

Virtual Pathology Education in Pandemic Times: Challenges, Solutions and Future Implications

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ABSTRACT

In view of the highly contagious nature of SARS-CoV-2, slide reviews with multi-headed microscopes can no longer be a safe approach in pathology instruction. The outbreak has disrupted the routines of pathology education and interactive didactic conferences. The emerging challenge here is to develop practical laboratory sessions in virtual environments. This has given rise to multiple other challenges in the development of virtual pathology education, some of which are highlighted in this commentary. The main difficulties center around the integration of virtual learning technologies into a pathology curriculum and incorporation of digital pathology infrastructure into an educational platform. Maintaining the competency standards in virtual pathology education (VPE) during a pandemic may prove to be another significant challenge. The quality of virtual learning depends on several factors including infrastructure provisions, deployment of modern equipment, faculty knowledge and learner engagement. In response to the educational challenges in pandemic times, VPE has utilized some invaluable digital platforms that provide access to various virtual pathology cases and slide reviews.

This commentary examined the impact of COVID-19 on pathology education at undergraduate and postgraduate levels. It also explored the potential solutions to overcome the present challenges and future implications for virtual pathology education and practice.

Keywords: COVID-19, Impact, Pathology, Virtual learning, Undergraduate education, Residency, Digital technology

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Introduction

In March 2020, social distancing was mandated for medical students who were at risk of contracting and transmitting the novel coronavirus in hospitals and traditional in-person classrooms (1). The current pandemic has brought about major disruptions to pathology education around the world (1). Given the highly transmissible nature of the virus, conducting clinical pathology

sessions and slide reviews with multi-headed microscopes could be deemed as a high-risk activity (1, 2).

In response to this state of affairs, lecturers and professionals in the field of pathology have called for a transition from on-site slide reviews to virtual meetings. Specialized virtual platforms enable pathology educators to deliver educational content enriched with digital pathology data. Learners can join

whenever suits them and interactively provide feedback on pathological case reports (3, 4).

In this commentary, the authors examined the impact of COVID-19 on pathology training at undergraduate and post-graduate levels. Furthermore, solutions are offered to overcome these challenges, while the potential advantages of switching to virtual pathology education are also discussed.

Challenges and Proposed Solutions for Pathology Education in Pandemic Times

Maintaining competency standards at undergraduate level is a rising challenge for pathology departments struggling with constant disruptions in COVID-19 era. These standards correspond to the minimum residency requirements set out by Iran's national pathology education board.

Competency-Based Pathology Education (CBPE) focuses on translating pathology knowledge into diagnostic skills, and clinical practice and reasoning. The criteria for practicing as a qualified physician include acquiring a broad knowledge of the physiological and pathological processes of each organ system, profound understanding of pathobiology and disease mechanisms, and developing the diagnostic and therapeutic skills through lifelong learning (5).

For undergraduate pathology students, practical microscopy sessions are a necessary part of their competency-based education, enabling them to visualize and detect normal and abnormal cells and tissues (1, 2). However, the pandemic has brought the in-person interactions in microscopy classes and workshops to a standstill. In order to facilitate CBPE at the undergraduate level, pathology departments need to hold virtual laboratory sessions, use digital (virtual) microscopy and switch to teleconferencing and tele-feedback (3).

The second principal challenge is to deliver effective pathology education at the graduate level. Reviewing slides with a mentor and more than one resident may be critical in the areas of Anatomic Pathology (AP) education,

Cytopathology, and Surgical Pathology (SP) rotations (6). During the pandemic, standard pathology residency programs and on-site slide review meetings are not considered safe or practical (1, 2).

However, as pathology residency programs were under pressure to continue providing residency rotations and complete the pathology training, directors of pathology departments began to readapt their educational strategies. Some institutions continue their real-time in-person *practical meetings* by enforcing safety measures, including the use of Plexiglas to separate faculty and trainees and mandating the use of face masks. Others project the slides using a projector, and in this way trainees can participate in discussions and study the slides while complying with the distancing protocols (6, 7). Still others turn to broadcasting the microscope view to the participants. This innovation involves using a camera attached to a microscope and sharing microscope view with trainees through videoconferencing applications (3). To observe the social distancing regulations, most pathology residency programs provide rotation schedules for SP residents, allowing them to attend on-site meetings and receive virtual pathology education from home (7). They transfer their didactic classes and on-site discussion sessions to a virtual platform (8). Recent evidence suggests that the methods using a microscope, camera and Zoom application have enabled learners to actively engage in real-time discussions, while limiting the risk of COVID-19 exposure (6-9).

To conclude, switching to a virtual platform appears to be a potential means of addressing the present challenges, enhancing safety and keeping high-quality training on track.

Reconstructing Pathology Education within a Virtual Environment

A major challenge in the use of an educational platform is the reconstruction of practical laboratory sessions in a virtual environment. The quality of virtual learning depends on faculty experience, learner

engagement, infrastructures, and the use of modern equipment (3-5). Pathology instructors face several problems in developing virtual content, applying innovative educational techniques, managing educational schedules, and providing feedback to learners without face-to-face interaction. Not all institutions have the required resources and facilities like slide scanning, online educational content (e.g., gross dissection), pathology learning modules, and online textbooks. Implementation of a Virtual Pathology Education (VPE) program with such limitations could also be a challenging undertaking (4).

Many pathology societies offer free online educational content. Examples of such sources include pathology wiki websites, websites providing image collections, and organizations offering pathology lectures and learning modules. Also, the internet facilities of pathology departments provide trainees with free educational content, often in the form of case presentations accompanied by multiple-choice questions (3-7). In addition, gross dissection videos created prior to COVID-19 are available on YouTube and usually accessible on pathology departments' official websites. Furthermore, the pre-pandemic gastrointestinal (GI) pathology learning modules created by pathology residents in the past are similarly available online.

The pathology slides could be digitized using scanners, and then stored and shared online. In a real-time setup, the microscopes are equipped with a camera that broadcasts the microscope view through a videoconferencing tool, and thereby participants receive the educational content on their internet-enabled gadgets (laptops, tablets, and smartphones) (3-7). Although there are several advantages in using digital microscopy and digital slide archives such as Anatomy's Virtual Microscope Database, there are also crucial limitations. VPE should come up with a platform that enables learners to use digital sources in a way that simulates the traditional pedagogical approach. The common concerns

among educators are technical and logistical issues. The interruptions caused by slow internet connectivity can have a big impact on an online experience of slide reviews. The histologic and cytologic details are not as sharp, and microscopic trainings are compromised (1, 4). Among other drawbacks, one can point to the compatibility issues with various devices and operating systems, lack of slide availability, slow response time, and lack of user-friendly platforms. Accordingly, in present circumstances, experts recommend all educational institutions with resources to create their local slide archive so that instructors can upload their own educational slide sets and enrich the local archive (10, 11).

Post-Pandemic Implications for VPE and Pathology Residents

The pandemic has been a valuable experience in terms of exposing the challenges facing pathology residents and laboratories during an outbreak. These residents have learned the clinical, regulatory and ethical considerations; they have been trained to evaluate specimen collection tools as well as the kits for polymerase chain reaction (PCR) testing. They have also gained a deeper perspective of the issues surrounding the supply chain. Moreover, proper training has been provided for rapid validation of the latest testing equipment. The pathology trainees can now better perceive the significance of prudent practice in laboratory environments. Considering the economic impact of COVID-19 on laboratories and healthcare systems, pathology residents have formed a better understanding of laboratory experts' critical role in epidemiologic studies and public health (1, 9). Educational dimensions of the pandemic has further highlighted the critical concepts in laboratory medicine, including sensitivity, specificity, predictive value, test interpretation and limitations, supply chain issues, safety, and quality (7-9). These experiences can prove valuable, especially in dealing with possible future pandemics (10).

Furthermore, VPE presents an opportunity

for extended access to visiting rotations when in-person rotations remain limited for the 2021-2022 academic year (1, 2). Even after the pandemic, pathologists may use virtual technologies to optimize the efficacy of pathology education and practice (12).

Another advantage of the widespread shift toward digital platforms is that pathologists are growing more competent in using virtual technologies and tele-pathology in education. They can now discuss pathology cases with multidisciplinary boards at virtual collaborative platforms. The virtual conference platforms such as Skype, Webex, and Zoom are qualified for the surgical pathology training program. Furthermore, Zoom provides an opportunity for virtual conferences wherein multiple pathologists present their cases (3-7). Pathologists can also share the slides on their computer screens with other participants in real time.

VPE has several significant benefits, and the demand for this approach will likely be greater in post-pandemic times, especially among medical students in remote centers and rural areas. Undergraduate medical students are often underexposed to diagnostic pathology. In this respect, VP slide reviews can increase learner exposure to a wider variety of cases and provide opportunities to practice pathology skills. Finally, VPE is believed to potentially strengthen pathologists' competencies in telepathology.

Conclusion

In view of the above-mentioned points, shifting to virtual settings would almost transform every aspect of pathology education. Most significantly, VPE is delivered through a platform in which learners can develop their competencies under interactive supervision and practice their skills independently. VPE programs could adopt innovative strategies for continued support and services during the pandemic. This will set the stage for a transformation of routine education from in-person classes to virtual settings. For Pathology trainees, virtual meeting tools are growing more critical for maintaining

communication and enhancing educational activities. In spite of all the challenges, virtual environments present multiple opportunities that are vital to ensure continued education in crisis times.

Moreover, the increasing application of digital pathology in VPE allows for increased exposure to pathology cases during the pandemic. Traditional on-site microscope-based practices are limited by the number of microscope heads and pathology slides, whereas virtual platforms can accommodate more viewers, display more cases and provide the flexibility of telepathology. However, some issues are yet to be improved. Further research is required as to how best to integrate the digital pathology microscopy infrastructure into the VPE platforms and utilize video conferencing modalities in formal pathology curriculum.

Conflict of Interest

The authors declare that they have no conflict of interest.

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