Web-based Conferencing: What Radiology Educators Need to Know

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Advances in technology have resulted in the significant growth of web-based conferencing and teaching. While these remote sessions have many advantages, they may result in challenges and frustration for both host and attendees when there are technological issues, poor or distracting audio, or ineffective presentation styles. Knowing a few basic concepts behind web conferencing and preparing in advance can markedly improve the experience and facilitate effective distance learning and collaboration.

Key Words: Webinar; Education; Conferencing.

INTRODUCTION

Technology advances over the last decade or so have enabled us to connect to others via the web for voice and video conferencing. This technology has been applied to a wide range of applications in the medical community. The most basic—simple group audio conference calls—are now standard and have significantly reduced the need for travel for face to face meetings. Multidisciplinary conferences such as tumor boards are enhanced by having the ability for providers offsite to discuss patient care algorithms with specialty experts (1−4). Broadcasting lectures from one site to another allows learners to access high-quality education institutionally, regionally, nationally, or internationally. This has been creatively deployed in a wide variety of settings across medicine (including residencies), dentistry, nursing, podiatry, psychiatry, pharmacology, and rural and global health among others (5−14). Web-based teaching is the foundation of massive open online courses. It has been used for patient education and support groups (14). Radiology multi-day conferences such as RSNA, ARRS, and AIUM run a "virtual" conference in parallel to the live conference and a few may be entirely virtual (15).

These technologies open a myriad of possibilities for teaching remotely within a healthcare system, or across the world (4,5), as well as offering a more "personal" approach to conference calls. They enable trainees and faculty to have access to world class speakers at convenient times. They allow collaborative learning experiences in group projects for learners with or without faculty facilitation (10,11). Any program that can be displayed on a computer can be shared, thus potential uses go well beyond slide presentations. Webinars may be virtual only (all participants are remotely connected), or a mixture of virtual and live (some participants are remotely connected and some present in the room). Significant cost and time savings (travel, accommodation, food, time away from work) can be realized by virtual "attendance" rather than travel to an onsite meeting. However, for some there may be loss of engagement, focus, and interactivity in addition to loss of potential social/networking aspects of meetings.

As technology has been developed that supports audience interactivity via chat functions or audience response systems (ARS), the scope of web-based teaching has expanded to include areas previously requiring on-site presence. Two examples are psychiatric interviewing and laparoscopic skills training (13,16). Studies that have evaluated the efficacy of web-based teaching have shown it to be effective and well-received by learners, particularly when an interactive component is included (1,2,4−8,10,11,13,14,16). Some institutions have hardwired video conferencing systems to remote sites to provide a more secure connection for patient-related activities such as tumor boards (although even these may require internet connectivity for full functionality). In most cases, it is the ready availability of commercial web-conferencing software which has markedly increased the potential for teaching and conferencing.

Participating in a web conferencing to its full potential may pose challenging for both the faculty host and the attendee participants. Issues with connectivity (both audio and video), background noise, and limited engagement of attendees in conversations may all be barriers. Chat windows and audience

response, each valued solutions, result in their own challenges, particularly for the host.

This article is intended to build foundational knowledge and proffer tips to run and participate in successful web conferencing.

SOFTWARE

The aim of this article is to guide users to common features, not proprietary specific functions. Terminology relevant to web conferencing is shown in Table 1. Both free and fee-based software are available (Table 2) (17). Free services may offer limited functionality (e.g. not all connectivity options may be available, among them file sharing) or limited participant numbers or conference call length. Many institutions subscribe to one of the larger video conferencing services. Some institutions also have "bridge lines" that permit audio only conferencing, typically a fixed call-in number. An important initial step is to confirm if your institution has a video conferencing subscription with your local information technology (IT) department. Webinar hosts must establish an account, but webinar participants need not. Most software vendors offer three primary components: audio conferencing, video conferencing, and screen sharing. For audio only calls (no slides or screen displays needed), only the audio conferencing is vital. To show slides/screen, screen sharing must be enabled on the presenting computer–either on the host or participants' computers. There are usually options to share the whole screen or the current application (the latter is less prone to showing inadvertent material such as email notifications). Video conferencing is required to see the host and the participants, or they see you. Some services also permit instantaneous file sharing, white boards, and polling. Most software offers the option for the conference to be set up for a specific date and time, as well as support instant conferencing. The latter can be helpful during a regular phone call when the need for video/screen sharing becomes apparent. Recordings can be stored in the cloud or on institutional servers.

Some software requires installation of a program or a browser add-on at the time of the session, potentially problematic for some institutional IT platforms due to firewalls and other IT restrictions, while other software is purely web-based. Most software offer mobile apps that facilitate connections across devices. Some enable secure, encrypted connections, key if personal health information (PHI) is being discussed. Most massive open online courses, (MOOCs) small private online courses (SPOCs) (9), and some learning management systems (LMS) have embedded proprietary software. There are also specialized websites such as www.chartrounds.com that securely connect medical professionals internationally for web-conferencing (3,4). Further discussion of these is beyond the scope of this article.

INTERACTIVITY

Interactivity refers to two-way communication via a computer-user interface, and may be verbal-, chat-, or poll-mediated or use

TABLE 1. Terminology

Term	Explanation
Web meeting or web conferencing	Usually a small group audio +/− video discussion between a relatively small number of participants
Webcast or web-event	Information dispersed to a large audience via the Internet, usually one way only. Audio or video.
Webinar or "virtual symposium"	An interactive online seminar that includes a presentation and Q&A and may include other interactive elements
Host(s)	A person who initiates the start of the web conference and has overall control of conference aspects, specifically screen sharing, private chats, call muting, and so on. The host has screen controls not usually seen by the other participants such as a detailed participant list. Most software now permits multiple hosts to be identified or transferred during the session; hence, the host is no longer of necessity the primary speaker or conference facilitator.
Participants	The webinar or meeting attendees
Screen sharing	A host or participant's computer screen displayed to others on the call. Usually two options− show entire screen, or show single application. The latter is particularly useful if one does not want email or message notifications to be displayed to the group. The host has overall control of screen sharing but can enable others to screen share their computers.
Audio conferencing	Live audio feed conference without video
Video sharing/conferencing	Live video feed from a participant's webcam is shown with their name in a small separate window
File sharing	Files uploaded and downloaded by host and participants during the session
Audience response system (ARP)	Web-based software usually separate from the web-conferencing system
Polling	Instant polls embedded within the web-conferencing system
Chat	A separate window that allows communication between all or specific attendees (e.g. the host and a specific participant)

TABLE 2. Web-conference software available (limited list of most commonly used) (17)

Software	Free Version Available?	File Sharing?	Polling?	Mobile Friendly?	Other Features
CiscoWebex	Limited functionality. Free for three participants only	Yes	Desktop version only	Yes	Interface can be challenging for hosts
Zoom	Limited functionality Group calls limited to 40 mins free version	Yes	Yes	Yes	
Skype	Limited functionality	Yes	No	Yes	Low cost
GoToMeeting	Yes Free for three participants only	No	No	Yes	Extra features with higher cost plans. Easy interface. Automatic transcription of calls
JoinMe	Yes, for three participants only	Yes	No	Yes	No download needed, simple interface
Adobe Connect	No	Yes	Yes	Yes	Expensive but extensive features for distance learning
UberConference	Yes 10 participants	Yes	No	Yes	No PINS required
Google Hangouts	Yes	No	No	Yes	Limited functions but free for basic conferencing
ClickMeeting	No	No	Yes	Yes	Increased features at higher cost. Good for large webinars

NB: functions and cost available in software versions change rapidly and subscribers should check websites for the most current information. Fees are usually per monthly or annual subscription. For the purposes of this paper, higher cost services were considered those > $50 /month. For single use purposes, a single monthly subscription may suffice.

external apps or programs. Verbal communication works well for smaller groups. With a large group, verbal communication may become unmanageable and difficult for attendees to "interrupt". The chat function can then be used to ask questions and to notify the host of technical issues. It can, however, be challenging for a host to run the session and monitor and respond to chats at the same time. It is often optimal to have a separate individual monitor and respond to chats and feed questions to the primary speaker. This is most effectively achieved by assigning this administrator the web conference host role and enabling the speaker to adopt screen sharing to lead the conference.

Polling and other audience response systems ARS enable the audience to respond to specific questions; this interactivity is embedded in some but not all webinar platforms, and may not be available in the free software versions. Polling does not generally have correct and incorrect responses identified, while other types of ARS may. To meet this need, an audience response system run in parallel is very effective. Examples include Poll Everywhere (San Francisco, California www.polleverywhere.com), RSNA Diagnosis Live[TM] (RSNA, Oak Brook, Illinois), Nearpod[TM] (Fort Lauderdale, Florida, nearpod.com), Turning Point Live[TM] (Turning Technologies, Youngstown, Ohio www.turningtechnologies.com/turningpoint/) and Socrative[TM] (Edmonton, Alberta https://www.socrative.com/) which typically have no fee for limited participant numbers up to 30–40. RSNA Diagnosis Live[TM] is designed for use by academic institutions and works very well in these settings (contact diagnosislive@rsna.org). When used in parallel with the web-conferencing system, polling requires attendees log in to the audience response system via a separate window on their computer, tablet or smart device.

THE SUCCESSFUL WEBINAR PARTICIPANT

For a participant, optimizing an audio only connection is typically straightforward. Connect from a quiet place. A headset improves the experience, be it by phone or computer. Typically, the participant calls a toll-free number, enters the supplied conference number usually followed by the # (pound) key and follows audible instructions. It is best to announce oneself at a break in conversation, to assure the host is aware that you have joined the call. A key function for both audio and video calls is to remove your background noises by pressing the mute button on the audio connection (computer or phone). Background noises are incredibly distracting and disruptive, particularly in multiplicity. When in a public place, a headset is particularly recommended to further reduce background noise. To speak, unmute and participate in discussion. Note that failure to unmute is the most likely explanation when nobody seems to be paying attention to your comments! The host usually has the ability to mute all or selected attendees although it is often difficult to identify specific background noise culprit(s) in real time. This may lead the host to simply mute all participants, requiring callers to unmute to participate. It is important to know that generally only one participant can be heard at anytime, with a break in the conversation needed for a participant to add comments or questions. This tends to lead to somewhat stilted conversation, one of the challenges of web conferencing.

For a participant, optimizing video connections requires lead time, particularly for a new or different computer or webinar platform. Often it is necessary to run and install software or a browser add on in the initial setting. It is difficult for the host to problem solve technical and institutional constraints (firewalls and policies) while actively running the ongoing conference. Following the video connection, the audio connection may be made via computer (often easiest if you have a built-in microphone), phone call to the number provided, or reverse call from the service. Reverse calling means that the service will call you if you select that option and provide your phone number. The latter is advantageous as it precludes the need to manually enter conference code numbers. Forgetting to make the audio connection is a common explanation for being able to see but not to hear the conference host. Participants may also have the option to share video from a webcam. Be mindful of active webcam pros and cons. On the one hand, inadvertent sharing during multitasking or in an informal setting can be embarrassing or distracting to conference participants. On the other hand, in a small group video sharing increases engagement. For a large group it is generally unhelpful.

Making an audio connection via more than one route, typically via phone and computer, often leads to painful feedback noise. Mute or disconnect one audio source. Occasionally this occurs with a single computer connection and necessitates switching to a phone line audio call.

Using a mobile device with one of the dedicated web-conferencing apps can be very useful, especially if not in an office setting. However, slides may be difficult to see on smaller smartphones, especially case images, and generally a tablet or computer is preferred for video connection. For those who connect using smartphones while driving or walking, being distracted should be acknowledged as a safety issue, and no video connection should be made.

THE SUCCESSFUL WEBINAR HOST

Before the Session

Preparation is key. The amount of prep work required is predicated on the complexity of the planned web-conferencing session. A simple audio-only call just requires the host initiate the call at least 5 minutes in advance to allow others to login. It is very frustrating and confusing for participants to wait on the line for the call to open. More complex sessions, particularly those that include chat or audience response system functions, should be thoroughly vetted using the host equipment prior to the session. Logistics include deciding on one or more host speakers, selecting the meeting format, familiarizing oneself with basic software functions such as identifying participant names, understanding screen sharing, how to change hosts or presenters, changing audio connections and finding the link to send out if needed.

We highly recommend running a test session. To accomplish this, set up a trial session in the software and have one or more others call in and check all components of the system: Ensure the internet connection is adequate – consider using a hardwired connection rather than wireless connection. What browser(s) seem to work best? Can the participant log in easily? Can she/he clearly hear the host? Can she/he see the host screen? Try out the chat system and, if applicable, screen sharing and file sharing. Decide on host and/or participant video cam – while it assists audience engagement for some, it can be distracting for others including the host. Practice muting and unmuting calls. Test both embedded (polling software in the web-conferencing system) and parallel ARS by having your test participant connect and answer the intended questions/polls. Test different audio connection methods to determine audio host ease and participant audio quality. A headset with computer or phone connection is best, and even an inexpensive headset typically provides superior audio. For presentations to a combined live and remote audience, a wireless headset (e.g. bluetooth) or high-quality podium microphone is key to speaker mobility and clarity.

As host, decide if you need a separate webinar administrator and how you plan to approach audio muting. The administrator's primary task is to facilitate audience interaction and muting, record the session, and support the faculty host. The administrator serves as the meeting host and passes screen sharing to the speaker(s). Most software systems enable passing the host or presenter functions to others easily. This markedly reduces the stress of running more complex sessions. Regarding audio, if participants number five or more, we advise the host to use the "mute all" functionality after users are logged on. This will mute all background noise; participants can be asked to interact via chat rather than audio. To maintain engagement, it is imperative to plan to pause for periodic questions (audio or chat) or include scheduled Questions and Answers (Q&A) at the session end. Allow time for participants to unmute themselves to ask the questions. Prepare for the Q&A with prewritten questions in case none are submitted. Communicate at the beginning of the webinar if you are planning to have Q&A at the end or during the session.

Host preparation also includes typical speaker tips: prepare a lecture that meets the specific audience's needs, practice the talk multiple times refining script in real-time, check lecture timing, and practice engaging a conversational voice and appearance (particularly important for virtual only sessions, as computers seem to accentuate monotonal speaking). Smiling intermittently during the presentation (even during sessions without video connection) modulates your voice to engage the audience, and oneself. Consider recording the lecture in advance to critique for clarity and quality. Precisely the same "brain friendly" tips for resident noon conference are all the more important for webinars (18). Specifically, slides should be simple, clear, attention-grabbing with minimal text and maximal visual impact. As many participants attend webinars on mobile devices, prepare the slides with large font text and similarly large images. Videos, websites, and other applications are readily incorporated by screen sharing these applications. Plan to incorporate an interactive component if possible and include

personal anecdotes ("this is a patient I saw on call" or "I missed this finding once, so I want to make sure that you do not...") to engage the audience. The speaker is not able to use "presenter mode" during many web presentations, underscoring the need to be very familiar with content. Printing out separate speaker notes/script as reference can be very helpful.

Advance Information to Participants

When scheduling the session using the software tool, be mindful of time zone limitations. Participants from the West Coast typically require sessions be scheduled no earlier than 10a Eastern Standard Time (EST). Similarly, a 2p or earlier Pacific Standard Time (PST) start is needed for East Coast attendance. Ensure the information sent to participants is streamlined and accurate: date and times (with different time zones listed), live contact link for video conferencing with listed phone contact numbers. Email participants in advance, ideally employing a platform that includes a calendar invite with all needed information. Alternatively, the webinar platform may permit the host to enter attendee names in the application. Any information about ARS must be clearly relayed, to include how participants will connect and what equipment is needed (e.g. smartphone). Recommend a high-speed internet connection and if appropriate, the best browser to use. If advance login is needed to test connections, clearly state that. Give advance notice that you will mute participants if applicable, and instructions about chat. Include the session learning objectives as appropriate. Resend information one or two days prior to the webinar date.

During the Session

It is imperative the host is in a quiet room with no access by children, pets, or others. If need be, hang a "conference call"

sign on the door to reduce interruption. Silence cell phones if not in use during the call. Reboot the computer prior to any video calls as other open programs may interfere with connections and slow screen sharing. Limit open programs to only those needed, typically PowerPoint and an internet browser. Turn off all email notifications and messaging apps (which can often be seen during screen sharing). Enlarge the cursor to use as an easily visible pointer on slides or adopt use of one of the annotation functions in PowerPoint/Keynote. Start the session 5 minutes (audio only) to 15 minutes (video) before the stated start time. Assure the headset is working if using. Open the participants' window to confirm participants are logging in successfully. Open the first slide if slides are being projected and click the share screen button. This is used as a visual prompt to newly logged-on attendees that they have joined successfully. Recheck both audio connection and video display by asking the earliest who arrive if they can see and hear you well, thereafter mute yourself temporarily. Troubleshooting tips are outlined in Table 3. When you switch from the webinar window to another program such as PowerPoint, your webinar tools remain available usually as a hover function at the top of the screen (you may need to move your cursor to the top to display them). The participants' window is usually only visible to the host but video shares of participants and host will be seen by all. At the start time, unmute and introduce host(s) and webinar topic. Welcome participants and emphasize the learning objectives of the session, engaging the audience early by stating what the session intends to accomplish for them. We recommend waiting no more than 2−3 minutes past the planned start time to formally begin. For smaller or less formal conferences, one may need to wait longer to achieve a participant quorum. If callers are to be muted, forewarn them as such, instructing them to actively unmute in order to be heard, that you will stop for Q&A periodically and unmute all, or to use chat

TABLE 3. Troubleshooting Tips

Problem	Solution
Participants cannot log in to see host screen or host cannot launch the session	Select a different browser, reboot your computer or change computers. Internet Explorer is notorious for connectivity issues and Chrome, Firefox or Safari may be more successful.
Participants cannot see host slides	Assure host screen sharing is active. If need be, close and reopen host browser.
Software crashes or freezes during a session	Close and reopen the browser and log back in quickly. The web session typically remains open and other participants need not log back in.
Audio connections are poor	Opt for a different connection (convert computer to phone, cellular line to landline, use headset).
Individual participant cannot hear audio	Ensure audio connection was made and computer is not muted. Try another connection method.
Participant cannot be heard	Ensure audio connection made and not muted.
Host cannot be heard by any participant	Ensure Host made the audio connection and that Host is not muted.
Background noise or audio feedback	Host mutes all (or specific culprits), thereafter remembering to unmute participants during discussion and questions.

Never use a system that has not been tested in advance.

functionality. One helpful feature is for the host to also send this as a chat to all participants and include specifics of the interactive components clearly stating when Q&A will occur. The "mute all" function may need to be repeated some minutes into the webinar as new callers join later into the session. If audio remains open to all and background noise becomes problematic, quickly review the participant list to see who is indicated/tagged as speaking (usually by some form of animated speaker icon as shown in Figure 1, though some systems move speakers to the top of the participant list or highlight in the main window). Mute the noisy participant.

The host should speak clearly, at a controlled pace with variable intonation. One author finds using a wireless headset and presenting standing up "imagining an audience" helps her sound natural during virtual-only conferences. For live conferences with a podium microphone, speak directly toward the microphone and do not drift back or away from the podium. Employ the mouse pointer to indicate on slides as needed but avoid the irritating "follow-along-with-Bob" tracing of every word with the cursor. Avoid a laser pointer in combined live/virtual audiences as the laser pointer will not be seen by the virtual participants.

To facilitate interactive Q&A, it is best to repeat questions received from the live audience or chat to fully include the virtual audience. Using the word "you" in presentation such as "Today you will learn how to. . .." or "Would you like to ask any questions" engages participants. Humor (politically correct!) can also be helpful albeit challenging in the absence of feedback. Avoid pauses longer than 2−3 seconds unless specifically needed to allow participants time to read a slide (forewarn the audience) or to ask questions. And again, allow

time for questions during or at the end of the session by unmuting all or using chat. Give participants time to unmute and there is often a short audio delay so pace questions accordingly. Chat may be accomplished by either the host or the administrator reading the questions. Finish on time, thank participants for their attendance, and include an email address for later questions that arise.

Recording Sessions

Many programs support recording the session, either to local hardware, the cloud, or an institutional server (internet or intranet). The amount of available cloud storage may limit the size of the webinar that may be stored or may require purchase of additional cloud storage space. Familiarize yourself ahead of time with the recording controls and start recording at the session outset. A post-it reminder note to start recording is helpful for the host, given the intrinsic stress of the situation. A separate administrator role may also be assigned this task. Recordings may be available for a limited period of time (e.g. a year). Editing access is generally only given to the conference host, although view links can be sent out to attendees. Remember conferences posted on an intranet site typically limit access to institutional members, sometimes only when on site. Any sensitive information to include PHI and quality assurance (QA) should, in general, not be recorded.

Confidentiality and Security

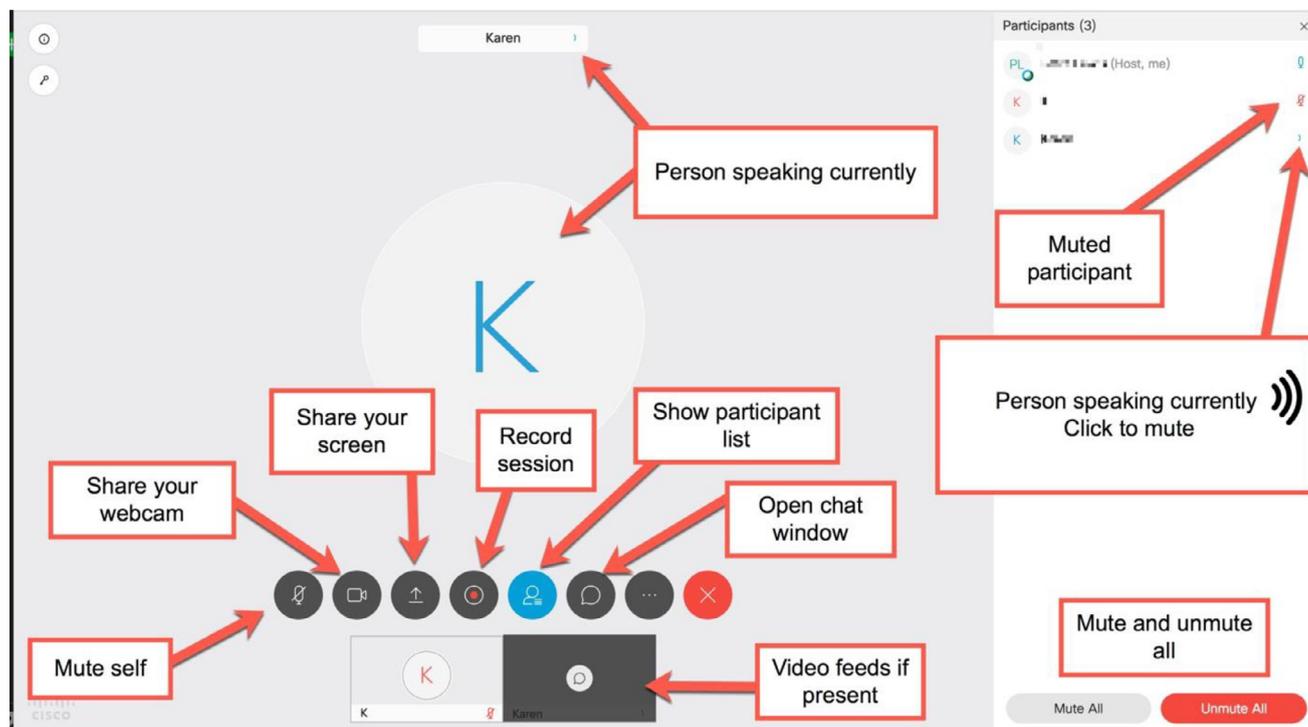PHI must be protected and secured. Outside of very specialized limited access conferences such as tumor boards that

Figure 1. Example of a typical webinar screen set up. This one is from Cisco Webex^{TM} but most have similar controls. (Color version of figure is available online.)

usually have hardwired or secured (encrypted) connections, no PHI should be disclosed. (1,2). Even a "secure" internet connection becomes insecure if nonauthorized users have access to the link. This becomes even more important when webinars are recorded and distributed. Similarly, use of copyrighted material from others should be minimized, particularly for any webinar to be commercially distributed (i.e. for a fee). Noncommercial uses are generally covered under the Fair Use Law, but the host should avoid the use of stock images that have not been purchased, as well as including references to avoid plagiarism (e.g. on diagrams) (19).

After the Session

It is ideal to follow the webinar with a direct send of slides, recorded link, or other supporting documentation to the registered participants. To broaden impact and improve skill set, request feedback and suggestions for other webinar topics. A short participant survey may accomplish both goals. Tracking participant numbers is easily accomplished by most web-conferencing software.

MULTI SPEAKER CONFERENCES

In line with new learning theories and paradigm shifts in medical education, traditional large onsite conferences are being reshaped by continuous professional development emphasis on e-learning and by millennials' embrace of digital resources (16,20,21). Large multi-speaker conferences pose unique challenges to stream successfully. Here are some tips for hybrid in-person/streaming success:

- *Administrator support:* use multiple computers and staff to manage in-room A/V, remote broadcast, and participant Q&A, chat, and Twitter if using (having them act as the host). This administrator serves to manage the broadcast and the in-room A/V and lighting controls. The administrator should continuously monitor audio and video quality from separate devices on a separate internet connection, for example PC and tablet together with studio monitor headphones.
- *Equipment*: employ a professional microphone aimed properly at the presenter; use a high-speed, low-latency internet connection, assure redundancy of all critical hardware (podium PC, microphone, Internet connection, external mouse).
- *Faculty:* all presenters should submit slides in advance and present from the single podium computer desktop; this single computer should feed both in-room screens and online stream to ensure synchronization of slides and mouse pointing. Often faculty must be repeatedly reminded to point using the mouse and speak directly into the microphones
- *System testing:* crucial to test everything in advance, namely the actual venue; the equipment being used; and the presentation slide decks

For large sessions, multisession webinars, and multi speaker conferences, it is very helpful to include a contact phone number for IT supportif connection issues occur.

CONCLUSION

Web-conferencing tools provide an excellent means of providing distance learning, hybrid live, and distance learning and video conferencing. For these sessions to run smoothly, participants and host alike must be aware of best practices (22,23). For the host, educational sessions require considerable preplanning, technology familiarity, and practice. Finally, it is important to know that highly interactive conferences, experiential learning, hands-on techniques, and highly sensitive-topic conferences (PHI, Morbidity and Mortality, QA) are generally best given and received in person rather than virtually.

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