

Transition From a Standard to a Hybrid On-Site and Remote Anatomic Pathology Training Model During the Coronavirus Disease 2019 (COVID-19) Pandemic

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• **Context.**—As teaching hospitals institute social distancing and defer nonemergent procedures to cope with the coronavirus disease 2019 pandemic, the need for daily on-site presence, unless necessary, has been reduced for all medical staff, including trainees. Pathology training programs must adapt to these changes to ensure overall safety without significantly compromising training and the educational mission of the institution.

Objective.—To describe the hybrid on-site and remote anatomic pathology training model in response to the coronavirus disease 2019 pandemic that was implemented in our pathology department and report the clinical fellows' responses to the survey about their experiences.

Design.—The hybrid model was implemented March 25, 2020. Fellows alternate weekly between working on site and working remotely. On site, fellows wear personal protective equipment and maintain social distancing. Remotely, fellows use digital pathology to review cases and supplement with online educational activities. Virtual “coffee breaks,” meditation, and exercise are part of the curriculum. Online platforms, including WebEx, Google Classroom, and Canvas, are used to continue educational

activities. The survey was open May 19 through June 8, 2020.

Results.—Twenty-eight of the 29 clinical fellows (96%) responded. Many of the respondents indicated substantial increase in their skill with using digital pathology and online platforms during the pandemic. The top most helpful resources were the United States and Canadian Academy of Pathology interactive microscopy courses (found very or somewhat helpful by 22 of 23 clinical fellows; 96%), ExpertPath (19 of 23; 82%), the College of American Pathologists virtual learning series (18 of 23; 78%), the World Health Organization Blue Books (16 of 23; 70%), the American Society of Cytopathology webinars (14 of 23; 61%), and our institutional digital slide collection (12 of 23; 52%).

Conclusions.—Hybrid on-site and remote training can maximize anatomic pathology learning opportunities while maintaining the safety of trainees, hospital personnel, and the community.

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As of July 30, 2020, the coronavirus disease 2019 (COVID-19) pandemic caused by the severe acute respiratory syndrome coronavirus 2 had resulted in more than 150 000 deaths in the United States alone.¹ The highly

contagious nature of COVID-19 and the fact that much remains unknown about this disease has threatened the safety of all communities, especially health care workers. Unlike “all-hands-on-deck” emergency situations that necessitate recruitment of all available personnel with medical expertise, including trainees, the COVID-19 pandemic necessitates social distancing to slow the spread of disease.

At our institution, decreasing nonemergent activities, such as elective surgeries, and decreasing the physical presence of personnel who are deemed nonessential were adopted as the major strategies to protect our patients and ensure the safety of employees. In addition, institutional policy mandated that no more than 5 people could be present in the same room, and all personnel were to remain at least 6 feet (1.83 m) apart from one another. Although trainees are indispensable in patient care and their participation in disaster relief situations helps them develop various skill sets they need to function independently, the educational and clinical service benefits of having trainees on site during the COVID-19 pandemic had to be balanced against the

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imperatives to ensure the safety of trainees and comply with the stay-at-home orders issued by our state.

In the specialty of anatomic pathology, in which training is weighted heavily toward education and mentored review of cases rather than provision of direct patient care, the physical presence of all trainees on campus is not essential for daily operations, in light of stay-at-home orders during the current pandemic. In response to the changes necessitated by the COVID-19 pandemic, the Department of Pathology at MD Anderson Cancer Center (Houston, Texas) rapidly and substantially restructured the anatomic pathology fellowship curriculum and modified clinical and educational operations. The result was a hybrid on-site and remote training model. We later surveyed trainees and faculty about their experiences with this new model. Here, we describe the development and implementation of the model and report the clinical fellows' responses to the survey.

MATERIALS AND METHODS

COVID-19–Related Problems That Influenced Design of the Hybrid Curriculum

Before the COVID-19 pandemic, anatomic pathology fellows at our institution spent most of their day previewing cases under a microscope, generating pathology reports, and attending sign-outs with the attending faculty, which is the established form of training at all pathology residency/fellowship programs. All fellows were provided 1 hour of protected time to attend a didactic lecture each morning. Exposure to pathology cases and reviewing cases simultaneously with faculty members using dual-headed or multiheaded microscopes has been the crux of the educational activities in our fellowship program; these activities prepared fellows to be diagnostically competent and ready for independent practice. Additional interactive training, including interesting-case conferences around multiheaded microscopes led by either a faculty member or a fellow, was also an important educational activity that enhanced the overall training of the fellows. All the aforementioned educational activities required close contact on a routine basis to ensure Accreditation Council for Graduate Medical Education–mandated training requirements.

The COVID-19 pandemic left our department facing several challenges. In the early days of the pandemic, when national leaders were trying to understand the magnitude and impact of the virus, stay-at-home orders were in place mandating only essential providers to be on site, maintaining at least a 6-foot (1.83-m) distance. This, combined with a sharp decline in case volumes, reduced in-person learning opportunities for trainees. We had to make immediate changes to the curriculum to both satisfy the social distancing guidelines and ensure adequate training for the trainees. Recognizing this sudden unfavorable impact of the pandemic on education, many pathology societies and training programs opened up free online training modules. This resulted in a dramatic increase in online resources for trainees, who now suddenly had to navigate the overwhelming number of available online resources as a substitute for lost in-person learning opportunities. Other authors have also identified this second problem regarding the volume of available resources: Mukhopadhyay et al² recently reviewed the online educational resources for pathology trainees and found a huge number, including digital pathology tools, social media platforms, whole slide imaging collections, and online courses and lectures, that trainees and educators have to navigate. Machado et al³ wrote a letter to the editor titled "I Am Having Trouble Keeping Up With Virtual Teaching Activities" and calling for creation of a structured curriculum to maintain high quality of medical education. To address these problems, and in an effort to minimize disruption in learning and also continue clinical services, we created and rapidly implemented a hybrid curriculum for our pathology trainees that

combined in-house and remote work. We developed and implemented the hybrid curriculum for all the trainees in the departments of pathology (clinical fellows) and translational molecular pathology (research fellows). In order for the fellows to get exposure to clinical material within the guidelines of social distancing, we implemented a hybrid curriculum that combined on-site and remote working schedules. Here, we describe the development and implementation of the hybrid curriculum and report the clinical fellows' responses to the survey.

Resource Selection

The resources for remote learning were identified on the basis of recommendations from the trainees and faculty members. Resources that provide continuing medical education (CME) credits in the form of a certificate were highly encouraged and given preference because the certificates served to track the progress of the fellows and provide proof of their scholarly activities. We petitioned major organizations, including the United States and Canadian Academy of Pathology (USCAP), the College of American Pathologists (CAP), and the World Health Organization (WHO), to provide free online resources to the graduate medical education community during the global pandemic, and they all responded favorably. The USCAP bridged the gap in hands-on clinical training through their many interactive microscopy courses with CME credits (such as Common and Challenging Diagnostic Dilemmas on Frozen Section Service). After carefully scrutinizing all the available resources, the anatomic pathology education manager collaborated with program directors to select accredited resources for the trainees.

Curriculum Design for Clinical Trainees

To protect our patients, ensure the health of our workforce, and reduce the impact of the novel coronavirus on our community, our institution implemented new social distancing guidelines and practices, which resulted in significant reduction in the number of employees on campus and required us to develop a new way of delivering education in our pathology fellowship programs. The hybrid curriculum was developed and implemented for all the trainees in the departments of pathology (clinical fellows) and translational molecular pathology (research fellows).

Clinical fellows are divided into 2 teams. During the first week, team A rotates on campus to cover the various services and team B works remotely. Then the teams switch and team B works on campus for a week while team A works remotely. With the significant reduction in case volume, all services were manageable with only one fellow on campus rather than the usual 2 to 3 fellows. Most importantly, this scheme of using 2 teams resulted in a 50% reduction in the occupancy of the 3 fellow rooms. The weekly rotation was a natural choice to ensure continuity of patient care.

The hybrid curriculum for clinical fellows has distinct in-house and remote components. When the fellows are working in house, they follow the traditional schedule of previewing cases and generating reports. The sign-out is conducted by alternative means, such as by screen sharing using WebEx (Cisco Systems), phone, and email, to minimize face-to-face interactions between trainees and faculty members and promote social distancing. The sign-out experience is further described in the Discussion section under Digital Review of Cases. When the fellows are working remotely, they are provided with the fellowship log in a Microsoft Word file to document at least 8 hours of clinical, scholarly, and health and well-being activities that they perform on a daily basis. Please see the example weekly fellowship work log for working from home in Supplemental Table 1 (see supplemental digital content at <https://meridian.allenpress.com/aplm> in the January 2021 table of contents). Documented clinical activities include reviewing high-quality patient care images captured using the Aperio digital pathology slide scanner (Aperio Group, LLC), rendering a diagnosis, preparing the report, and signing out virtually with faculty in multiple locations (digital pathology). Examples of scholarly activities include work on research projects, work on

Table 1. Recommended Resources for Clinical Fellows^a

1. American Society of Dermatopathology Case Study Archives (<https://www.asdp.org/education/case-study-of-the-month/case-archive/>)
2. American Society of Cytopathology Live Online Educational Series (<https://cytopathology.org/page/liveonlineseries2020>)
3. American Society for Clinical Pathology online courses (<https://www.ascp.org/content/membership/get-involved/access-online-courses>)
4. ARUP Laboratories (<https://arup.utah.edu/education/videlIndex.php>)
5. CAP ebooks (<http://ebooks.cap.org/>)
6. CAP Virtual Lecture Series and CAP courses and programs offering CME credits (<https://www.gotostage.com/channel/capvls> and <https://learn.cap.org/default.aspx>)
7. CAP Performance Improvement Project Cases (<https://www.cap.org/member-resources/councils-and-committees/surgical-pathology-topic-center>)
8. Canvas-Study@MDAnderson (learning management system)
9. Dana-Farber Cancer Institute Connect:Science seminar series (<https://www.dfcc.harvard.edu/events/dfcc-connecting-the-scientific-community-seminar-series/>)
10. UCLA DermOID Online Interactive Dermatopathology cases and quizzes (<https://derm-oid.ctrl.ucla.edu/>)
11. Johns Hopkins Surgical Pathology Unknown Conference (<http://apps.pathology.jhu.edu/sp/> and <http://apps.pathology.jhu.edu/cyto/>)
12. ExpertPath (<https://app.expertpath.com/login>)
13. Google Classroom (<https://classroom.google.com/>)
14. Massachusetts General Hospital Remote Learning Resources (<https://learn.mghpathology.org/index.php/remote>)
15. MD Anderson Cancer Center Resources (clinical and research)
16. MD Anderson Cancer Center Digital Slide Collection (virtual sign-out)
17. MD Anderson Cancer Center Employee Assistance Program
18. MD Anderson Cancer Center Scientific Publications Webinars and Videos
19. PathCast (https://www.facebook.com/pathCast/videos/?ref=page_internal)
20. PathologyOutlines (including board review–style questions for all subspecialties) (<https://www.pathologyoutlines.com/review-questions>)
21. USCAP: eLearning Center (interactive courses with CME credits) (<https://www.pathlms.com/uscap>)
22. USCAP: Juan Rosai’s Collection of Surgical Pathology Seminars (<https://www.rosaicollection.org/>)
23. WHO Blue Books (<https://whobluebooks.iarc.fr/>)

Abbreviations: ARUP, Associated Regional and University Pathologists; CAP, College of American Pathologists; CME, continuing medical education; UCLA, University of California, Los Angeles; USCAP, United States and Canadian Academy of Pathology; WHO, World Health Organization.

^a All websites were accessed on July 2, 2020.

quality improvement projects, and preparation for board certification examinations. All fellows, regardless of whether they are working on site or remotely, are required to attend morning didactic lectures and evening slide conferences via WebEx, participate in interactive microscopy courses offered by the USCAP through their eLearning center, attend virtual lectures offered by the CAP, and attend webinars offered by Associated Regional and University Pathologists, Inc (ARUP Laboratories, Salt Lake City, Utah). The USCAP, the CAP, and ARUP Laboratories all award CME credit and a certificate upon completion of each course.

Fellows are also encouraged to take advantage of non-CME-awarding virtual learning opportunities, including a wealth of resources available through our institution’s online education center; PathCast (online pathology lectures on demand in the Facebook page and YouTube channel [Google]); the CAP webinar series; the unknown cases series from the Johns Hopkins Collection (Baltimore, Maryland); Hot Topics by the American Society for Clinical Pathology; the Juan Rosai collection of surgical pathology seminars offered by the USCAP; and live educational series and webinars offered by the American Society of Cytopathology. Additional learning resources provided at our institution include ExpertPath (online pathology books, Elsevier), which has images and discussions corresponding to thousands of common and complex diagnoses and which allows learners to earn point-of-care learning credits. Trainees also use the CAP virtual e-books, online WHO Blue Books (International Agency for Research on Cancer), OncLive videos and discussions (MJH Healthcare Holdings, LLC), and podcasts of educational relevance. Two main platforms used for collaborating among faculty and fellows include Google Classroom and the Canvas (Instructure) learning management system. A comprehensive list of recommended resources used in the hybrid curriculum is provided in Table 1.

Curriculum Design for Research Trainees

For our research trainees, responsibilities while working remotely include any of the above as appropriate. In addition, they collaborate remotely with principal investigators and research mentors on current or ongoing projects; perform data and bioinformatics analyses and complete online courses offered at the MD Anderson Cancer Center UT Health Graduate School of Biomedical Sciences; participate in English as a second language conversation classes, cancer biology seminars, interdisciplinary translational education and research training activities, and journal club as need and interest dictate; and collaborate with clinical oncologists. Electives for research trainees include courses on writing grant proposals, CME courses designed for laboratory professionals offered by ARUP Laboratories, and weekly virtual talks and seminars for researchers offered by the Dana-Farber Cancer Institute (Boston, Massachusetts) as part of its Connect:Science seminar series (see Supplemental Table 2).

Our institution also provides holistic employee support during the COVID-19 pandemic, and trainees are encouraged to take advantage of these resources. For example, our Employee Assistance Program hours have been extended to help with resource needs and to discuss work-related concerns as well as mental and physical health and well-being of all employees, including clinical employees working with patients, and, for employees who are quarantined, via virtual chat and support groups. Our graduate medical education office provides a virtual “coffee break” during which trainees can connect remotely and share thoughts and ideas. Trainees are required to log a minimum of 2.5 hours of wellness activities per week and submit these hours to the program director and fellowship office at the end of each week. The clinical competency committee evaluates this log before credit is awarded.

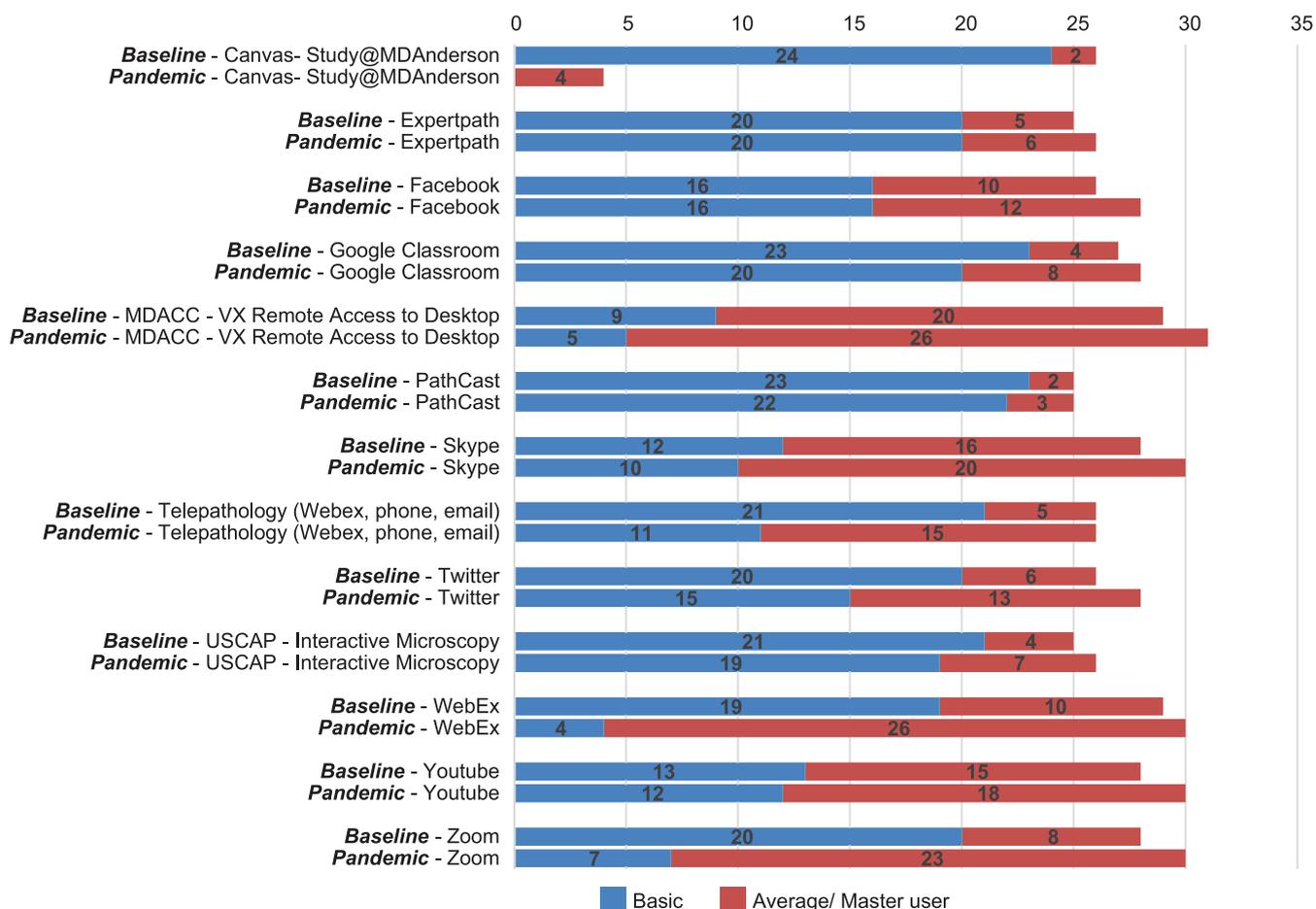


Figure 1. Level of skill with the recommended platforms and applications before and during the coronavirus disease 2019 pandemic. Baseline, before the pandemic; Pandemic, during the pandemic. Abbreviations: MDACC, MD Anderson Cancer Center; USCAP, United States and Canadian Academy of Pathology; VX, ??.

Survey Design

In order to assess the feasibility and effectiveness of the hybrid curriculum in pathology fellowship training during the pandemic, we collaborated with our office of institutional research, department of academic analytics and technology, to create an institutional review board–approved online survey using Qualtrics (Provo, Utah, and Seattle, Washington), an institutionally approved survey and quizzing tool. The survey was designed using mostly interactive questions and included up to 3 open-ended questions for each respondent. The survey was announced on May 19, 2020, and distributed via email to all clinical and research faculty, trainees, and administrators in the departments of pathology (clinical fellows) and translational molecular pathology (research fellows). The survey was open from May 19 through June 8, 2020, for participants to respond. The survey asked about skill level using multiple applications before and during the COVID-19 pandemic, quality of coursework and experience when done remotely, and whether different types of remote experience were less effective, equal to, or more effective than the in-person experience.

RESULTS

The hybrid curriculum was designed during approximately 48 hours, from March 21 to March 23, 2020, and implemented on March 25, 2020. We were redefining how pathology fellowship training is delivered, remotely rather than on site, and we were able to bring this vision to reality in record time.

Demographics

A total of 85 respondents participated, of whom 28 (33%) self-identified as clinical fellows, 35 (41%) as clinical faculty, and 22 (26%) as research fellows. The response rates were 96% (28 of 29) for clinical fellows, 52% (35 of 67) for clinical faculty, and 88% (22 of 25) for research fellows (Table 2). In this manuscript, we summarize the responses of the clinical fellows.

Experience With Online Platforms and Applications Before and During the Pandemic

The respondents were asked to rate their level of experience with the following online platforms and applications before and during the pandemic: Canvas, ExpertPath (Elsevier), Facebook (Facebook, Inc), Google Classroom, institutional remote access, PathCast, Skype (Microsoft Corporation), Telepathology, Twitter (Twitter, Inc), USCAP

Participant Group	No. of Participants/ Total No. Invited (%)	% of Total Respondents
Clinical fellows	28/29 (96)	33
Clinical faculty	35/67 (52)	41
Research fellows	22/25 (88)	26
Total	85	100

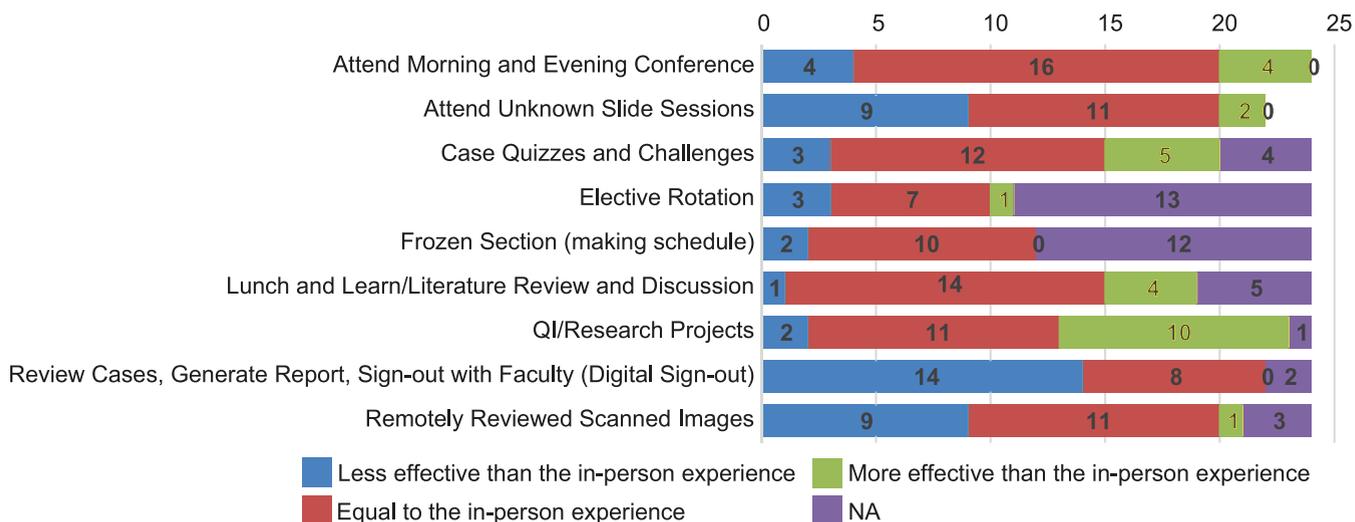


Figure 2. Quality of remote versus in-person learning experiences. Abbreviations: NA, not applicable; QI, quality improvement.

interactive microscopy, WebEx, YouTube (Google LLC), and Zoom (Zoom Video Communications, Inc). The majority of the respondents indicated that before the pandemic, they had no to a novice level of skill with all of the platforms except Skype and YouTube. Many of the respondents indicated that during the pandemic, they significantly increased their skill with institutional remote access, Skype, Twitter, USCAP interactive microscopy, WebEx, YouTube, and Zoom. These findings are summarized in Figure 1.

Quality of Remote Versus In-Person Educational Experiences

Respondents were asked to evaluate the quality of remote compared with in-person educational experiences. The respondents indicated that remote experiences were less effective for reviewing cases and generating reports but equal in quality to in-person experiences for morning and evening conferences, unknown-slide conferences, quizzes and case challenges, and literature review and discussion. Respondents rated remote experiences as superior for quality improvement and research projects (Figure 2).

Helpfulness of Educational Resources

Twenty-three resources were recommended to the users to explore during the COVID pandemic (Table 1), and respondents were asked to evaluate the level of helpfulness of these resources as 1, very helpful; 2, somewhat helpful; 3, not helpful; or 4, not applicable (because the respondent did not use the resource). The top most helpful resources were the USCAP interactive microscopy courses (rated as very helpful by 22 of 23 respondents; 96%), ExpertPath (19 of 23; 82%), the CAP virtual learning series (18 of 23; 78%), WHO Blue Books (16 of 23; 70%), American Society of Cytopathology webinars (14 of 23; 61%), institutional digital slide collection (12 of 23; 52%), the USCAP Juan Rosai collection (10 of 23; 43%), American Society of Clinical Pathology courses (9 of 23; 39%), and the ARUP Laboratories CME course (7 of 23; 30%) (Figure 3).

The top most helpful health and well-being activities were physical exercise (10 of 15 respondents; 67%) and COVID-19 town hall meetings (6 of 15; 40%) (Figure 4).

Responses to Open-Ended Survey Questions

The survey included 3 open-ended items for clinical fellows: (1) "Please share your comments on the changes in the learning environment since the COVID-19 pandemic," (2) "How would you recommend we improve the effectiveness of the program?" and (3) "Is there anything else you would like to add about the online learning experience?" The comments from the survey are summarized in Table 3.

DISCUSSION

The disruptive effect of the COVID-19 pandemic on medical education and training is evident in the increased publication of editorials and letters that express concerns about compromised medical education and a need for change.^{4,5} Here we describe our own response to ensure the continuity and high quality of pathology training during the COVID-19 pandemic. All components of a traditional training curriculum were transitioned to the hybrid curriculum, and trainees were able to continue training virtually without major interruption.

Methods of Communicating With Trainees

We observed that social media, such as Twitter and Facebook, was the preferred method for trainees to obtain updates and announcements regarding the lecture series and available resources. Social media reflects a new way to disseminate information, and our findings indicate the importance of training programs' becoming competent in the use of social media platforms. Early in the academic year, it may be helpful to identify a trainee who is active and proficient in social media. He or she may be given a leadership role—for example, social media director—with responsibility for keeping fellow trainees and program faculty members updated with academically relevant information.

Recommended Online Learning Tools and Resources

The majority of recommended online resources selected for the hybrid curriculum were from the leading professional organizations in pathology, including the USCAP, CAP, American Society of Cytopathology, and American Society of Clinical Pathology. These organizations have increased

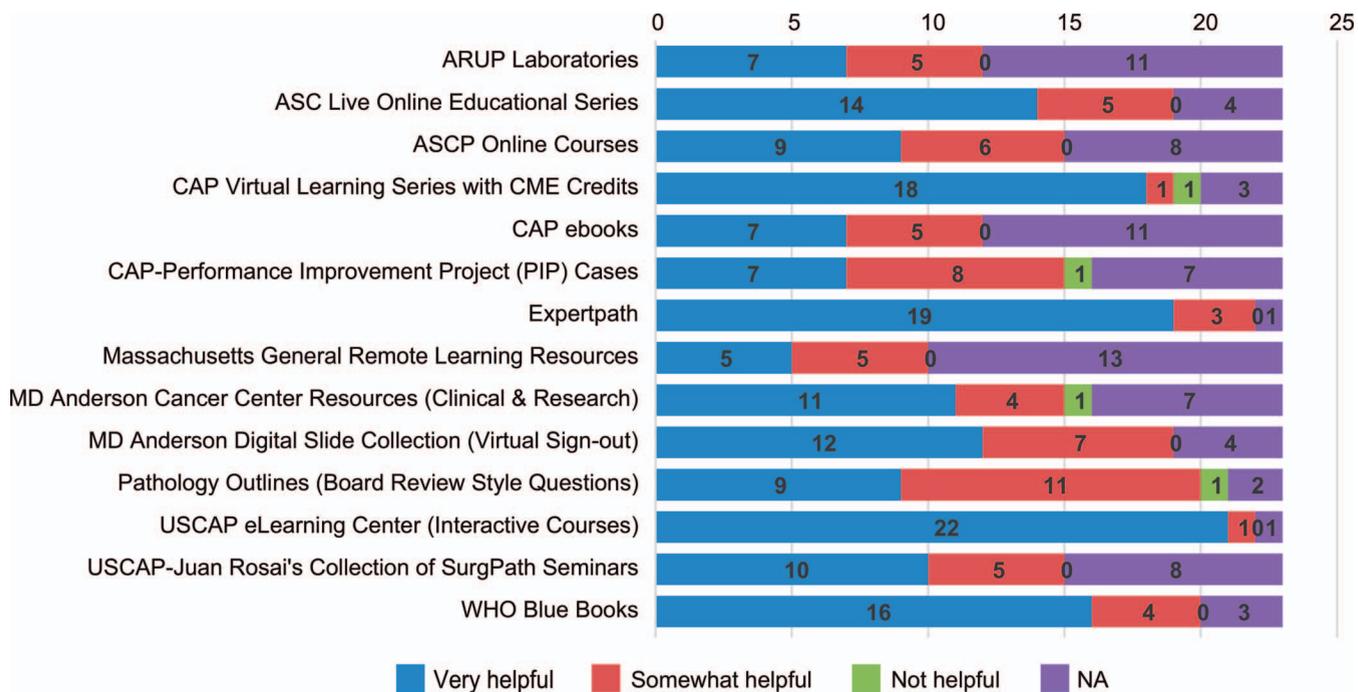


Figure 3. Helpfulness of the learning resources recommended to the anatomic pathology clinical fellows during the coronavirus disease 2019 pandemic. Abbreviations: ARUP, Associated Regional and University Pathologists; ASC, American Society of Cytopathology; ASCP, American Society for Clinical Pathology; CAP, College of American Pathologists; NA, not applicable; USCAP, United States and Canadian Academy of Pathology; WHO, World Health Organization.

the accessibility of their educational materials to trainees free of charge during the COVID-19 pandemic.

A very high percentage of trainees indicated that the USCAP interactive microscopy courses were very helpful. These live sessions, targeted for practicing pathologists, are presented by experts in the field and videotaped for viewers to watch at a later date. Each session alternates between microscopic slides, PowerPoint presentations, and interactive sessions with attendees. A CME certificate is provided upon completion of the course and the survey. This type of

presentation simulated the unknown-slide conferences to keep the viewers engaged. One big drawback of the USCAP interactive microscopy courses is the expense. Given the positive feedback from our trainees, it may be beneficial for organizations such as the USCAP to offer a discounted price for trainees or provide an institutional purchase option.

Other highly rated online resources included the CAP virtual learning series, American Society of Cytopathology webinars, and American Society of Clinical Pathology courses. These survey results further underscore the crucial

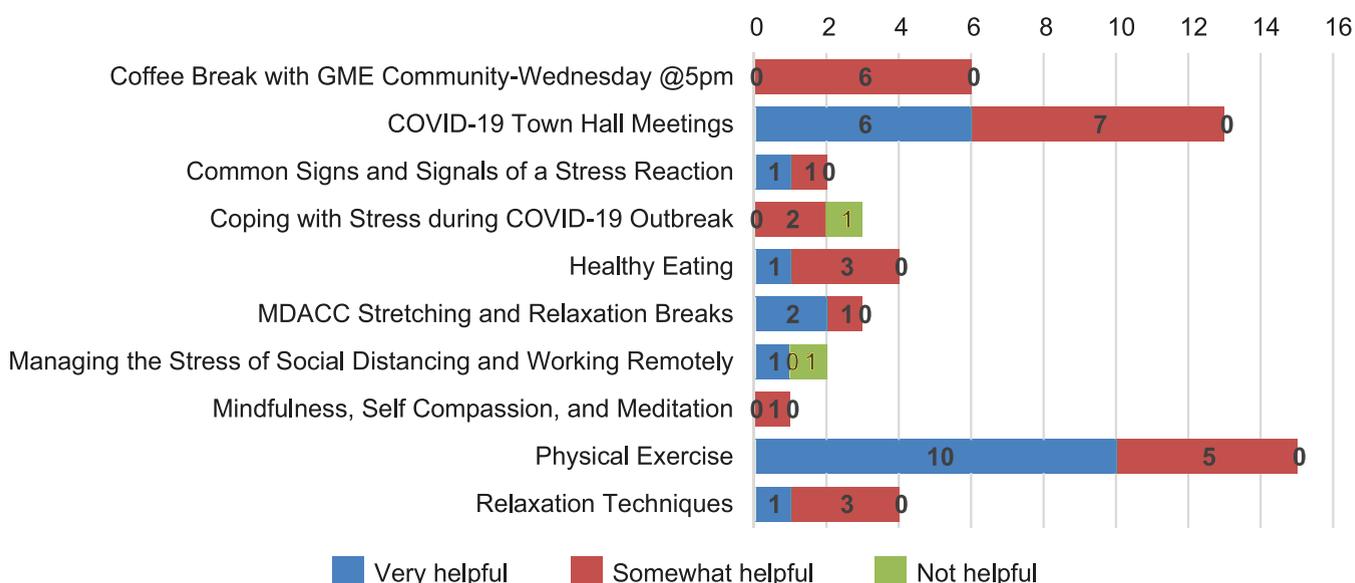


Figure 4. Quality of the health and well-being activities recommended to the anatomic pathology clinical fellows during the coronavirus disease 2019 (COVID-19) pandemic. Abbreviations: GME, graduate medical education; MDACC, MD Anderson Cancer Center.

Table 3. Summary of Survey Comments

Suggestions	Technical Issues
<ol style="list-style-type: none"> 1. Record MD Anderson didactic lectures 2. Put all resources in one location 3. The hybrid format gives fellows flexibility on training and educational activities 4. Get more free USCAP interactive microscope teaching courses 5. Give more slide sessions with faculty while on service 6. Protect morning WebEx lecture time from other duties 7. If space available, bring all fellows back 8. Set up subspecialty interest cases pool with scanned cases and set up a better digital viewing platform with higher resolution 9. Establish access to online WHO Blue Books 10. Keep and increase virtual interesting case conference, although the quality is not ideal 11. Having the virtual physical exercise is very important to keep people engaged 	<ol style="list-style-type: none"> 1. Problems with remote access to electronic pathology platform 2. Some respondents did not have a high-resolution screen at home 3. Challenges with learning different platforms

Abbreviations: USCAP, United States and Canadian Academy of Pathology; WHO, World Health Organization.

role that professional organizations play in pathology training and the need for these educational activities to continue beyond the pandemic era. Trainees should be encouraged early in their career to become members of professional organizations and become familiar with their available resources and benefits.

Of all the online digital resources we asked about, among the ones rated most helpful by trainees were ExpertPath and the online WHO Blue Books. Based on our experience during the COVID-19 pandemic, we recommend that academic pathology departments work closely with their institution's library to provide these resources for trainees. The institution may consider providing these resources in lieu of book funds that are traditionally allocated for trainees. The easy accessibility and real-time updated information in online resources such as ExpertPath and the WHO Blue Books set these apart from traditional textbooks, which require physical storage space and frequent purchases of updated editions. Although physical books cannot necessarily be replaced completely by online tools, providing online digital resources at the institution level is more cost-effective and pragmatic than individual purchase by the trainees.

Although didactic materials and lectures were appreciated by trainees, it is self-evident that these resources cannot replace review of slides. Trainees felt that our institution's collection of scanned digital slides and the USCAP Juan Rosai collection were very helpful in providing continuity of training and improving their diagnostic skills. At our institution, representative slides of all cases are scanned using Aperio digital scanners. The scanning allows quick access without the need to pull physical slides and allows permanent storage with preservation of slide quality. For training and education of pathology trainees, our department is making an effort to incorporate whole slide imaging as part of the daily operation to initiate an institutional study collection.

Videoconferencing as an Important Educational and Training Tool

Our institution mandated that no more than 5 people could be in the same room, and this policy precluded interactive sessions at which fellows gather around multi-headed microscopes for daily interesting-case conferences or morning didactics in our main conference room. A videoconferencing tool was the solution to overcome these physical limitations. As a department, we chose to deliver all videoconferences using Cisco WebEx, which is the video-

conferencing platform officially endorsed by our institution. WebEx served as an excellent "virtual room" where the fellows and the attending could meet to continue their clinical and scholarly activities.

Most of the morning didactic lectures were presented in the form of a presenter speaking while showing PowerPoint slides, and afternoon microscopic sessions, or digital pathology, were presented using an attached camera. The major advantage of WebEx was that trainees could join the conferences regardless of their location, which is helpful for those working remotely. In addition, easy accessibility allows efficient time management. Another great function of WebEx is the ability to record the conferences for permanent storage of the information. This opens up a possibility to expand the audience if the materials can be accessed by the alumni to obtain CME credits or shared with resource-poor institutions. For example, the University of Miami (Coral Gables, Florida) has shared their experience of "tele-education" and international partnership with Clinica Good Hope and Universidad Peruana Union in Lima, Peru.⁶ The applicability of videoconferencing tools is limitless and borderless, as long as the use is in line with institutional policy and complies with professional standards.

However, no technologies are foolproof. An important caveat is that the quality of videoconferencing is greatly dependent on the speed of the Internet connection. We found that the audio and video quality was compromised occasionally during high-traffic times, and, rarely, WebEx was not available in time to start a conference. Furthermore, in the initial phase of using WebEx, one of the biggest challenges was becoming familiar with the functionality and encouraging users to overcome their natural resistance to new technologies. Initially, users often forgot to mute or had difficulty connecting to the audio because of the default computer audio output setup. To resolve these technical issues, attendees were automatically muted upon entry, and several trainees volunteered to become "expert users" to provide technical support while they were on site on a rotating base. Fortunately, the unusual circumstance of the COVID-19 pandemic encouraged users to try new technologies and adapt to WebEx quickly. Without this type of unusual circumstance, adoption of virtual learning in the hybrid curriculum might have been met with resistance.

The major negative feedback received from the WebEx users during conferences was the lack of interaction. The presenters expressed initial discomfort in "talking to a computer screen" and disliked the minimal to no audience response. The presenters felt that their presentation was not

engaging and were concerned that their delivery method was not effective for learning. On the flip side, attendees felt uncomfortable speaking in the microphone because of the potential audio delay and occasional instances of multiple attendees unmuting their microphone and speaking simultaneously, which caused reverberation. For attendees, without the visual cues of their surroundings, it was difficult to know when to speak. Although the video function was available, the users felt that the simultaneous use of video and audio compromised the audio quality. To overcome this challenge, we encouraged use of the chat box to increase audience participation. Some fellows volunteered to be moderators and passed chat-box questions to the presenter for smoother presentation. One recommendation for increasing interaction is to use PollEv (Poll Everywhere), an online polling system that can be incorporated into a presentation. This was used successfully in one of the morning didactics, and the fellows responded positively. Similarly, some of the virtual applications allow visual alerts ("raising hand," "approve," "like") to convey such information to the presenter.

Several faculty members conducted live slide session through WebEx using a camera connected to a microscope (Olympus BX43). The effectiveness of slide conferences was highly dependent on the resolution of the camera connected to the microscope and the familiarity of the presenter with maneuvering slides in a visual-friendly way. The current resolution of the camera in our institution required the presenter to pause and focus the microscope for acuity and for the camera to adjust to the light source. Some faculty members chose to use scanned images to conduct unknown-slide conferences. One additional disadvantage of WebEx noted by the trainees was distraction from the surroundings in the shared office space.

Digital Review of Cases

Supplementing education using a videoconferencing tool did not prove to be a major problem; however, simulating the clinical training environment of reviewing live cases and generating reports was more challenging. As of March 26, 2020, the US Centers for Medicare & Medicaid Services⁷ ruled that "a temporary testing site may be the pathologist's home." This permission was paramount in promoting a digital pathology sign-out. For trainees and faculty members on site, some faculty members used WebEx to share the computer screen that showed the microscopic slide using the connected camera for reviewing live cases and generating pathology reports with fellows at the same time. This form of feedback was helpful because trainees can receive real-time feedback on morphologic features described by the attending pathologist. Some faculty members opted to use email or phone calls to give feedback on the cases previewed by the fellows.

For trainees and faculty members working remotely, all consultation slides are routinely scanned using Aperio/Leica scanners, allowing trainees to review the scanned digital images and work up the case in real time. Some trainees felt that virtual review of the slides was challenging, especially in cases with a high number of slides and those that required cytologic details. Although scanned images expanded the use of digital pathology, some trainees expressed that digital pathology was not an adequate substitute for review of physical slides and in-person sign-out.

In general, trainees felt that the remote experience did not alter the quality of didactic conferences. However, some of the trainees considered that overall sign-out and interactive microscopic sessions were inferior when conducted remotely. This may be resolved with better-resolution cameras and interfaces/platforms that are optimized for digital pathology.

Canvas and Google Classroom Can Be Innovative Platforms for Collaborative Efforts

Because trainees are working at different locations during the COVID-19 pandemic, lack of interaction may be viewed as a lost opportunity for collaborative work. Google Classroom and Canvas are 2 Web-based platforms to facilitate file sharing between teachers and students.⁸ Depending on the goals and needs, these 2 classroom platforms can be customized to create practice tests with study guides for board examinations for trainees. With the function of Quiz Statistics (Canvas) or Grade (Google Classroom), the faculty can follow up on the trainees' performance and thus develop individual plans to target a student's weakness as needed; Quiz Statistics and Grade provide objective quantitative criteria for the trainee's milestone evaluation. Beyond serving as learning platforms, Canvas and Google classroom can be used to create a course or orientation modules to welcome incoming trainees. An advantage of these platforms is that they allow enrollment of learners who do not yet have an institutional username and password. This can be particularly helpful for incoming fellows, who can gain early access to educational materials prior to their arrival on campus, which will free up more hours for hands-on time at our institution.

At our institution, Canvas has been used by the cytology section to teach procedures, such as punch or core biopsy, by providing videos that can be viewed by the trainees at any given time. Google Classroom was used by a subspecialty section to provide learning material and quizzes and also to connect incoming fellows to the current fellows.

The major advantage of the classroom platforms, as opposed to a simple videoconferencing platform, is the ability to track fellows' performance by checking their participation and the content of their submitted work. The biggest drawback of the classroom platforms was the need to learn new functionality and identify the most effective way to use the platform for pathology training. For instance, the participants in general felt that the level of effort required to learn Google Classroom and navigate the Web site was more than the benefits they received from these activities, taking away the joy and the intention of education. For this reason, it will be imperative in the future to choose simple and user-friendly platforms. To our knowledge, use of these platforms in pathology postgraduate education has not been explored widely or reported in the literature. Therefore, our use of these classroom platforms was an innovative exploration of a virtual learning environment as part of a pathology training curriculum.

Our hybrid curriculum provides trainees with a durable solution for effective and efficient learning, which is important as we predict that social distancing may become the new normal and remote work may be part of our long-term operation. Although the curriculum is designed specifically for anatomic pathology fellowship trainees, we believe that this curriculum can be modified and applied to other pathology fellowship and residency programs. We

hope that our experience will serve as a guide for curriculum development at other institutions in the future.

Current Status of Educational and Wellness Activity at Our Pathology Departments in Our Institution

As of July 15, 2020, we are gradually working back toward in-person sign-out, and departments of anatomical pathology and translational molecular pathology training programs are operating in the new normal of social distancing and use of digital pathology for sign-out and educational purposes. Our institution has revised its workplace distancing criteria to provide a consistent and thorough approach to occupancy, staffing, and social distancing criteria for clinical and research areas.

Our leaders worked with facilities management, health care systems engineering, and infection control to study areas and applied recommendations for what can physically be done with spaces while maintaining safe distancing. Furthermore, our facilities planning and construction team conducted room assessments throughout the hospital and installed room capacity signs on each door, limiting the number of occupants to allow 40 square feet (3.71 m²) per person in each room, including break rooms and other spaces that typically have more than one person at a given time. Floor decals were installed in several locations to help remind employees and patients to keep the proper distance.

At the start of the academic year (July 1), new fellows were assigned additional offices to reduce the number of occupants in each room. For example, a room that was equipped to accommodate 15 fellows before the pandemic is now limited to 12 fellows; another room that accommodated 10 fellows is now limited to 8. As such, the total number of fellows' offices/workstations has increased from 4 to 7; the offices are located on floors 1 and 3, still accessible to sign-out rooms and faculty offices. Moreover, our institution has already permanently integrated working remotely into its business operations.

Regarding learning, online platforms are common at institutions of higher education, and will likely be more common as a result of this pandemic. As our case volumes continue to increase, faculty and fellows are required to maintain working hours similar to those prepandemic. As such, the hybrid curriculum is not a long-term solution, because it was used primarily to provide continuity to education when a stay-at-home order was in place. On the other hand, the course of the pandemic is still uncertain, and, should stay-at-home orders be mandated in the future, our current experience will allow easy and immediate implementation of this curriculum so trainee education will not be interrupted or compromised.

However, this survey has helped us to identify problems and solutions to improve our digital process. Digital pathology has become a permanent part of our department operations, with a short-term goal of scanning all clinical slides. The fellows have access to all scanned cases in the department, through the integrated imaging software in our laboratory system, for review at work or at home to further supplement their training. Currently, we have 4 high-speed scanners and have purchased 4 more. Simultaneously, our department is developing a business to proceed to fully digital sign-out. Along with whole slide scanning, a sign-out station is also an important component of digital pathology. In July, all fellows were provided a brand-new laptop with VPN remote access along with a docking station

and big monitor to facilitate dual computer monitors at home.

MD Anderson Cancer Center also provides resources for the anticipated needs of the departments and training programs. For example, our academic analytics technology team supports all departments in designing courses and placing them on a digital platform. The simulation center develops and supports innovative, state-of-the-art education, training, and competency validation to enhance patient care and safety. The education design and instruction office provides instructional design services, educational products, and education technology resources that support online, flipped, blended, and classroom learning modalities. Tech support is provided 24-7 by 4info to help with any type of computer issue. As such, our pathology department is able to integrate our needs with the resources that are available through the institution, and we have ongoing conversations with persons who manage the learning management systems (such as Study@mdanderson [Canvas]). Our laboratory information systems team provides technical support dedicated to the division of pathology and laboratory medicine.

With the development of techniques, the remote interaction through high-technology equipment will gradually reach the effect of traditional face-to-face interaction. During this transition time, we are providing a combination of in-person sign-out with glass or digital slides.

The goals and objectives of the study were primarily to determine whether the immediate needs of the pathology trainees were met during a crisis without losing the integrity of the training program, and to share our findings with other colleagues during the course of the pandemic. We are continuing to fine-tune the curriculum as well as its implementation to include the new fellows who started on July 1. We will survey those fellows who have left the program to see whether they have experienced any gap in their training, and that information will be included in a separate follow-up study.

Regarding wellness and fitness, before the pandemic, each fellow received 16 hours of wellness leave (taken in increments of 2-4 hours) per academic year for any self-care needs. MD Anderson has several programs available to help employees manage the demands of the workplace and personal responsibilities, to improve the quality of work-life balance and job performance, and to reduce stress (Supplemental Table 3). The hour of protected time consists of a mixture of didactic lectures and other activities that are embedded in the standard curriculum. Before the pandemic, this included chair yoga, stretching, meditation practice, fatigue and stress management, and maintaining proper nutrition. Currently we encourage fellows to monitor their activity level and take periodic breaks from their seats to increase physical activity. Stretching and chair yoga exercise videos are available online to help them continue their daily exercise/activity.

This current hybrid curriculum has been seamlessly incorporated into the educational enterprise of our departments. It appears on the monthly schedule as "wellness," with at least 2 mandatory hours per month in the 8-to-5 schedule, which give fellows the freedom to choose any activity of their choice. Employees have access to a large collection of soft-skill courses offered through the University of Texas system. In addition, scholarly activities (ie, quality improvement and research projects) are designated hybrid/remote learning activities.

CONCLUSIONS

The unprecedented COVID-19 pandemic provided us with an opportunity to explore virtual learning environments and motivated us to create the hybrid curriculum. Implementation of the hybrid curriculum required coordination, technical support, and a strong willingness to adapt alternative methods. To ensure successful implementation of the hybrid curriculum, high-quality cameras and high-speed Internet with good connectivity are required. Virtual learning has become an important component of medical education, and it will become necessary for pathology departments to embrace new technologies and social media platforms. The hybrid curriculum was an innovative way to maximize learning opportunities while maintaining social distancing in the COVID-19 pandemic era. This was the first step to embrace virtual learning in postgraduate education in pathology training and warrants further exploration and development in response to changes in the landscape of pathology education.

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