Cardiology training using technology

Technology-enabled cardiology training and education for effective learning in the COVID-19 era and beyond

Background and significance

The coronavirus disease-2019 (COVID-19) pandemic has had an unparalleled impact on cardiology training worldwide. In the next few sections, we highlight several foundational considerations for building a successful technology-enabled model in the new normal for cardiology training.

Types of technology-enabled learning and associated infrastructure

Key features of the e-learning process are centred on the internet with international sharing of learning resources, information broadcasts and knowledge flow through network courses, and flexible learning in a computer-based environment that overcomes barriers of distance and time. A United Kingdom (UK)-based group of registrars have come together to engage global experts for regular teaching webinars on core cardiology curriculum topics. This approach to learning could change the way fellow ‘training days’ are delivered for continuing professional development, which can in turn mitigate pre-existing rota commitments and travel requirements.1

Internationally, cardiology societies have reverted to e-learning portals and video-conferencing for continuing medical education, including the European Society of Cardiology Scientific Congress 2020 which was delivered as a digital experience. Whilst virtual live sessions and replays have previously been made available for various subspecialty conferences over the years, the COVID-19 era has indeed accelerated the widespread adoption of digital content delivery platforms at a much larger scale than before.

Augmented reality through medical holography and extended virtual reality with various degrees of immersive, overlay, and integrative interactivity are part of the spectrum of mixed reality techniques that are highly applicable in educational domains. Already available for interactive teaching by allowing intuitive depth perception and accurate understanding of 3D anatomy and surgical procedures within hands reach, these technologies may be leveraged to replace in part what trainees previously learned during in-person clinical rotations. A future further extension of mixed reality could be haptic rendering techniques, whereby a haptic feedback system’s capacity to transcribe palpable physiologic parameters into tactile information can provide an operator with valuable real-time information that can improve procedural learning.2

The effects of COVID-19 on procedural training can be moderated by simulation-based e-learning delivered in various formats, including virtual patients, computer-based physiology simulators or advanced surgical simulators that allow the practice of procedures such as valve replacement or coronary artery bypass surgery. These can be most valuable in the earlier stages of learning a new procedure when there is a higher propensity for complications.

Simulation-based training has been shown to improve transoesophageal echocardiography (TOE) procedural skills.3 Simulation-based training for coronary angiography has also been shown to reduce procedure time and improve technical ability in real-life patient procedures.4 Trainees can learn at their own pace in a stress-free environment with immediate feedback for improved manual dexterity, whilst minimizing risks during this learning phase.

Customized learning through continuous computerized algorithm assessment can be used to compare individual decision-making with real-life expert decision-making. In the form of self-teaching and active learning known as adaptive learning, more emphasis is placed on areas where a trainee requires further development. One study of TOE interpretation among anaesthesia residents showed that an adaptive learning module resulted in improved accuracy and proficiency.5

Trainee review of instructional materials before the actual class can be very helpful for learning within a paradigm known as the flipped classroom approach, whereby class time is used more constructively to identify mixed competency levels, learner difficulties, and differentiated learning preferences. One study showed superior quality improvement in residents who underwent a flipped classroom curriculum.6 Video-based coaching has also been shown to be effective in training for coronary intervention and transcatheter valve procedures.7

Equitable access for all

Webinar series can be made accessible to all. Interested trainees can register or request access by sending a message through Twitter or email. Live viewers can also request ‘certificates of viewing’. Webinars can be recorded and are generally very well-received with some reaching almost 500 views in less than three weeks.1 Organizational support and endorsement through societies can enable vital and equitable
sharing of useful resources in cardiology education without geographic bounds and make for progressive and outward-looking initiatives.

There has been concern however that overreliance on virtual remote methods of instruction can worsen digital inequality with regards to internet access, computer skills and application of internet knowledge, and potentially create a generation of digital outcasts. On the other hand, online versions of traditionally in-person conferences such as the ESC Scientific Congress 2020 have attracted more than three times the usual number of participants compared to previous years, a testament to overcoming the economic and travel barriers of physical distance through the use of digitalization. To ensure equitable procurement to the benefits of virtual learning, basic infrastructure such as internet and device access needs to be made available to learners from varying demographics.

**Needs-adapted technology for trainees with disabilities**

When providing access to higher education for people with disabilities, it is important to highlight that disability is activated differently online. Impairments that might experience significant disability in the analogue world, such as for a wheelchair user, may be less impacted when online. People with impairments related to vision, cognition, hearing, and manual dexterity may find online environments significantly disabling. In this regard, learning material available online can be more accessible than analogue content as electronic text can be read aloud and transcribed to braille form and audio files can be converted to text. The e-learning environment can also provide students with a greater degree of flexibility in time and place such as tutorial discussions that take place on asynchronous discussion boards. The three features of the disclosure, accessibility, and flexibility help enable people with disabilities to engage in a higher education learning environment. As such, needs-adapted technology through web-based lecture systems is valuable for both cardiology trainees with disabilities and the broader trainee population.

**Confidentiality and Governance**

Platforms like Zoom, Bluejeans, and WebEx allow sharing of patient-level data through Health Insurance Portability and Accountability Act-compliant services. Since assessments in e-learning are frequently supervised by proxy, it may be difficult to monitor for and regulate activities such as cheating. E-learning content may also be vulnerable to piracy and plagiarism. Ground rules and code-of-conduct specific to e-learning should thus be laid out to all stakeholders to ensure a fair and principled construct within which virtual training is conducted. Strategies to perform remote examination invigilation include requesting the examination candidate to scan the room for educational materials prior to starting the online examination; and mandating that audio and video functions are enabled throughout the examination so that the invigilator is able to supervise candidate conduct. With regards to online discussions, a ‘netiquette’ (online etiquette) is available and can help maintain effective and respectful conversations, with specific guidance on the need to cite data sources.

**Conclusion**

With due consideration of the various technology-enabled learning options and associated infrastructure needs as well as the adoption of strategies for participant engagement under the umbrella of sound and just governance, virtual learning and training in Cardiology can be effective, inclusive and equitable for the current and future generation of cardiologists through COVID-19 era and beyond.

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