

The Virtual Streptococcal Seminar Series and Trainee Symposium: Adaptations of a Research Community during the COVID-19 Pandemic

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The COVID-19 pandemic has forced academic research communities to develop online means of learning, networking, and engaging in new research. To allow increased interaction and engagement of the streptococcal research community during the COVID-19 shutdown, we organized the Virtual Streptococcal Seminar Series and Virtual Streptococcal Trainee Symposium and advertised via e-mail and social media outlets. The seminar series initially met weekly on Thursdays at 12 pm Eastern Daylight Time and transitioned to monthly seminars, while the trainee symposium spanned 3 days in September 2020. In this study, we analyzed seminar attendance data and online recording accesses from the first 20 seminars and found community engagement to be independent of speaker gender, career stage, geographic location, and organism of interest, with an average of 124 live attendees and 1,683 recording accesses per seminar. We also report attendance and speaker statistics from the 3-day Virtual Streptococcal Trainee Symposium, which hosted a total of 38 trainees from five continents presenting on *Streptococcus pneumoniae*, *Streptococcus agalactiae*, *Streptococcus pyogenes*, *Streptococcus suis*, oral streptococci, or *Enterococcus faecalis*. The Virtual Streptococcal Trainee Symposium averaged 119 live attendees per session, with a total of 220 unique attendees from six continents across the 3-day event. We conclude that while online platforms do not replace in-person conferences, the seminar and symposium successfully engaged the streptococcal research community and have provided a forum for scientific sharing during the COVID-19 crisis.

INTRODUCTION

In the face of the COVID-19 pandemic, academic research was brought to a halt (1), encouraging scientists to develop virtual platforms to facilitate scientific engagement and discussion. In addition to the closing of research laboratories, most research conferences were canceled after March 2020 (2). As scientific conferences are a primary source for networking, collaborations, and exposure to cutting-edge research, their cancellation due to COVID-19 negatively impacted scientific communities and, particularly, trainees, including graduate students, postdoctoral fellows, and those who would soon be entering the job market (3). To mitigate this loss for research communities and trainees, some conferences converted to an online format (4, 5) and, as the pandemic progressed, academic researchers led grassroots efforts to organize virtual seminar series for

various research subdisciplines. By April 2020, many in the scientific community began to investigate the use of virtual webinar platforms. While these series did not replace the experience of in-person conferences, they filled a need for scientific engagement and research exposure during the global shutdown.

The cancellation of the scheduled August 2020 Streptococcal Biology Gordon Research Conference and Seminar (GRC/GRS) left a gap for streptococcal research community engagement. We therefore hypothesized that organizing and implementing a webinar-based seminar series could engage streptococcal researchers across the globe. To investigate this hypothesis, we organized two complementary events, the Virtual Streptococcal Seminar Series and the Virtual Streptococcal Trainee Symposium, and analyzed participation. The first event was a weekly seminar series hosted on Thursdays at 12:00 pm Eastern Daylight Time (EDT) to highlight established and early-career investigators in the field, and the second event, a 3-day trainee symposium highlighting the research conducted by graduate students, postdoctoral fellows, and research associates. Herein, we investigate community participation by retrospectively analyzing Zoom webinar attendance and seminar recording accesses as a function of speaker gender, career stage, geographic location, and organism of interest. Our data indicate that the online seminar and symposium formats were

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successful in engaging the global streptococcal research community during the COVID-19 pandemic.

METHODS

Target population and advertising

This series was sponsored by Kelly Doran and organized by Lindsey Burcham and Brady Spencer at the University of Colorado Anschutz Medical Campus (CU-AMC) in Aurora, CO. To reach scientists with a particular interest in streptococcal research, the seminar was advertised by e-mail to the previous attendees and registered attendees for the 2018 and 2020 Streptococcal Biology GRC/GRS, respectively. In an attempt to attract a broad and diverse audience, the organizers also advertised through social media platforms (Twitter and Facebook) (6). On Twitter, the organizers primarily interact with other academic scientists, while the organizers' Facebook accounts primarily reach social contacts; however, overlap exists in the networks across the two platforms. In addition to the organizers' personal Facebook accounts, the Doran Laboratory's public Facebook page was also used to target a scientific audience. The initial advertisement for the seminar series included a save-the-date flyer and an interactive link to join an e-mail mailing list to receive seminar updates (created using Google Forms).

Throughout the series, individual flyers were created to advertise each seminar. These included the speaker's name and affiliation, a photograph, and the seminar title. After the initial e-mail list was established, reminder e-mails were sent at the beginning of each week containing an advertisement for the upcoming seminar, an extended seminar series schedule, and the link and password to participate in the upcoming webinar. Seminar flyers were also posted to social media at the beginning of each week. On Thursday afternoons following each seminar, the seminar recordings were posted to the CU-AMC Department of Immunology & Microbiology secure server and the recording link and password were distributed via e-mail along with a flyer advertising the next seminar. To increase cybersecurity, webinar access information was only disseminated via e-mail and all e-mails included a disclaimer discouraging participants from sharing the information over social media.

Seminar series structure and organization

The seminar time, 12:00 to 1:00 pm EDT, was chosen to accommodate colleagues across a wide range of time zones: Pacific Daylight Time (9:00 am) to Central European Time (5:00 pm). To further accommodate colleagues with time constraints or those in incompatible time zones, approval was received from each speaker to record seminars and post the link under password protection to the University of Colorado's secure cloud. The series launched on April 23, 2020, and featured 16 consecutive weekly seminars through

July. In August 2020, the series transitioned to biweekly seminars, and then to monthly seminars in September 2020. Conscious efforts were made to choose diverse speakers to ensure representation across gender, career level (established or early-career investigators), location, streptococcal species of interest, and race and ethnicity.

This virtual seminar series was hosted through the University of Colorado Zoom license (Zoom Video Communications, San Jose, CA) and an additional Zoom add-on provided access to the webinar platform. Funds were provided by Kelly Doran. The organizers served as webinar hosts, the speakers were promoted to panelists, and all hosts and panelists had full control of screen-share, video, and microphone while attendees were unable to access any of the above. To reduce the risk of technical difficulties on the day of the seminar, a brief practice session was scheduled with each speaker to test Zoom connection and screen-share. On the day of the seminar, speakers shared their screen with the attendees prior to the start time while attendees joined the webinar. The organizers began the seminar at 12:00 pm EDT with a brief introduction to the Zoom webinar platform and the speaker's accomplishments and contributions to science throughout their career. Established investigators were given 45 minutes to speak, with 10 to 15 minutes allotted for questions. In seminars featuring early-career investigators, two speakers presented, each for 25 minutes with 5 minutes for questions. All questions were held until the end of the presentation. To ask questions, seminar attendees had the option to type their questions into the Q&A or into the webinar chat or they could virtually raise their hand. With the raise hand option, the attendee would be granted access by the hosts to control their microphone and could ask their question to the speaker directly. All seminars were recorded via Zoom, and the recordings were posted to the University of Colorado secure cloud for attendees to access with link and password.

Trainee symposium structure and organization

To ensure colleagues around the world had equal opportunity to participate, the symposium was hosted over 3 days at three different times of day: Tuesday, September 8, from 6:00 to 8:30 pm EDT, Wednesday, September 9, from 2:00 to 4:30 pm EDT; and Thursday, September 10, from 11:00 am to 1:30 pm EDT. In July 2020, a call for trainee abstracts was advertised by e-mail, during the introductions of the seminars, and on social media. Trainees submitted abstracts via Google Forms and were given the option of an oral presentation (12-minute presentation, 3 minutes for questions) or a flash talk (3-minute presentation, 2 minutes for questions). Along with the abstract, applicants were asked to provide a presentation title, the name of their mentor, their training status and year, their pronouns, presentation format preference, university affiliation, preferred presentation time of day, whether they would soon be on the job market, and whether they were interested in leading a

symposium session as a discussion leader. Presentation times were assigned based on (i) presentation time preference and (ii) presentation format request. Preference for oral presentations was given to those who indicated they were on the job market and those who signed up before the original deadline of July 27. Symposium speaker invitations were sent via e-mail in early August 2020 asking for confirmation of the presentation date and time. After symposium speakers were confirmed, a full trainee symposium agenda was generated (including presenter name, principal investigator name, and affiliation) and was advertised on Twitter, Facebook, and by e-mail. Presentation titles were not shared on social media platforms to protect the trainees' research.

The first two days of the symposium featured three trainee sessions per day and the last day of the symposium featured two trainee sessions and a keynote address delivered by an established investigator in the field. The keynote presentation was hosted during the normal seminar time on Thursday at 12:00 pm EDT. Session discussion leaders were selected on a volunteer basis, and their session was assigned based on their preferred time slot. Discussion leaders were responsible for introducing the speakers and facilitating the question-and-answer portion of each session. Rather than meeting with all 38 speakers, the organizers coordinated with the session discussion leaders via Zoom to familiarize them with the Zoom webinar platform and to provide logistical information for the symposium. Similar information was distributed to the remaining speakers in the form of an informational video, and all speakers were encouraged to reach out to the organizers or their discussion leader with any questions or concerns.

During the symposium, the organizers provided a brief opening message, and discussion leaders were then responsible for running the event. Following each session, short breaks allowed time for the organizers to convert speakers from the previous session back to attendee status, while promoting the next set of speakers to panelist status. Oral presenters shared their screens while the discussion leader introduced them in order to keep the program on time. As the flash talk sessions allowed only 5 minutes per speaker total, the participants sent their four to six presentation slides to the organizers ahead of time. All slides were assembled into a single presentation that was broadcast and advanced by the organizers. This eliminated the need for extra time for alternating screen-sharing between each flash talk speaker. To further ensure the symposium schedule kept to time, discussion leaders turned their video on to indicate that the speakers were nearing the end of their time. For oral presentations, discussion leaders turned their video on with 2 minutes remaining, and in flash talks, discussion leaders turned on their cameras with 30 seconds remaining. Lastly, to protect the trainees' unpublished data, the trainee presentations were not recorded or uploaded to the university cloud account. Trainee speakers were given the option, however, to record their own presentation via Zoom for personal use.

Data collection and analysis

The data presented here were classified as non-human subject data by the University of Colorado Anschutz Medical Campus Colorado Multiple Institutional Review Board (COMIRB), eliminating the need for IRB approval. Live seminar attendee information was accessed using Zoom Webinar Attendee Reports and reported as the number of unique viewers. These values indicate webinar accesses from a computer and do not include panelists and call-in attendees. Further, viewers who joined the meeting on multiple devices or those who left and returned to the webinar were counted only once, which limited inflation of the participant data. Data were also collected on the accesses to the seminar recordings from the CU-AMC secure cloud. The numbers reported reflect total recording accesses and do not account for multiple accesses by individual people. Statistical analyses for comparisons of two groups of data were performed using a Mann-Whitney *U* test, while comparisons of more than two groups were performed using a Kruskal-Wallis test. Statistical significance was determined by $p < \alpha$, with $\alpha = 0.05$, and confidence intervals (CI) are reported as 95% confidence of the mean. All analyses were performed using GraphPad Prism 9.0.0.

RESULTS

Speaker distribution and seminar attendance

To assemble a schedule of speakers, we sought to include representation across gender, career stage, geographical location, and streptococcal species of interest. Speaker invitations were sent via e-mail, and seminars were advertised in advance by e-mail and on social media platforms Twitter and Facebook (7). The first 20 virtual seminars featured a total of 24 speakers over 30 weeks, with a relatively even representation of female (54%, 13/24) and male (46%, 11/24) speakers. Due to constraints across time zones, the majority of the streptococcal seminar speakers (79%, 19/24) were affiliated with institutions in the United States, while the remainder of speakers were affiliated with institutions in Europe (21%, 5/24). In organizing the series, speakers were invited from four major areas of streptococcal research: *Streptococcus pneumoniae* (33%, 8/24), *Streptococcus pyogenes*, or group A *Streptococcus* (29%, 7/24), *Streptococcus agalactiae*, or group B *Streptococcus* (21%, 5/24), and oral streptococci (17%, 4/24).

To alleviate time zone constraints for colleagues who could not participate in the live seminar on Thursdays at 12:00 pm EDT, written approval was received from each speaker to record seminars and to make the recordings available to those on our e-mail mailing list, as described in the Methods. Data collected retrospectively from the Zoom webinar attendee reports indicated a peak live attendance at the first seminar with nearly 250 attendees

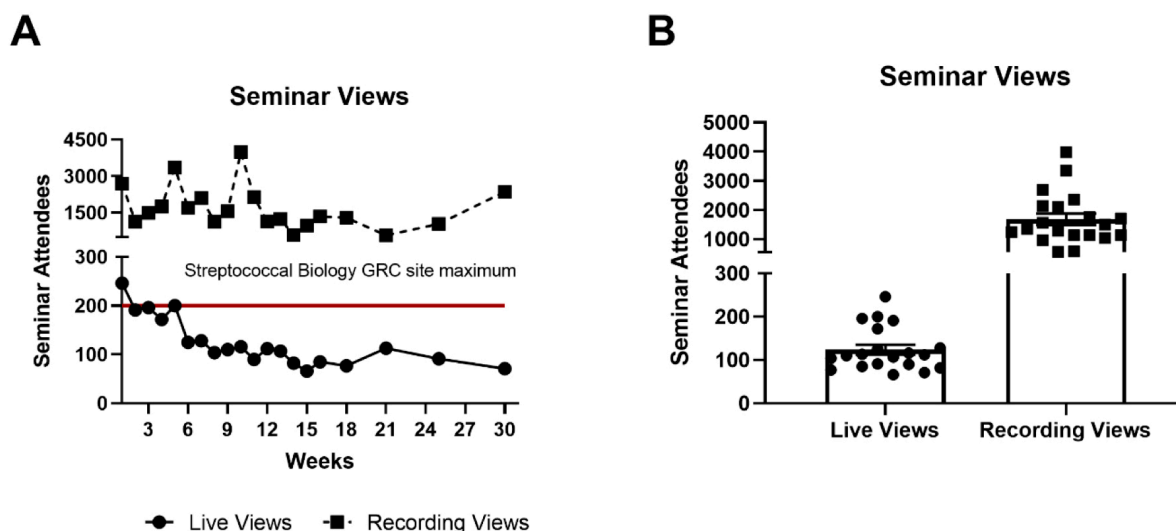


FIGURE 1. Virtual Streptococcal Seminar series participation. Live participation and accesses to video recordings are displayed over time (A) and as total average views (B). The red line in panel A represents the maximum attendance permitted for the 2018/2020 Streptococcal Biology Gordon Research Conference site.

(Fig. 1A). The number of live attendees fell slightly near week 6 in the seminar series, likely due to laboratories and campuses reopening at various capacities following the COVID-19 shutdowns. Interestingly, despite this initial drop, live seminar attendance remained consistent after week 6, with nearly 100 live attendees per seminar. Online accesses for seminar recordings remained consistent, with an average of over 1,500 accesses per seminar (~14 times higher than the live attendance numbers). To compare our virtual webinar attendance data with in-person conference attendance, a red line was included in Fig. 1A to indicate the 200-person maximum attendance permitted at the site of the 2018 Streptococcal Biology GRC. Collectively, the average Virtual Streptococcal Seminar Series live attendance was lower than the maximum attendance of an in-person GRC, but this virtual webinar platform allows for flexible, online participation, which is not an option for many in-person conferences. In total, across the first 20 hosted seminars, a mean of 124 live attendees (CI: 101 to 148) and 1,683 recording accesses (CI: 1,271 to 2,095) per seminar were observed (Fig. 1B).

Seminar impact

To determine whether seminar speaker demographics or research content contributed to seminar participation, the attendance metrics (live attendance and recording accesses) were analyzed as a function of the speaker gender, speaker career stage, and organism of interest. When analyzing seminar participation by speaker gender, career stage, and streptococcal species of interest, we observed equal distribution in participation in both live attendance and recording accesses (Table 1). Further, conscious efforts were made to invite diverse speakers based on the above criteria and on race and ethnicity. Together, these data indicate that

participation from the streptococcal research community in the Virtual Streptococcal Seminar Series was independent of speaker demographics and research content.

Trainee symposium impact

After receiving strong support during the Virtual Streptococcal Seminar Series, we hypothesized that a virtual event highlighting trainee research might be welcomed by the community. Thus, we organized a 3-day trainee symposium to provide trainees in the field of streptococcal research a platform to share their results, network, and establish new collaborations. To facilitate international participation, we hosted the trainee symposium over three days and at three different times of day, including an evening session (6:00 to 8:30 pm), a late afternoon session (2:00 to 4:30 pm), and a morning/early afternoon session (11:00 am to 1:30 pm) (all times EDT). In total, 38 speakers representing five continents participated in the trainee symposium. Of those speakers, 68% identified as female and 32% identified as male (Table 2), and they represented various training statuses: research associate, research fellow, postdoctoral fellows, and graduate students. The trainee presentations also covered a range of organisms including *S. pneumoniae*, *S. agalactiae*, *S. pyogenes*, oral streptococcal species, *S. suis*, and *Enterococcus faecalis*. Varying the times of the symposium sessions did encourage international participation, as days 1 and 2 included speakers affiliated with Australian, European, or South American institutions, while day 3 included speakers affiliated with European and Asian institutions; however, speakers affiliated with North American institutions were most highly represented throughout the symposium. Upon analyzing live symposium attendance, we observed 117 participants for day 1, 128 participants for day 2, and 113 participants for day 3. It is important to note that

TABLE I.
Virtual Streptococcal Seminar Series participation by speaker demographics.

Seminar participation		Live attendees		Recording accessed	
Speakers		Mean	95% CI	Mean	95% CI
Gender	Male	122.1	91.8–152.3	1,700	984.6–2,416
	Female	119.6	88.9–150.3	1,595	1,235–1,956
Investigator career stage	Early career	111.1	89.3–132.9	1,458	1,148–1,768
	Established	127.6	95.1–160.2	1,776	1,189–2,362
Organism of interest	<i>S. pneumoniae</i>	128.1	80.0–176.3	1,663	1,092–2,234
	<i>S. agalactiae</i>	124.6	74.1–175.1	1,308	601.6–2,014
	<i>S. pyogenes</i>	125.3	76.8–173.8	2,186	1,174–3,198
	Oral strep. species	93.3	61.2–125.3	1,074	942.9–1,206

Attendance/recording access data organized by speaker demographics. Mean and 95% CIs of live seminar attendance and accesses to seminar recordings were calculated in GraphPad Prism.

on the first day of the symposium, a Zoom crash resulted in a brief shutdown of the webinar. The webinar was reinitiated within 5 minutes and the symposium recovered 109 of 117 live attendees. In total, throughout the 3-day event, the symposium attracted 220 unique attendees representing six continents. Collectively, these data support online symposia as promising avenues for scientific sharing and networking.

DISCUSSION

To investigate whether an online streptococcal webinar series would garner global attendance and participation, we advertised the Virtual Streptococcal Seminar Series via social media and through e-mail contact with past attendees of the 2018 Streptococcal Biology GRC. We advertised a link to join a mailing list to receive e-mail updates for the Virtual Streptococcal Seminar Series and received overwhelming support for the series, with over 700 people ultimately requesting e-mail updates including principal investigators, postdoctoral fellows, graduate students, scientists associated with major funding agencies, and scientists working in publishing and industry across six continents. From April to November 2020, we hosted 20 virtual seminars highlighting a total of 24 established and early-career investigators in the field of streptococcal biology and averaging 124 live attendees per seminar. For those unable to attend due to scheduling conflicts or whose time zone prohibited live attendance, we provided access to online recordings of the live seminars. We observed approximately 14 times more interaction in accesses to the seminar recordings than live attendance. Based on the enthusiasm for the seminar series, we then organized a Virtual Streptococcal Trainee Sym-

posium to provide an opportunity for trainees to present their research to the field. Our trainee symposium hosted speakers from five continents across varying training levels as well as more than 200 live unique attendees.

Altogether, the seminar series received overwhelming support from the streptococcal community and allowed participation from colleagues throughout academia, industry, government, and scientific publishing. By eliminating restrictions associated with registration and travel costs, and providing options for live attendance or recording access, the series was able to reach a wide range of scientists around the world. Based on positive feedback from attendees via e-mail and social media, participants specifically appreciated the flexibility and accessibility of online seminar recordings. Providing these online recordings was of utmost importance to us as, in addition to time zone limitations, we understood that many colleagues were balancing working from home, parental responsibilities, and other scheduling conflicts, and that these conflicts or responsibilities were exacerbated by the COVID-19 pandemic. We were also able to use this series as a platform to communicate information to our community, including promotion of the Black in Microbiology Week program and funding opportunity updates from the National Institutes of Health. In the future, we will continue to use this webinar platform to provide important information to this research community.

It is important to note that, though the streptococcal community has benefitted from this series, the online webinar format does not replace all aspects of the in-person conference experience. Disadvantages of this platform include limitations in networking, limited time allotted for questions and discussions with speakers, time zone conflicts, and importantly, limited face-to-face interaction as

TABLE 2.
Virtual Streptococcal Trainee Symposium participation.

		Day 1 n (%)	Day 2 n (%)	Day 3 n (%)	Composite n (%)
Speakers		n = 14	n = 14	n = 10	n = 38
Gender	Male	6 (43%)	5 (36%)	1 (10%)	12 (32%)
	Female	8 (57%)	9 (64%)	9 (90%)	26 (68%)
Geographic location	North America	12 (86%)	10 (71%)	6 (60%)	28 (74%)
	Europe	0	3 (21%)	2 (20%)	5 (13%)
	Asia	0	0	2 (20%)	2 (5%)
	Australia	2 (14%)	0	0	2 (5%)
	South America	0	1 (7%)	0	1 (3%)
Trainee status	Graduate student	7 (50%)	10 (71%)	9 (90%)	26 (68%)
	Postdoctoral fellow	6 (43%)	3 (21%)	1 (10%)	10 (26%)
	Research associate	1 (7%)	0	0	1 (3%)
	Fellow	0	1 (7%)	0	1 (3%)
Organism of interest	<i>S. pneumoniae</i>	7 (50%)	7 (50%)	5 (50%)	19 (50%)
	<i>S. agalactiae</i>	2 (14%)	3 (21%)	3 (30%)	8 (21%)
	<i>S. pyogenes</i>	2 (14%)	1 (7%)	1 (10%)	4 (11%)
	Oral strep. species	2 (14%)	1 (7%)	1 (10%)	4 (11%)
	<i>S. suis</i>	0	1 (7%)	0	1 (3%)
	<i>E. faecalis</i>	1 (7%)	1 (7%)	0	2 (5%)
Live attendees		117 /*109	128	113	220 unique attendees

Participation of trainee speakers across gender, geographic location, trainee status, and organism of interest. Data are presented as the number of speakers and the corresponding percentage within a given demographic. For day 1, initial live attendance is followed (*) by the number of recovered attendees after the Zoom crash and restoration of the webinar.

attendees do not have video capabilities in the webinar platform. An additional limitation of this webinar-based platform is the need for reliable internet access. The concept of a digital divide or digital gap, whereby access to internet connectivity disproportionately affects underrepresented and minoritized populations, has worsened inequalities in access to virtual healthcare and education during the COVID-19 pandemic (8–10). Mechanisms to increase accessibility to online conferences should be explored further if virtual conferences become more common in the future. Finally, some meetings like the GRC/GRS, specifically encourage the sharing of unpublished data and strictly prohibit photography or videography during presentations. Though

we made every effort to disable recording downloads, online platforms such as this one cannot eliminate all risks of attendees downloading, photographing, or recording research presentations. These concerns could greatly reduce the likelihood of scientists sharing their unpublished data on a webinar-based platform.

Despite these limitations and potential hurdles, many academic groups successfully used virtual platforms during the COVID-19 pandemic to create opportunities for trainees and established scientists. Efforts by the National Summer Undergraduate Research Program (NSURP) resulted in the pairing of 250 underrepresented and minoritized mentees with mentors around the world and provided students

opportunities to engage in scientific research without physically traveling to hosting laboratories (11). The New Haven Local Section of the American Chemical Society also hosted a virtual symposium to highlight student research and reported benefits of reduced operating costs, ease in presentation judging, and removal of geographic barriers limiting attendance (12). Further, #BlackInX movements on Twitter including #BlackInNeuro (13), #BlackInMicro (14, 15), #BlackInImmuno (16), #BlackInCancer (17), and numerous others organized hugely successful online programs in a matter of weeks to celebrate, connect, and support Black researchers and to promote professional development, networking, and community amongst Black scientists. Specifically, the #BlackInMicro movement reported over 3,000 registrants from six continents and thousands of virtual attendees across the live panels and talks (14, 15). Finally, many additional online academic seminar series or conferences were established in 2020 within the microbiology field on *Acinetobacter baumannii* (18), *Klebsiella pneumoniae* (19), *Pseudomonas aeruginosa* (20), and *Staphylococcus aureus* (21) via Twitter. These examples were successful in filling a need in their respective scientific communities and highlight community interest in virtual conferences and professional development events.

Collectively, organization and implementation of the Virtual Streptococcal Seminar Series and Trainee Symposium engaged the streptococcal research community (as well as other scientists working on different microorganisms) and provided an international platform for sharing scientific data. We conclude that this seminar platform successfully filled a niche in the streptococcal community following the cancellation of the August 2020 Streptococcal Biology GRC. As the world continues to cope with the stresses and restrictions caused by COVID-19, we anticipate the continued rise of web-based conferences. Though unable to fully replace the experience of an in-person scientific conference, web-based conferences could either supplement the current conference model or stand independently and fill a separate niche. The benefits of online conference platforms include reduced operation and registration costs and less travel, ultimately presenting a more cost-effective and eco-conscious option for academic conferencing (22, 23). As the COVID-19 pandemic has continued, we extended the Virtual Streptococcal Seminar Series monthly through March 2021.

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