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Self-Reported COVID-19 Infections and Social Mixing Behavior at Oncology Meetings

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Received Mar 25, 2022; Accepted for publication May 2, 2022

Purpose: The COVID-19 pandemic largely suspended in-person scientific meetings because of risk of disease spread. In the era of vaccination and social distancing practices, meetings have begun returning to in-person formats. We surveyed attendees and potential attendees of 2 oncology meetings in the United States to identify rates of mixing behavior and the subsequent rate of self-reported COVID-19 infection.

Methods and Materials: We collected via survey reported social mixing behavior and COVID-19 positivity (within 21 days of meeting conclusion) of actual and potential in-person attendees of the American Society of Clinical Oncology (ASCO) Quality Care Symposium held September 24 to 25, 2021, and the American Society for Radiation Oncology (ASTRO) Annual Meeting held October 24 to 27, 2021. Conference speakers and other participants were identified through publicly available meeting materials and targeted via e-mail when possible. Recruitment of additional attendees and potential attendees was also conducted through a sharable link promoted via oncology newsletters and social media. Descriptive statistics alone were performed owing to low COVID-19 event rates.

Results: Response rates from targeted conference participants with publicly available e-mails were 27.4% for the ASCO and 14.3% for the ASTRO meetings. The ASCO survey produced 94 responses (48 in-person attendees). The ASTRO survey produced 370 responses (267 in-person attendees). Across both meetings, 3 of 308 (1.0%) in-person attendees versus 2 of 141 (1.4%) nonattendees tested positive for COVID-19. Low COVID-19 positivity rates were reported among in-person attendees spending more (>20) versus fewer (≤20) hours attending live sessions (2.2% vs 0%) and among indoor social event participants versus nonparticipants (0.8% vs 1.9%). Attendees largely felt comfortable attending additional in-person meetings after experiencing ASCO (87.5%) or ASTRO (91.9%) and felt mask compliance was good or excellent at ASCO (100%) and ASTRO (94.6%) meetings.

Conclusions: In-person meetings do not seem to be contributing to high rates of new COVID-19 infections in the setting of vaccine and social distancing mandates, supporting paths forward for at least partially in-person conferences as COVID-19 becomes endemic. © 2022 Elsevier Inc. All rights reserved.

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Disclosures: S.B.E. sits on the American Society for Radiation Oncology steering committee. All other authors have no disclosures to declare.

Data sharing statement: Research data are stored in an institutional repository and will be shared upon request to the corresponding author.

Acknowledgments—The authors acknowledge Cristin Watson, Director of Professional Development, American Society for Radiation Oncology, and Lauren Milner, American Society of Clinical Oncology, for their support in understanding meeting protocols and regulations in place for 2021. Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijrobp.2022.05.002.

Int J Radiation Oncol Biol Phys, Vol. 114, No. 1, pp. 30−38, 2022
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https://doi.org/10.1016/j.ijrobp.2022.05.002
Introduction

The coronavirus disease 2019 (COVID-19) pandemic has brought disruption to nearly all facets of life and work. Early in the pandemic, it became clear that meetings involving large congregations of people from diverse geographic locales was associated with risk of significant disease spread. One of the earliest reports of a COVID-19 “super-spreader event” was a large biotechnical meeting in Boston, which resulted in an estimated 330,000 additional cases of COVID-19 worldwide.1 As a result of these publicized incidents and the risks of travel and large gatherings, in-person scientific meetings were canceled2 or converted to virtual formats. These concerns were particularly relevant to those treating patients with cancer, as immunosuppressed patients transmitted the disease have a higher risk of death,3 despite improvements over time.4 The success at reproducing the full in-person experience on virtual platforms has been debated,5 as the utility of scientific meetings arises from both engagements with formal presentations and from unstructured networking and discussion with colleagues at other institutions. As COVID-19 vaccines became available and cases waned, several medical organizations began to consider in-person meetings with precautions. To our knowledge, social mixing behavior at in-person meetings and the subsequent rate of self-reported COVID-19 infections after in-person oncology meeting attendance has not previously been reported.

Methods and Materials

A survey was developed to assess the social mixing behavior of actual and potential in-person oncology meeting attendees (Appendix E1). The study was deemed exempt from institutional review board review. Two oncology meetings were targeted: the American Society of Clinical Oncology (ASCO-QCS) 2021 Quality Care Symposium and the American Society for Radiation Oncology (ASTRO-AM) 2021 Annual Meeting. ASCO-QCS had 700 registrants (including in-person and virtual, personal communication, Lauren Milner). ASTRO-AM had 5905 registrants (including in-person and virtual, personal communication, Cristin Watson). Vaccination was required for both meetings (verification via the CLEAR application for ASCO-QCS and attestation required for ASTRO-AM), and masks were mandated during the conferences, except when lecturing or actively eating or drinking. Both meetings were hybrid (in-person and virtual).

For the target population, we sought to identify in-person meeting attendees as well as nonattendees (made up of both virtual or potential attendees), to allow identification of any additional risks caused by in-person meeting attendance, meeting associated social mixing, or travel. Oncologists, patient advocates, meeting speakers, and exhibitors were eligible to participate. Publicly posted meeting programs for both meetings were reviewed, and conference speakers and participants were identified from these programs (Fig. 1).

![CONSORT Diagram](image)

**Fig. 1.** CONSORT (Consolidated Standards of Reporting Trials) diagram demonstrating study cohort selection. **Abbreviations:** ASCO = American Society of Clinical Oncology; ASTRO = American Society for Radiation Oncology.
Table 1  Survey responses of in-person ASCO Quality Care Symposium in-person attendees and nonattendees

| Continent of residence               | ASCO Quality Care Symposium in-person attendees, n (%) | ASCO Quality Care Symposium nonattendees, n (%) |
|--------------------------------------|-------------------------------------------------------|-------------------------------------------------|
| North America                        | 46 (95.8)                                             | 37 (97.4)                                       |
| South America                        | 2 (4.2)                                               | 0 (0)                                           |
| Europe                               | 0 (0)                                                 | 0 (0)                                           |
| Africa                               | 0 (0)                                                 | 0 (0)                                           |
| Australia                            | 0 (0)                                                 | 0 (0)                                           |
| Asia                                 | 0 (0)                                                 | 1 (2.6)                                         |
| Role                                 |                                                       |                                                 |
| Radiation oncologist/medical oncologist | 21 (43.8)                          | 20 (52.6)                                       |
| Oncologist in training               | 10 (20.8)                                             | 4 (10.5)                                        |
| Medical physicist                    | 0 (0)                                                 | 0 (0)                                           |
| Patient advocate                     | 3 (6.3)                                               | 2 (5.3)                                         |
| Exhibitor                            | 1 (2.1)                                               | 0 (0)                                           |
| Student                              | 0 (0)                                                 | 0 (0)                                           |
| Meeting staff                        | 1 (2.1)                                               | 0 (0)                                           |
| Other                                | 12 (25.0)                                             | 12 (31.6)                                       |
| Age                                  |                                                       |                                                 |
| 18-29 years old                      | 0 (0)                                                 | 1 (2.6)                                         |
| 30-39 years old                      | 17 (35.4)                                             | 13 (34.2)                                       |
| 40-49 years old                      | 17 (35.4)                                             | 12 (31.6)                                       |
| 50-59 years old                      | 7 (14.6)                                              | 8 (21.1)                                        |
| 60-69 years old                      | 7 (14.6)                                              | 10.5 (4)                                        |
| 70 years old or older                | 0 (0)                                                 | 0 (0)                                           |
| Tested for COVID-19 in 3 weeks following the meeting | | |
| Yes, I had testing because of symptoms | 1 (2.1)                                              | 2 (5.4)                                         |
| Yes, I underwent asymptomatic testing | 14 (29.8)                                             | 4 (10.8)                                        |
| No, I was not tested                 | 32 (68.1)                                             | 31 (83.8)                                       |
| Did not respond                      | 0 (0)                                                 | 0 (0)                                           |
| Vaccination status                   |                                                       |                                                 |
| I am >2 weeks following full vaccination | 47 (97.9)                                         | 36 (94.7)                                       |
| I am not vaccinated                  | 1 (2.1)                                               | 1 (2.6)                                         |
| I have received 1 of 2 planned vaccination | 0 (0)                                                 | 1 (2.6)                                         |
| Perceived importance of avoiding COVID-19 | | |
| Very important                       | 44 (91.7)                                             | 30 (79.0)                                       |
| Somewhat important                   | 4 (8.3)                                               | 6 (15.8)                                        |
| Neutral                              | 0 (0)                                                 | 1 (2.6)                                         |
| Not that important                   | 0 (0)                                                 | 1 (2.6)                                         |
| Not important at all                  | 0 (0)                                                 | 0 (0)                                           |

(Continued)
Identified conference speakers and participants found to have a publicly available e-mail were directly invited to complete the survey. The survey was promoted on social media, both through posts on Twitter, as well as by replying to posts that had the hashtags #ASCOQTY21 or #ASTRO21. Sharing the link with colleagues was encouraged. Links to the survey were also promoted through the oncology newsletters “ARROgram” and “QuadShot News” during the collection period.

After consent, participants were asked demographics, the perceived importance of avoiding COVID-19 infection, and vaccination status. Branching logic was used to query baseline potential for COVID-19 exposure (risks from household contacts and social behaviors for the 4 weeks surrounding the meeting), and subsequent self-reported COVID-19 infection. A conservative 3-week period for diagnosis of COVID-19 infection was chosen to allow for 14 days of incubation, followed by up to 7 days of symptoms before testing was undertaken. Individuals who reported attending both ASCO-QCS and ASTRO-AM in-person were excluded from the analysis of ASTRO-AM in-person attendees, given the potential for ambiguity in the attribution of outcomes. Descriptive statistics alone were performed in the setting of low COVID-19 event rate.

### Results

For ASCO-QCS, there were 55 respondents to the e-mail targeted survey to conference speakers and participants (response rate 27.4%). An additional 31 responses were received through an anonymous link for this cohort, making the total ASCO-QCS respondents 86, with 48 responding as in-person attendees (Fig. 1). For ASTRO-AM, 167 e-mail-targeted respondents completed the survey (response rate 14.3%). An additional 203 responses were received through an anonymous link for this cohort, making the total ASTRO-AM respondents 370, with 267 responding as in-person attendees. Seven ASCO-QCS attendees also attended ASTRO-AM and were excluded from the ASTRO-AM analysis (all without reported COVID-19 infection).

Both ASCO-QCS and ASTRO-AM meeting attendees were predominantly medical or radiation oncologists and 30 to 50 years of age (Tables 1 and 2). One-fourth to one-third of in-person attendees underwent COVID-19 testing (27.1% ASTRO, 31.9% ASCO). Among those not testing positive, 99 (22.0% of combined respondents) underwent asymptomatic testing and 15 (3.6% of combined respondents) underwent testing in the presence of symptoms. Despite the vaccine mandate, 6 in-person attendees of ASTRO (2.3%) did not meet this requirement. Attendees at both meetings largely reported feeling comfortable attending additional in-person meetings after experiencing ASCO-QCS (87.5%) or ASTRO-AM (91.9%) meetings and that mask compliance was good or excellent (100% ASCO-QCS and 94.6% ASTRO-AM, Table 3).

Across both meetings, 3 of 308 (1.0%) in-person attendees versus 2 of 141 (1.4%) nonattendees tested positive for COVID-19 (Fig. 2). In the ASCO-QCS cohort, 1 attendee (2.1%) and 1 nonattendee (2.6%) tested positive (Table 1),

| Table 1 (Continued) | ASCO Quality Care Symposium in-person attendees, n (%) | ASCO Quality Care Symposium nonattendees, n (%) |
|----------------------|------------------------------------------------------|-------------------------------------------------|
| **Number of social activities performed** | | |
| 0 | 8 (16.7) | 14 (36.8) |
| 1 | 10 (20.8) | 7 (18.4) |
| 2 | 15 (31.3) | 5 (13.2) |
| 3 | 12 (25.0) | 6 (15.8) |
| 4 | 1 (2.1) | 4 (10.5) |
| 5 | 2 (4.2) | 2 (5.3) |
| 6 | 0 (0) | 0 (0) |
| 7 | 0 (0) | 0 (0) |
| **Diagnosed with COVID-19** | | |
| Yes, diagnosed within 3 weeks of meeting conclusion | 1 (2.1) | 1 (2.6) |
| Yes, diagnosed at the meeting | 0 (0) | 0 (0) |
| Yes, diagnosed with COVID-19 inside this time frame but did not attend the meeting in person | 0 (0) | 0 (0) |
| No | 47 (97.9) | 37 (97.4) |

Abbreviation: ASCO = American Society of Clinical Oncology.
| Continent of residence | ASTRO Annual Meeting in-person attendees, n (%) | ASTRO Annual Meeting nonattendees, n (%) |
|------------------------|-----------------------------------------------|----------------------------------------|
| North America          | 260 (100)                                     | 97 (94.2)                              |
| South America          | 0 (0)                                         | 4 (3.9)                                |
| Europe                 | 0 (0)                                         | 1 (1.0)                                |
| Africa                 | 0 (0)                                         | 0 (0)                                  |
| Australia              | 0 (0)                                         | 0 (0)                                  |
| Asia                   | 0 (0)                                         | 1 (1.0)                                |
| Role                   |                                               |                                        |
| Radiation oncologist/medical oncologist | 116 (44.6) | 64 (62.1) |
| Oncologist in training | 25 (9.6)                                      | 15 (14.6)                              |
| Medical physicist      | 67 (25.8)                                     | 18 (17.5)                              |
| Patient advocate       | 3 (1.2)                                       | 0 (0.0)                                |
| Exhibitor              | 14 (5.4)                                      | 2 (1.9)                                |
| Student                | 8 (3.0)                                       | 0 (0.0)                                |
| Meeting staff          | 14 (5.4)                                      | 1 (1.0)                                |
| Other                  | 13 (5.0)                                      | 3 (2.9)                                |
| Age                    |                                               |                                        |
| 18-29 years old        | 31 (11.9)                                     | 7 (6.8)                                |
| 30-39 years old        | 115 (44.2)                                    | 41 (39.8)                              |
| 40-49 years old        | 66 (25.4)                                     | 31 (30.1)                              |
| 50-59 years old        | 34 (13.1)                                     | 12 (11.7)                              |
| 60-69 years old        | 13 (5.0)                                      | 9 (8.7)                                |
| 70 years old or older  | 1 (0.4)                                       | 3 (2.9)                                |
| Lanyard color and associated behaviors |                                        |                                        |
| Red (comfortable with greeting from 6 feet) | 3 (1.1) | 13 (12.6) |
| Yellow (comfortable with talking at conversational distance and elbow bumps) | 97 (37.3) | 49 (47.6) |
| Green (comfortable with high fives and handshakes) | 154 (59.2) | 21 (20.4) |
| Black (not specified)  | 6 (2.3)                                       | 7 (6.8)                                |
| Did not respond        | 0 (0.0)                                       | 13 (12.6)                              |
| Tested for COVID-19 in 3 weeks following the meeting |                                        |                                        |
| Yes, I had testing because of symptoms | 9 (3.5) | 4 (3.9) |
| Yes, I underwent asymptomatic testing | 61 (23.6) | 18 (17.7) |
| No, I was not tested   | 187 (72.5)                                    | 80 (78.4)                              |
| Did not respond        | 1 (0.4)                                       | 0 (0)                                  |
| Vaccination status     |                                               |                                        |
| I am >2 weeks following full vaccination | 254 (97.7) | 102 (99.0) |
| I am not vaccinated    | 2 (0.8)                                       | 1 (1.0)                                |
| I have received 1 of 2 planned vaccination | 4 (1.5) | 0 (0) |

(Continued)
and in the ASTRO-AM cohort, 2 attendees (0.8%), and 1 nonattendee (1.0%) tested positive (Table 2).

Among in-person attendees, there were similar low COVID-19 positivity rates among those spending more hours (>20 hours) versus fewer hours (≤20 hours) attending live sessions at ASCO-QCS (0% vs 2.9%) and ASTRO-AM (1.5% vs 0%), and between participants in indoor social events versus nonparticipants during the meeting period at ASCO-QCS (0% vs 5.3%) or ASTRO-AM (0.9% vs 0%).

Most attendees traveled to the meetings via airplane and reported good mask compliance of themselves and others during travel (Tables 2 and 3). They also reported similar session attendance as prior years, and some social event attendance (Tables 2 and 3). In-person attendees reported some larger-scale social mixing during the meeting, with 46.1% of attendees reporting attendance at gatherings of >20 people where guests were at least partially unmasked (Appendix E2).

### Discussion

There was no difference in the rate of self-reported COVID-19 infection between in-person attendees and nonattendees. This study suggests that in-person scientific meetings do not contribute to high rates of new COVID-19 infections as can be discerned from this limited data set.

The meetings were successful at creating an environment where participants felt comfortable. In-person attendees in our study reported high rates of compliance with mask and vaccine mandates and reported feeling comfortable attending other in-person meetings after experiencing the ASCO-QCS or ASTRO-AM.

Although data are limited, the literature supports our findings. There have been randomized trials that single large indoor gatherings can take place during the pandemic with additional screening measures, as seen in 2 trials assessing live concerts.6,7 Additionally, data from college football

### Table 2 (Continued)

| Perceived importance of avoiding COVID-19 | ASTRO Annual Meeting in-person attendees, n (%) | ASTRO Annual Meeting nonattendees, n (%) |
|------------------------------------------|-----------------------------------------------|------------------------------------------|
| Very important                           | 177 (68.1)                                    | 81 (78.6)                                |
| Somewhat important                      | 63 (24.2)                                     | 17 (16.5)                                |
| Neutral                                  | 13 (5.0)                                      | 2 (1.9)                                  |
| Not that important                      | 4 (1.5)                                       | 2 (1.9)                                  |
| Not important at all                    | 3 (1.2)                                       | 1 (1.0)                                  |

| Number of social activities engaged in surrounding the meeting |
|---------------------------------------------------------------|
| 0                                                             | 12 (4.6)                                      | 25 (24.3)                                  |
| 1                                                             | 38 (14.6)                                     | 26 (25.2)                                  |
| 2                                                             | 75 (28.9)                                     | 24 (23.3)                                  |
| 3                                                             | 64 (24.6)                                     | 13 (12.6)                                  |
| 4                                                             | 50 (18.1)                                     | 11 (10.7)                                  |
| 5                                                             | 13 (5.0)                                      | 1 (1.0)                                    |
| 6                                                             | 9 (3.1)                                       | 2 (1.9)                                    |
| 7                                                             | 4 (1.2)                                       | 1 (1.0)                                    |

| Diagnosed with COVID-19 |
|--------------------------|
| Yes, diagnosed within 3 weeks of meeting conclusion | 1 (0.4) | 0 (0) |
| Yes, diagnosed at the meeting | 1 (0.4) | 0 (0) |
| Yes, diagnosed with COVID-19 inside this time frame but did not attend the meeting in person | 0 (0) | 1 (1.0) |
| No | 258 (99.2) | 102 (99.0) |

**Abbreviation:** ASTRO = American Society for Radiation Oncology.
| **Table 3** Reported meeting experience of in-person ASCO Quality Care Symposium and ASTRO Annual Meeting attendees | ASCO Quality Care Symposium, n (%) | ASTRO Annual Meeting, n (%) |
|---|---|---|
| **Attendance of conference social events** | | |
| Attended outdoor social events only | 10 (20.8) | 4 (1.5) |
| Attended indoor social events | 29 (60.4) | 225 (86.6) |
| No | 9 (18.8) | 31 (11.9) |
| **Time spent attending live meeting sessions** | | |
| <5 hours | 2 (4.2) | 3 (1.2) |
| 6-10 hours | 10 (20.8) | 21 (8.1) |
| 11-15 hours | 9 (18.8) | 40 (15.4) |
| 16-20 hours | 13 (27.1) | 54 (20.8) |
| >20 hours | 14 (29.2) | 135 (51.9) |
| Did not respond | 0 (0) | 7 (2.3) |
| **Attendance of meeting sessions versus prior years** | | |
| Went to fewer sessions this year versus prior years | 13 (27.1) | 73 (28.1) |
| Went to about the same number of sessions this year versus prior years | 30 (62.5) | 144 (55.4) |
| Went to more sessions this year versus prior years | 4 (8.3) | 31 (11.9) |
| Did not respond | 1 (2.1) | 12 (4.6) |
| **Mode of transportation to conference** | | |
| Plane | 27 (56.3) | 215 (82.7) |
| Personal vehicle | 10 (20.8) | 37 (14.2) |
| Train or bus | 11 (22.9) | 8 (3.1) |
| **Mask use during travel to meeting among individuals using mass transit** | | |
| All the time | 30 (79.0) | 147 (65.9) |
| Majority of time | 7 (18.4) | 70 (31.4) |
| Equal use of mask and no mask | 0 (0) | 3 (1.4) |
| Minority of the time | 0 (0) | 1 (0.5) |
| Did not respond | 1 (2.6) | 2 (0.9) |
| **Perceived mask use of others during travel among individuals using mass transit** | | |
| Excellent | 14 (29.2) | 88 (33.8) |
| Good | 21 (43.3) | 115 (44.2) |
| Fair | 3 (6.3) | 17 (6.6) |
| Poor | 0 (0) | 3 (1.2) |
| Did not take mass transit | 10 (20.8) | 37 (14.2) |
| **Perceived compliance with meeting’s mask mandate** | | |
| Excellent | 36 (75.0) | 166 (63.8) |
| Good | 12 (25.0) | 79 (30.8) |
| Fair | 0 (0) | 6 (2.3) |
| Poor | 0 (0) | 3 (1.2) |
| Did not respond | 0 (0) | 6 (2.3) |

(Continued)
suggests that interplayer contact is associated with low rates of transmission,\(^8\) with observational data for stadium fans failing to show large level outbreaks after Southeastern Conference college football games with filled outdoor stadiums averaging 80,000 attendees.\(^9\) Our limited data are consistent with these findings.

This study has several limitations. ASTRO-AM 2021 attendance was 50% of pre-COVID-19 attendance despite using roughly the same venue footprint. Whether these results would hold true for a fully subscribed meeting is not informed by this data set. This study sample is limited by social desirability bias. Respondents may have underreported their social mixing behavior and overstated their vaccine and mask compliance to seem more responsible. There is the potential for nonresponse bias as well. These authors did not receive cooperation from ASTRO or ASCO and thus did not have access to full meeting attendance lists for participation solicitation, and it is possible that conference speaker behaviors could differ from general meeting attendees. It is also possible that subjects with COVID-19 infection after a meeting were either more or less likely to respond, depending on their personal stance on the appropriateness of in-person meetings.

The response rate for this study could not be precisely calculated because of the use of social media for recruitment. This study proved to be a recruiting challenge, as neither ASTRO nor ASCO divulges e-mails or other contact information for meeting attendees or members. Likewise, owing to member privacy concerns, neither organization elected to promote the survey. Response rates to the e-mail invitations were between 15% to 30%, which is consistent with expected survey response rates, although the percentage of total meeting attendees this represents is smaller. In the future, it would be ideal that this sort of investigation is supported

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**Table 3 (Continued)**

| Feel comfortable attending other in-person meetings after experiencing this meeting | ASCO Quality Care Symposium, n (%) | ASTRO Annual Meeting, n (%) |
| --- | --- | --- |
| Strongly agree | 32 (66.7) | 170 (65.4) |
| Agree | 10 (20.8) | 69 (26.5) |
| Neither agree nor disagree | 2 (4.2) | 14 (5.4) |
| Disagree | 1 (2.1) | 2 (0.7) |
| Strongly disagree | 3 (6.3) | 1 (0.5) |
| Did not respond | 0 (0) | 4 (1.5) |

*Abbreviations: ASCO = American Society of Clinical Oncology; ASTRO = American Society for Radiation Oncology.*

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**Fig. 2.** Self-reported COVID-19 positivity for combined American Society of Clinical Oncology Quality Care Symposium and American Society for Radiation Oncology Annual Meeting in-person attendees and combined nonattendees.
and promoted by the meeting organizers to capture the data more fully.

Finally, the study is limited by the virus itself. New variants continue to emerge, and the rate of transmission during in-person meetings in the setting of each new variant is unclear. It is also possible that self-reported COVID-19 infections and the true prevalence of COVID-19 infection are not equivalent. Asymptomatic infections can account for over 40% of confirmed cases, so future studies should consider advocating postmeeting asymptomatic testing. Despite these limitations, we are encouraged by this data. Attendees felt comfortable attending the conference, and high rates of symptomatic COVID-19 infection were not observed in this limited data set.

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