Online Conferencing Software in Radiology: Recent trends and Utility

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Introduction

The practice of social distancing and a shift towards working remotely across a gamut of professions has resulted from the global coronavirus disease 2019 (COVID-19) pandemic[1]. The capability to remain connected to coworkers despite distance, particularly in a work from home (WFH) scenario, has been facilitated through the use of online meeting applications that allow for video conferencing and other collaborative features such as screen sharing[2]. With collective efforts and learning at a distance having already gained increased attention in the radiologic community prior to the COVID epidemic [3], it is only natural that radiology departments would acclimate by incorporating online conferencing software into daily practice both during the COVID epidemic and, later, in introducing increased collaboration amongst educational institutions and medical practices in different cities and states.

Methods and Objectives:

- A literature search was performed using PubMed, and literature exemplifying utility of videoconferencing technology, both recently and in the past, was reviewed and incorporated into the discussion.
- Various platform features (screen sharing, annotation, recording) were compared and discussed with respect to utility.
- Topics of discussion with respect to radiologic workflow include teamwork, training, and patient care.

Collaboration

Collaboration can occur not only within the local medical community but also with those outside of it like industry specialists, medical researchers, and basic scientists.

- Research and departmental seminars can be held, recorded, and distributed for both students, faculty, attendees and non-attendees to later stream, reference, or use for training purposes
- Some institutions have used this technology to conduct clinical trial reviews. Remote "expert" readers at various sites can review clinical study data with real time access to images [4].

Virtual Peer Learning Models

- Virtual peer learning conferences can be beneficial supplements to traditional audit-based peer review.
  - Under the peer review model, radiologists numerically score peer mistakes to monitor individual performance and competency [5].
  - Conversely in a peer learning model, numerical scoring is not implemented and individual performance is not graded; cases are reviewed categorically in a way to foster collaborative learning from error [5].
- In one survey of perceptions of peer review, only 32% of radiologists felt that the in-place peer review model decreased medical error and 46% of radiologists reported that they participated only because it was mandatory [6].
- A virtual peer learning program implemented exclusively using videoconferencing, may enhance participation amongst radiologists.
  - Without exclusive use of videoconferencing, physically present participants engage more than remote participants; a standardized experience promotes equal participation and group sharing amongst team members.
  - A virtual peer learning model is also beneficial to radiologists as it costs attendees less than 1hr/month of administrative time (on average $194/h) [5].
- In one such example, this system allowed radiologists, residents, fellows, and medical students from 14 institutions in 10 states to engage in valuable peer feedback, improvement, and learning.
  - In order to gain an even wider audience, meetings were recorded and posted on YouTube for streaming across the globe [7].

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Major Platforms

Platform	Package	Max # of participants	Screen Sharing	Control Sharing	Chat Feature	Multi-source Audio	Recording	Annotation Tools	HIPAA compliant	Mobile Device Compatibility	Desktop Compatibility
GoToMeeting	Professional	150	✓	✓	✓	✓		✓	✓	✓ iOS ✓ android	✓ Mac ✓ PC ✓ Chromebook ✓ Linux
	Business	250					✓ unlimited cloud storage ✓ transcripts				
	Enterprise	3,000					✓ unlimited cloud storage ✓ transcripts				
Microsoft Teams	Requires Office 365 subscription	250	✓	✓	✓	✓	✓ cloud storage ✓ transcripts		✓	✓ iOS ✓ android	✓ windows ✓ mac ✓ Linux
Cisco webex	Free	100	✓	✓ without passing control	✓	✓	✓ desktop storage	✓	✓	✓ iOS ✓ android	✓ any web browser, no downloads necessary
	Starter	50					✓ MP4 file ✓ 5GB cloud storage ✓ transcripts				
	Plus	100					✓ MP4 file ✓ 10GB cloud storage ✓ transcripts				
	Business	200									
zoom	Basic	100	✓	✓	✓	✓	✓ desktop storage ✓ MP4 file ✓ 1GB cloud storage	✓		✓ iOS ✓ android	✓ Mac ✓ Linux ✓ Windows
	Pro	100									
	Business	300					✓ MP4 file ✓ 1GB cloud storage ✓ transcripts				
	Enterprise	500					✓ MP4 file ✓ unlimited cloud storage ✓ transcripts				
	Healthcare		✓ cannot record				✓ desktop storage for clinical applications ✓ cloud storage for non-clinical applications		✓		✓ integrated with Epic ✓ integrated with medical devices
skype		50	✓	✓	✓	Dial in for additional fee	✓ stored in chat up to 30 days			✓ iOS ✓ android	✓ Microsoft edge ✓ Google chrome

Table 1: Feature comparison of major videoconferencing platforms. Chosen platforms (Zoom, Skype, WebEx, GoToMeeting and Microsoft Teams) were listed by G2.com in March to June 2020 as the top 5 of 10 videoconferencing platforms. G2 scored and ranked platforms based on data incorporated from user reviews, online sources, and social networks[8]. Notably, the information presented in Table 1 reflects features available as of June 2020.

Patient Care

Virtual Tumor Board

- In one example, a virtual tumor board was implemented using Microsoft Teams and perceptions were surveyed. The virtual multidisciplinary conference was attended by a wide array of physicians and graduate medical trainees, and radiologic images were easily viewed by all participants at the start by using screen share features.
  - The majority of participants (57.9%) preferred a virtual to in-person tumor board.
  - Almost 80% of participants preferred to continue the virtual format even after in-person restrictions would be lifted [9]

Virtual Radiology Rounds

- In another example, Zember et al. successfully employed Skype into virtual radiology rounds[10]. Each session consisted of a micro-lecture and review of patient cases by both clinicians and radiologists.
  - In 89% of cases presented virtually, radiologists responded with an increase in confidence in their diagnosis/interpretation.
  - In 56% of cases, radiologists revised their report and interpretation.
  - Radiologists reported that clinician input and a closer proximity to the point of care, made accessible by videoconferencing, benefited their interpretation of image.

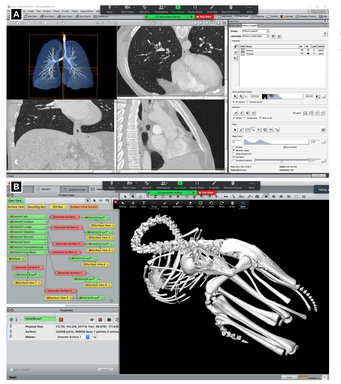
Training

Residency Training

- Collaborative features allow traditional read-out and "hot seat" style case conferences to occur as they would traditionally [11].
  - Annotation features of some platforms can be useful for questions and quizzes. "Screen share" features allow attendees (residents) to view the host's (faculty member) picture archiving and communication systems (PACs) screen remotely.
- Online conferencing software presents an intriguing potential solution to mitigation of the academic radiology community's concerns regarding the possible negative impact on resident education by the burgeoning trend of 24 hour radiology attending coverage.
  - The department of radiology from the Medical College of Wisconsin, has reported promising outcomes, as a result of a greater number of cases to which the resident is exposed, in their implementation of Skype into overnight emergency radiology workflow [12].

Cooperative Training Partnerships

- Shared screen tool has been highly effective in supporting cooperative training partnerships between our radiology department and the Department of Cell Biology and Anatomy.
- Conferencing software can be used to teach students, residents, or colleagues how to use cutting-edge three-dimensional (3D) modeling programs, like Mimics, VGSTUDIO, and Avizo, for rendering and segmenting surface models from CT and MR image data (Fig. 1).
- Conferencing software paired with Jupyter notebooks can be used to teach basic computer programming techniques as they relate to radiology-focused artificial intelligence application development (Fig. 2).



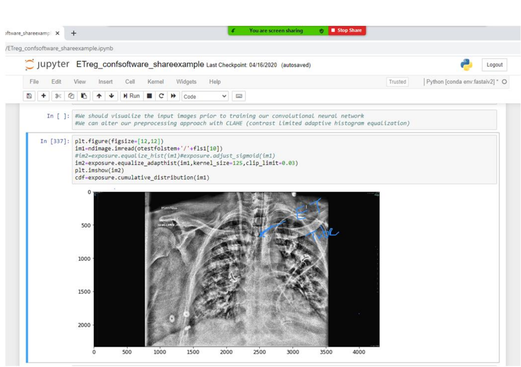


Figure 1. Screen shots of Zoom during two screen shares (clinical and basic science projects) demonstrating the use of the scientific visualization program Avizo (Thermofisher Scientific). **A)** The Avizo 7.1 segmentation module with a 3D model of an adult human lung and associated axial (top right), coronal (bottom left), and sagittal (bottom right) slices. **B)** The Avizo 9.1 main GUI with a 3D segmented surface model of a juvenile ostrich skeleton (*Struthio camelus*), and multiple rendered surface models deselected.
Figure 2. Example Zoom screenshot of a shared session explaining a Jupyter notebook being developed to investigate support device detection using a convolutional neural network for COVID-19 cases. Annotations can be used to highlight key findings in the images modified with digital processing. In this figure, the discussion leader has used Zoom's annotation tools to highlight the endotracheal tube position on a chest radiograph for an intubated patient with COVID-19. The radiograph in the screenshot has been manipulated with Contrast Limited Adaptive Histogram Equalization (CLAHE), and different participants can adjust these parameters in the notebook with control sharing.

Cautionary Considerations + Conclusions

Cautionary Considerations:

- All users, including radiologists, other physicians, and patients, should approach videoconferencing with caution concerning privacy and data sharing.
- With respect to patient data and privacy, the Office for Civil Rights at the U.S. Department of Health and Human Services has modified HIPAA enforcement policies in alignment with the use of telehealth services during the COVID-19 pandemic [13].

Conclusions:

- The practice of radiology is defined by a technologically driven communicative partnership with other healthcare professionals as well as patients, and with the variety of online conferencing software available, there is opportunity to enhance cooperative efforts.
- There is potential to capitalize on the many benefits of these platforms elucidated during mass physical distancing efforts in 2020 with respect to efforts in radiologic teamwork, training, and patient care.