timing of an event
301 may limit participation from particular groups and reduce diversity of participants.

3.1.3 Budget

303 Online conferences do not have many of the associated costs of an in-person event, such as room hire, catering and printing,
304 but there are still likely to be some, particularly for technical support and accessibility planning as many free virtual platforms
305 have limited capabilities (Barrows et al., 2021). Thoroughly research the various options to decide what mix of platforms and
306 tools is most suitable for your event (see Sect. 2.6). If you do decide to charge attendance, try to minimise the fees and consider
307 waivers for attendees from middle- and low-income countries. Be transparent to participants about where the money is being
308 spent.
309   If running a hybrid event, the fees for those attending virtually should be considered carefully. Clearly, many of the
310 costs associated with in-person attendance do not apply to someone attending remotely, but some costs will apply, e.g., speaker
311 expenses and running the online platform. The geoscience community is still trying to figure out how to charge for virtual

312   attendance at hybrid conferences, but for example, the Mineralogical Society of the UK and Ireland typically charge virtual
313   attendees fees 40–60% of those for in-person attendance, and the European Geophysical Union (EGU) also charged a reduced
314   registration fee for virtual attendees of their General Assembly. However, many events, such as the American Geophysical
315   Union (AGU) Fall Meeting 2023 (AGU, 2023) still charge registration rates for virtual attendance comparable to in-person
316   participation, reducing accessibility to participants with limited funding.

317   **3.1.4 Technology and event format**

318   Virtual events can offer much more flexibility than in-person events. Common virtual-event structures include a one-hour
319   panel discussion or webinar, or a more extensive series of short talks and discussions. With no need for the audience to travel
320   to the location of the event, sessions need not be consecutive or run on subsequent days. Talks may also be made available on
321   demand, with or without the participant having previously attended a session. There are many approaches to running virtual
322   events and new methods are continuously emerging which change how we engage online. There are opportunities to combine
323   multiple formats through virtual events, with a level of flexibility not previously available. The format used should be adjusted
324   to reflect the specific goals of the event (dissemination of research results/audience, participation, feedback, networking, etc.).
325   A good approach is to make fundamental decisions about structure (e.g., platform, talk availability through recordings/live
326   presentations, poster session formats, hybrid or fully virtual format) as far in advance as possible, announcing details early in
327   a clear, accessible and transparent way. Similarly, many people are not familiar or comfortable with some technologies and
328   can get overwhelmed by new platforms and software and overly complex instructions, resulting in their exclusion from
329   participation. Consider ways to overcome this such as making instructions as clear as possible, including annotated screenshots
330   to help guide participants, or offering support through correspondence with participants and speakers.

331   There are several types of platforms and technologies which can be used for online events, each having different
332   features and capabilities. As well as standard video-conferencing platforms such as Zoom, additional live streaming services
333   such as YouTube, Streamyard or Twitch may be used to reach a wider audience. Ancillary services may be used alongside the
334   main event platform in order to increase audience participation and inclusion (e.g., AhaSlides, Slideo) or to facilitate
335   networking (e.g., Gather Town). Consider that many platforms or services may be unavailable in some countries, and
336   consequently alternative ways of engagement may be needed to ensure accessibility (such as agreeing to upload recordings to
337   alternative video hosting platforms afterward). Similarly, different platforms have different accessibility features; consider
338   whether it offers options for captions when deciding where to host your event. Importantly, test the application of any platform
339   or tool in advance of running the event to ensure it works in the way that you had desired.

340   **3.1.5 Promotion and communication strategy**

341   The promotional strategy will depend on your target audience. Different target audiences mean different ways of
342   communication need to be considered. How will you ensure that event information is shared with all target audiences? How
343   will you reach audiences outside of your network and engage people who are not traditionally involved? If your event is open

344 to everyone, consider how your promotional strategy will make it clear that all people are welcome. For communication with
345 speakers and other participants, announce deadlines early and remind people when they are approaching.

346   Social media can be a great tool for spreading the word about an event, along with disseminating a registration link.
347 However, other methods should not be forgotten as many people do not engage with social media. Consider email campaigns,
348 printed posters for notice boards, inclusion in newsletters and mailing lists. When utilising these methods, consider the
349 accessibility of the content being distributed. Ensure the use of alternative (alt) text for online content and accessible design in
350 the generation of any graphics (s3.1.6). A social media campaign may help gain momentum and get the most interaction. Plan
351 several posts before the event, such as a save the date, speaker introductions, description of themes and registration links in
352 the run up to the event to help increase engagement. Ensure adequate time to share the details as it can take a while for details
353 to be circulated. Accessibility of social media plans should be discussed in advance to avoid inadvertent exclusion. Working
354 with other groups to share event details can also help to reach a wider audience. Similarly, these groups could be used to
355 discuss ideas and gain feedback on plans.

356   A word of caution: even for free events, it is a good idea to require prior registration by the participants. Unfortunately,
357 there have been instances, where meeting links where shared publicly on social media, resulting in so-called 'Zoom bombings',
358 where individuals shared inappropriate content or otherwise disrupted the session. Prior registration minimizes the risk of such
359 disruptions. Additionally, a designated person should be in charge with handling such situations promptly by blocking that
360 individual.

361 **3.1.6 Specific tips for accessibility and inclusion**

362 There are several accessibility challenges to be considered for event planning, e.g., screen-sharing means screen readers cannot
363 describe images as they are being presented. There are some straightforward solutions to address these challenges, including
364 sharing of presentations prior to the event, with some more specific examples outlined below.

365

366 *Closed captions/subtitles:* Closed captions or subtitles are critical to maximise engagement with any event for a variety of
367 reasons. For example, people with hearing impairments and people whose first language is different from that of the conference
368 may depend on these to fully engage with the material being presented (Cooke et al., 2022; Dello Stritto and Linder, 2017).
369 Captions or subtitles may help people from all backgrounds to keep focused on the materials being presented, or if they are in
370 a noisy area, as not everyone has access to quiet working spaces. Further, they can also help people overcome screen fatigue
371 for virtual events and help participants to stay more engaged overall. It is important to highlight that closed captions (assumes
372 audio cannot be heard, includes sound effects) and subtitles (dialogue transcriptions only, assumes other audio can be heard)
373 offer different benefits, and for any event, the more relevant form should be selected (Rev, 2021).

374   Closed captions/subtitles can be deployed in a number of ways: many virtual event platforms offer in-built auto-
375 generation options and third-party artificial intelligence (AI) services are also available, though there may be issues with
376 accuracy if using auto-generated captions (Besner, 2019; Leduc, 2020). Human transcription services are often more accurate

377   than auto-generated and so are preferable, but they will typically cost more and may not be possible live. Research before the
378   event is needed to see what options are available and which service is available in your region or meets your audience's needs.
379   Legal requirements for closed captions during virtual events vary with geography and institution so check those relevant to
380   you before making any decisions.

381

382   *Transcriptions:* Plan to provide a written record of the session after it has taken place. These can be auto-generated by most
383   video conferencing platforms or provided by a third-party AI service. Check the quality of any transcripts before providing
384   them to attendees, particularly if auto-generated by software. Transcripts can be helpful in keeping a record of discussions and
385   debates that take place during an event, and can consequently be used as a resource to write up conference papers or blogs to
386   share outcomes after the event. Before the event, a person should be assigned transcription reviewing, as this can be a time
387   consuming process. Also consider the availability and accessibility of these resources: Can anyone access them? Will they be
388   shared in a follow up email or linked with recordings? Do people need to contact the organizing committee for them? Whatever
389   the decision, this needs to be communicated clearly to participants before and during the event.

390

391   *Languages:* Many people may be presenting and participating in their second or third language. Be patient and respectful of
392   the fact that people may be more accustomed to a different language the event is held in. Consider running parts of the event,
393   including social events, in a language other than the main language, depending on the demographic of participants. Similarly,
394   providing support for speakers that may not be presenting in their native language may help ensure people are comfortable
395   while presenting. These could include mentorship opportunities, practice runs or feedback services, and could significantly
396   help people's confidence in taking part in an event. As with closed captions, AI offers the possibility of live translation, partially
397   circumventing language barriers and improving accessibility.

398

399   *Sign language:* Sign language interpreters offer another way for people with hearing difficulties to engage with content.
400   However, forms of sign languages vary globally, and consideration needs to be given to what is most relevant to your event
401   and whether including sign language options would be appropriate, and if not, what alternatives can be utilised to ensure
402   accessible content.

403

404   *Accessibility in presentations:* Issue guidelines to participants about how to make slides accessible (AHEAD, 2023a; b). In
405   particular, be mindful of colour schemes and typefaces which may cause legibility problems for participants with colour vision
406   deficiency, dyslexia or similar (Wickline, 2000). There are several resources available to check accessibility (e.g., Colour
407   Oracle, Coblis - Color Blindness Simulator). Further, the amount of text on a single slide, the colour of the text and the contrast
408   between text and background are all important considerations. Avoid placing important information at the bottom of the screen
409   where it may be covered by subtitles/captions.

410

14

411 *Social media:* If planning a social media campaign (as described in Sect. 2.1.6), the accessibility of posted content needs to be
412 thought about in advance. Each platform offers different accessibility features that should be researched in advance. Ensure
413 the use of alt text if using graphics, and that graphics are designed in an accessible way (e.g., fonts, colour schemes). There
414 are many other considerations, such as avoiding the overuse of emojis or ensuring the use of capital letters in hashtags (i.e.,
415 camel case) to help screen readers engage more meaningfully with content. Consider assigning dedicated people to research
416 social media accessibility to ensure your content is accessible to everyone.

417

418 *Other considerations:* The inclusion of breaks during an event to allow rest is a crucial step to allow people to recover from
419 screen-time and prevent overstimulation. For online conferences, this could take the form of ensuring a conference's schedule
420 is well staggered to allow breaks and rest periods. For in-person conferences, have quiet spaces in place e.g., for people to de-
421 compress, breast-feed or pump breast milk. Having water refill stations and food for sale or for free available for the
422 participants on-site is another helpful consideration so people do not have to go too far, which may be an access barrier.
423 Similarly, if serving coffee and tea, have decaffeinated options available, or alcohol-free beverages if serving alcohol.

424 **3.1.7 Presentation format**

425 Virtual events offer a unique opportunity to have various styles of presentation. Talks within a conference session (or similar)
426 may be either live (given on the day), pre-recorded (recorded in advance, with the recording shared during the event), or a
427 combination of the two. There are many benefits to both styles, but pre-recorded talks allow for more accessibility options,
428 and they will ensure exact timings are maintained during the event. This is particularly useful if running a larger-scale
429 conference with multiple short talks or with multiple parallel sessions. However, care should be given to what your choice
430 means in terms of accessibility as screen readers may not be able to engage with presentations shared through a pre-recorded
431 video (Vasquez, 2021), so this should be made available beforehand to allow people to engage more meaningfully. There are
432 several pros and cons to both formats, with some summarised below:

433

434 *Live talks:*

435 Pros:

436 ● Less preparation time for both speakers and organisers when talks are presented live, as no rerecording is needed to
437   change any mistakes and organisers do not need to assign someone to review videos prior to an event.

438 ● More familiar to speakers, less likelihood of technology problems.

439 ● Makes live question/response more seamless.

440 Cons:

441 ● Requires steady internet with no unexpected outages.

442 ● Requires presence at the computer at certain time - difficulties with time zones, childcare, balancing with other work
443   obligations etc.

15

444   ● Only live captions are possible, whether from AI or live transcription services, which may not be perfect and require
445   additional funding.

446

447 *Pre-recorded talks:*

448 Pros:

449   ● May decrease the potential for stage fright or anxiety as the speaker can remove errors. However, this is something
450   of a double-edged sword, as the lack of specific timelines can cause people to devote excessive time to preparation,
451   leading to undue stress.

452   ● Allows flexibility for recording time as the presentation is submitted in advance, and it allows organizers to plan for
453   effectively as they will know the exact time for each talk.

454   ● Presence at the time of the event is not essential, although it is still useful/important to be present to answer questions
455   (see below) and to avail of possible networking opportunities.

456   ● Potential for talks to be watched "on demand", although consent should be sought from participants for talks to be
457   hosted online in a way that facilitates this.

458   ● If videos are clearly recorded, the audience would likely not be aware of it being pre-recorded unless told in advance
459   and could help avoid technical issues with speaker internet connection.

460   ● Crucially, allows time for preparation of accurate subtitle files rather than relying on AI. Subtitles can be checked
461   against the video in advance and corrected if necessary. Transcripts can be prepared in advance and distributed prior
462   to, or on the day of, the conference, allowing people to follow along with the talks on-screen.

463   ● Participants can choose to watch the video at a faster or slower speed, according to their needs.

464 Cons:

465   ● The presentation may take longer to prepare. If mistakes (in content or accessibility) are noticed after submission,
466   correcting this and re-recording creates an additional burden and can cause significant delays.

467   ● Who is responsible for providing captions of the video? Not everyone has experience or awareness on how to do this
468   – will you be providing guidance or assigning someone to produce the captions? This needs to be discussed and
469   decided in the early planning stages, ensuring transparency at all levels.

470   ● Video recording tools are not necessarily intuitive; at the very least this requires recommendations from organizers
471   about which software to use. Additional resources may be required for people to be able to produce their own videos.

472   ● If people are not familiar with sharing videos, technology challenges may cause delays to schedules, so practice runs
473   are needed to avoid any glitches on the day of events.

474   ● Not suitable for all kinds of sessions. Although they can be recorded and rewatched afterwards, panel sessions must
475   originally be live as all panellists and audience need to be present at the same time.

476   ● Many people do not like watching pre-recorded talks as it seems less personal.

477

16

478   A willingness to be flexible in your approach to accommodate the different needs of your presenters and attendees will go a

479   long way, though it is also important to be mindful of going too far the other way and creating too much of a logistical burden

480   for the event organisers.

481   **3.1.8 Other considerations for the pre-event organising stage**

482   *Code of conduct, etc:* Take time before the event to come up with a code of conduct and other housekeeping information and

483   provide this document to both speakers and attendees before the event. A code of conduct should include a list of what is/is

484   not permitted, and also any consequences there may be for those who choose not to abide by it. Consider having a way for

485   people to signify they need assistance from a member of the conference team, such as using the "raised hand" feature or a

486   particular emoji reaction included in most video conferencing software.

487

488   *Planning document:* Before the event, creating a central document or record with all details that may be needed on the day

489   should be generated. This can act as a central database for all relevant information and help address any challenges that arise

490   during the event. This should contain any prepared statements (e.g., code of conduct, Q&A process, information on recordings

491   if available, follow up statement) along with logistics information (speaker lists and contact details, access links,

492   announcements). All volunteers should have access to this resource before the event. A similar document should be designed

493   for presenters to give all relevant information, links, pre-planned questions, and other logistics and help ensure smooth running

494   on the day.

495

496   *Pre-event accessibility questionnaire:* To help ensure the needs of participants are met for your event, a pre-event questionnaire

497   should be thought about and distributed to gain insights into the accessibility needs of your participants. This form could be

498   linked with registration, depending on the platform being used (e.g., EventBrite) or circulated through social media/email lists.

499   This will greatly help planning, and ensure that people's needs are met for full inclusion during the event.

500   **3.2 Stage 2: During the event**

501   Much of the work for the actual running of the event will have been done in Stage 1, and this is why it is such a crucial step in

502   (virtual) event planning. This section discusses how some of the more specific features may run on the day, with accessibility

503   in mind, and includes elements that should be defined in the pre-event stage.

504

505   *Volunteers and staff:* What volunteers or staff are needed for during the event? While many events will need volunteers and

506   staff to host sessions or run discussions, there are many other roles that should be considered beforehand to ensure the smooth

507   running of an event, including technical support. All volunteers and staff should be confirmed before the event with

508   expectations clearly outlined and know what their role is.

509

510 *Questions from the audience:* Make sure the audience has the option to ask questions either verbally or in text (e.g., through a
511 chat box function) and clearly explain how questions can be asked at the start of the event to ensure full inclusion. If the event
512 is also being streamed to another platform (e.g., YouTube), ensure someone is responsible for monitoring for questions on the
513 second platform to allow all audiences to engage. Consider not recording the questions and answers part, to lower the hurdle
514 of asking a question.

515

516 *Introductions:* When introducing/talking to people, use gender-neural language, do not assume pronouns, and if possible, ask
517 people their pronouns before the event. This can form part of the introduction package that should be developed before the
518 event (Section 2.1.9). If a mistake happens, there are a lot of resources that can help to learn the correct way to respond (e.g.,
519 Pronouns.org, 2023). Avoid binary turns of phrase like 'Ladies and Gentlemen', which may inadvertently exclude people with
520 non-binary gender identities. Encourage people to include their pronouns in their online tag. However, there are many reasons
521 why people might not want to publicly declare their pronouns, so this should always be optional. When speakers introduce
522 themselves, it can be helpful for people with visual impairments for them to give a short visual description (e.g., I have brown
523 shoulder-length hair and today I am wearing a stripy white and yellow jumper) but do not force this as not everyone will be
524 comfortable with carrying out self-descriptions (see IDEA, 2021 for other examples).

525

526 *Camera etiquette:* Do not insist that cameras be switched on, as this may not be possible for every attendee. Streaming
527 attendees' videos can be problematic for people with a poor internet connection. Video fatigue (Bailenson, 2021) is also a
528 reality, and if an event is going on for several hours, people need a break from being watched.

529

530 *Event etiquette:* Remind people of the code of conduct at the start of every session including how/to whom to raise any
531 concerns. If parts of the session are being recorded, let the audience know this at the start of the session.

532

533 *Social media activity:* Using social media during an event, to share discussions, ideas and outcomes can be a great way to
534 encourage participation from a wider audience. Permission should be obtained for sharing anyone's research or image, and
535 contents should be shared with accessibility in mind (e.g., alt text).

536 **3.3 Stage 3: After the event**

537 Any activities for the post-conference phase (e.g., follow-up emails) should be planned in advance because people often need
538 to take time away after event planning and there may be limited volunteer and staff help for carrying out any after-the-event
539 plans. There are several aspects that should be considered, with some examples below.

540

541 *Recordings and Transcripts:* If providing recordings, ensure that full, accurate transcripts are available and that any
542 subtitles/captions uploaded are correct. Reviewing captions and transcripts can be a time-consuming process, so ensure that

543 enough volunteers and time are available for this. Decide in advance how soon after the conference you expect these to be

544 available, communicate this to participants and keep to this deadline.

545

546 *Follow-up email:* Whilst this is optional, it can be helpful to direct attendees (or those who registered but could not attend) to

547 any available recordings and relevant links/information. This also provides an opportunity for people to give feedback if

548 requested.

549

550 *Feedback:* Measuring feedback can be difficult, but a short questionnaire (or equivalent) could be included in the follow-up

551 email. This will require additional support to review and analyse the feedback, but it can be a great way to learn how to improve

552 accessibility for future events, which will be particularly useful if running an event for the first time. However, be mindful of

553 overwhelming the audience with surveys.

554

555 *Communication channels:* How can people get in touch with you/the organising team post-event? If using an email, someone

556 will need to monitor this and answer any questions. Some events may also have corresponding Slack/Discord/other platform

557 channels to help participants network and discuss more between themselves. If this is something to be launched for the event,

558 it will need consideration at an early stage to ensure engagement and accessibility.

559

560 *Certificate of attendance:* Some participants may be required by their workplaces or university to produce a certificate of

561 attendance for the event. Appoint a volunteer to respond to such requests.

562 **4 Conclusions & Summary of lessons learned**

563 The global COVID-19 pandemic caused a drastic shift in the way people communicate with each other. Many people were

564 forced into working from home due to lockdowns, causing working groups and research teams to utilise video conferencing

565 technologies far more frequently to ensure continued collaboration and connectivity. The restrictions on travel both locally

566 and internationally also had a drastic impact on geoscience events. As the pandemic progressed, many planned in-person events

567 began to be redesigned for a virtual platform, with novel and innovative ways created for participants to communicate and

568 network with each other. This virtual network has led to many new collaborations between people who may have never met

569 in-person, and it has also helped to strengthen relationships already in place, allowing for a more diverse, interconnected, and

570 effective research community across the world.

571

572 However, this move to a virtual landscape was sudden and consequently consideration has not always given to the accessibility

573 of these virtual platforms and events. Whilst we are currently seeing a resurgence in the number of purely in-person events,

574 the use of virtual and hybrid platforms is likely to continue, with many virtually-based groups now in existence, and flexible

575   and remote working options having been established. The move to a virtual and hybrid landscape also highlighted the

576   geographical and socio-economic disparities of in-person event accessibility, with the financial and logistical burden of travel

577   to events being felt by some researchers more than others. This has led to inequalities of opportunity and to biased attendances

578   at international in-person conferences which do not represent the entire spectrum of researchers. Further, moving back to

579   purely in-person events would dismiss the progress in accessibility and inclusion they have provided.

580

581   In cases where virtual components of an event have not been successful, future virtual elements should not be dismissed to

582   avoid future exclusion (Niner, 2021). Reflection on why an event or a component of one was not successful, asking for

583   feedback where possible, and learning from other examples, is suggested to create recommendations for how to try and make

584   future events more inclusive and engaging. It is important to discuss and plan accessibility and inclusion early in event planning

585   to ensure a safe and engaging environment for all potential participants (Gibson, 2021). Virtual conferences will only become

586   truly accessible and inclusive if the entire community actively works towards it (Niner, 2020), with active consideration and

587   discussion of best practices for different people. This includes consideration of which communities are best served by best

588   practice guidelines, and continual re-examination of procedure as technology and expertise develop new methodologies for

589   increasing success of conferences for everyone. As new ways of interacting with each other continue to be established, we

590   need to remember the lessons learned from the initial move to virtual events. If thought and consideration are not put into the

591   virtual part of future online and hybrid events, then these will not be effective and may exclude some participants.

592

593   In summary, there are some key considerations identified that can help with event planning to act as a starting place for

594   planning an inclusive and accessible virtual event:

595   ● Accessibility needs to be part of the planning phase, not an afterthought.

596   ● Decide early on the dates, length, purpose and title of the event, and communicate this information early and clearly.

597   ● Ensure diversity of the planning committee and speakers to ensure different ideas and viewpoints are considered.

598   ● Ask participants about their virtual access needs before the event and then ensure these needs are met throughout the

599   event.

600   ● Clearly outline planning/time commitment involved for volunteers/organisers and decide on roles (and associated

601   responsibilities) before the event, so everyone knows what they're doing and when they are needed (feeds into

602   communication). Ensure enough volunteers or staff for the event being organized. It can be quite overwhelming to

603   try to do multiple things (e.g., monitor chat and feed panel questions).

604   ● Evaluation of the event can be achieved through a short survey (prepare this during the pre-planning phase) sent to

605   participants shortly after the event. Asking about location/career stage/etc.. can help monitor and evaluate where your

606   network reaches and help in future event planning.

607   ● Communication is key!

608 While there are doubtless many other considerations around virtual accessibility not covered here, we hope that this article can

609 provide a checklist for those who wish to curate more inclusive and accessible virtual events going forward.

610 **5 Author contribution**

611 ALD, VRD and BW contributed equally to the formation of the article, including the initial draft development. KM, RAW,

612 AA, IC, CC, DY, MD, and LK all contributed to writing, reviewing and editing of drafts, and adding their experiences and

613 ideas, leading to the submitted version.

614 **6 Competing interests**

615 No competing interests are known at the time of submission.

616 **7 Ethical statement**

617 This article was produced during volunteered time by the authors and was not funded by any external group or award. As no

618 humans or animals were included in this work, and no personal information has been shared, no ethical review was required.

619 **8 Acknowledgements**

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