Assessing the Impact of the COVID-19 Pandemic on Training at the MD Anderson Cancer Center Anatomical Pathology Fellowship Program

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The COVID-19 pandemic continues to have profound impacts on society. As COVID-19 cases rose in the early stage of the pandemic in 2020, residency and fellowship programs that relied on in-person training struggled to find ways to continue providing high-quality education while at the same time maintaining everyone’s safety.1–4 Among these programs were pathology programs, in which training has been historically based on one-on-one sign-out sessions between trainees and attending physicians.

To provide high-quality and safe training during the peak of the pandemic, the anatomic pathology fellowship program at our institution (MD Anderson Cancer Center [MDACC], Houston, Texas) developed and implemented a hybrid virtual and in-person training model5 on March 25, 2020. To adhere to mandatory social distancing guidelines, fellows alternated weekly between working on-site and working remotely, which resulted in a 50% reduction in fellows working on-site at any given time. Remotely, fellows used various online resources and platforms to conduct patient care, research, and other educational activities. Through the advancement of digital technology, fellows could review “live” cases and virtually sign out in real time with attending pathologists from various remote locations. Conferences and teaching sessions were held via online platforms. Additionally, fellows earned continuing medical education credits by completing various interactive microscopy courses provided by national and international medical societies. The social distance guideline gradually relaxed with the introduction of the COVID-19 vaccines and boosters. The fellowship program resumed in-person training at 100% capacity. However, the program continues to offer digital and virtual educational activities as alternative and supplementary resources.

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During the period immediately after implementation of the hybrid model, a survey was distributed to the fellows. Based on this survey, the model seemed well received, with some limitations noted.\(^5\) In the study reported here, we aimed to further assess the impact of this hybrid model on training and education by analyzing the Accreditation Council for Graduate Medical Education (ACGME) survey results and board examination passing rates for fellows prior to, during, and after the peak pandemic period. Furthermore, we created and distributed a survey to solicit opinions on the training model from graduates from these same years.

**MATERIALS AND METHODS**

**ACGME Surveys**

ACGME surveys are distributed yearly by the ACGME to participants in accredited education programs, and the survey results are made available to the programs. The surveys provide an avenue for collecting anonymous feedback, and their main purpose is to assure that programs adhere to accreditation requirements. Programs not reaching a predetermined response threshold are flagged as noncompliant, with possible further actions/interventions.\(^6\) Questions are grouped into the following general categories: overall impression of the program, resources, professionalism, patient safety and teamwork, faculty teaching and supervision, evaluation, educational content, diversity and inclusion, and clinical experience and education. ACGME surveys were examined for the following academic years: 2018–2019 (before the pandemic), 2019–2020 (encompassing the pandemic peak, defined for this study as March through December 2020), and 2020–2021 and 2021–2022 (early and late following the pandemic peak).

**Board Examination Pass Rate**

We also examined whether the board examination pass rates for fellows in subspecialties requiring board examinations differed by training year.

**Online Survey Design**

In collaboration with our Office of Institutional Research, we created an institutional review board–approved survey. This survey contained questions for fellows regarding demographics, overall impression of the fellowship program, how well prepared they felt for their jobs as attending physicians, how confident they were in their jobs as attending physicians, and their fellowship experience. The survey was distributed via email and was open from August 30, 2022, through September 20, 2022. All the questions on the survey were distributed with appropriate sliding scales.

The peak of the COVID-19 pandemic and the accompanying restrictions affected predominantly the 2019–2020 academic year. This is also when the hybrid virtual and in-person training model was fully implemented (March 25, 2020). Thus, survey participants were grouped according to academic year(s) attended as follows (Figure 1): Group 1 (training before the pandemic): 2017–2018 only; 2017–2018 and 2018–2019; 2018–2019 only. Group 2 (training before the pandemic and during the pandemic peak): 2018–2019 and 2019–2020, 2019–2020 only, and 2019–2020 and 2020–2021. Group 3 (training in the early postpeak period): 2020–2021 only, 2020–2021 and 2021–2022. Group 4 (training in the late postpeak period): 2021–2022 only.

Please note that some trainees had completed 2 years of fellowship at our institution, explaining the overlap of academic years across different groups (Figure 1). Group 1 serves as a baseline of education for comparative analysis. Group 2 was most affected by the pandemic, as this group transitioned into the hybrid training model firsthand. As such, group 2 was provided with 2 sets of questions (prior to the pandemic and during the pandemic peak, when the hybrid model was implemented). Groups 3 and 4 transitioned out of the hybrid training model back into predominantly in-person education and experienced the easing of COVID-19–related restrictions. In addition to the sliding-scale questions, participants in group 2 were invited to answer a free-response question regarding additional thoughts about the hybrid training model. Finally, participants in group 4 were not asked questions about performance as attending, as fellows in this group may have been in the process of completing a second fellowship during the period when the survey was distributed.

**Statistical Analysis**

Online survey questions with sliding scales from 0 to 5 were grouped as follows: 0 to 1 = lowest group; 2 to 4 = middle group; 5 = highest group. Those with sliding scales from 0 to 10 were categorized as follows: 0 to 2 = lowest group; 3 to 7 = middle group; 8 to 10 = highest group. Associations between each question and group were evaluated using generalizations of the Fisher exact test. Groups 3 and 4 (the groups who trained after the pandemic peak) were grouped together for this analysis. As group 2 had experience of both prepandemic training and training during the height of the pandemic, prepandemic and pandemic-peak results for group 2 were compared using the Bowker exact symmetry test.

**RESULTS**

**ACGME Surveys**

The 2018–2019, 2019–2020, and 2020–2021 and 2021–2022 ACGME survey groups each had a response rate of greater than 90%. Most of the respondents in each group had a very positive overall opinion of the program and indicated that they would definitely or probably choose the program again. No differences regarding impressions of the...
program were seen between the prepandemic and pandemic-affected groups.

The following question categories of the ACGME survey were the ones most negatively affected during the pandemic-peak academic year, as assessed by percentage compliance with the program: faculty teaching and supervision, clinical experience and education, and patient safety and teamwork (Figure 2, A through C). Diving deeper into the specific questions from each category, the questions with the greatest score declines were the ones related to appropriate level of supervision and teaching by faculty, having 4 or more free days (defined as a day free of clinical work or required education) in a 28-day period, and information not lost during shift changes or the handover process (Table 1). Scores declined between the prepandemic period and the pandemic-peak academic year (2019–2020) and then recovered slightly, but not to the level of the prepandemic years (Table 1).

**DISCUSSION**

In this study, we found that responses to the ACGME survey and ours, as well as the board examination passing rates, indicated a maintained level of quality of the program.
education provided by the MDACC anatomic pathology fellowships during the pandemic peak and later when compared with prepandemic standards.

Group 1 had the lowest response rate to our online survey (14 of 45; 31%). Although group 1 had a lower response rate compared with the other groups (which can be explained by the difficulty of engaging participants in surveys, especially when the event being surveyed occurred in the relatively distant past), we believe that the high response rate in group 2 (which was the group most affected by the implementation of the hybrid training model, but that also had experience in training before the pandemic) allows an accurate comparison of prepandemic versus during and postpeak COVID-19 pandemic training.

Although the findings of this study indicate a robust response of the anatomic pathology fellowships to the limitations set forth by the COVID-19 pandemic related restrictions, certain issues were identified that can inform future implementation of the model, if required.

Decreased Case Volume During the Pandemic

One of the major challenges experienced during the peak COVID-19 pandemic was a decrease in case volume as a consequence of delaying or canceling elective and nonurgent procedures. This was brought up as an issue in a free-text response from a participant in group 2 (Table 2), and potentially was 1 factor contributing to the negative responses seen in groups affected by the pandemic. However, this was a nationwide issue, not specific to the

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**Table 1. Specific Questions From Each Category of the ACGME Surveys Showing the Greatest Score Declines During the Peak Pandemic Year (2019–2020)**

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<tbody>
<tr>
<td>Faculty teaching and supervision</td>
<td></td>
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</tr>
<tr>
<td>Appropriate level of supervision</td>
<td>4.9</td>
<td>3.3</td>
<td>3.9</td>
<td>3.8</td>
</tr>
<tr>
<td>Appropriate amount of teaching in all clinical and didactic activities</td>
<td>4.6</td>
<td>3.3</td>
<td>3.5</td>
<td>4</td>
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<tr>
<td>Clinical experience and education</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Four or more days free in 28-day period</td>
<td>4.9</td>
<td>3.9</td>
<td>4.3</td>
<td>3.7</td>
</tr>
<tr>
<td>Patient safety and teamwork</td>
<td></td>
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<tr>
<td>Information not lost during shift changes or the handover process</td>
<td>4.9</td>
<td>4.3</td>
<td>4.7</td>
<td>4.8</td>
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Abbreviation: ACGME = Accreditation Council for Graduate Medical Education.

*For the questions in the table, respondents expressed their degree of agreement with the statements on a scale ranging from 0 (completely disagree) to 5 (completely agree).*

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**Figure 3.** Summary of online survey results for the question categories showing relative improvement (Benefits) (A) and relative decline (Drawbacks) (B) in the COVID-19 pandemic–affected groups. Associations between each question and group were evaluated using generalizations of the Fisher exact test, with the P value shown above.
...there were fewer opportunities to review slides. Availability of virtual study set may be helpful, or access to see live cases from other services

I would appreciate all PowerPoint presentations from virtual lectures

Make sure that the scanned slides (pre-sign-out) will be available early during the day

I was able to catch up with my research projects and spend time with my family. I think it is more efficient to host some of the conferences or tumor boards in Zoom

The lack of the usual/large volume of cases and sign-out at the microscope was a huge educational loss during the pandemic

Limitations of home personal computer screen size and internet speed did hamper the interaction and detract from learning

The emphasis on Zoom talks made the lectures widely and readily available

Hybrid education was a necessity. It does not substitute [for] in-person training, and if given the choice, in-person training is preferred

It worked out, but I did feel decreased exposure to cases being evaluated on-site

The anatomical pathology fellowship program has done an excellent job and there is no potential improvement I can think of

Some attendings took advantage of the pandemic by using it as an excuse to not sign out with the fellows. Gratefully, those attendings were the minority

During my time at MDACC, the pandemic was just starting, and the full extent of supplemental educational opportunities were not made available yet at that time

Abbreviations: attendings, physicians; MDACC, MD Anderson Cancer Center.

pathology fellowships at MDACC. Although virtual options can supplement reviewing slides and other educational activities, the actual processing of specimens for intraoperative assessments or grossing currently is best appreciated via in-person interactions. This is 1 of the major issues that will also affect similar programs in the future, should need for their implementation arise again.

Integration of Digital Pathology

Even before the pandemic, digital pathology was a rapidly expanding field. Our institution was already implementing digital pathology, and many of the slides from cases were available in a virtual format. Briefly, glass slides were scanned using a Leica Aperio AT2 scanner (Leica Biosystems, Buffalo Grove, Illinois) at ×20 magnification (0.25 μm/pixel). The fellows and attending physicians accessed the whole slide image with Leica Aperio ImageScope viewing software (Leica Biosystems) on consumer-grade 24-inch dual monitors with 1920 × 1080 native resolution (1080 p) connected to computers provided by the institution on-site. The fellows were also able to access the images from institution-provided laptops or their own personal computers remotely (the details of the platform used are further discussed in our previous study). We recognize that such a service may not be readily available in many other institutions, and we acknowledge that the availability of these resources allowed our institution to implement the hybrid model more smoothly. These digital services were expanded during the pandemic, when virtually scanned slides were increasingly used in the context of the hybrid model to allow fellows to review cases from their homes.

Despite these advances and initiatives, several limitations became evident. During the period immediately after implementation of the hybrid training model, fellows indicated that it was difficult to review cases associated with a large number of slides. In the study reported here, limitations related to personal technical equipment at home (computer screen size, internet speed) were identified as an issue; these have also been noted in other, similar studies. Advances in computer hardware and software technology will hopefully make reviewing virtual slides more fluid and similar to the experience of looking at a physical slide. Provision of high-quality screens/laptops to the fellows for use at home could also be beneficial.

Virtual Faculty Teaching and Supervision

In addition to providing digital slides, one-on-one virtual sign-out sessions with attending physicians were an attempt to recapitulate the immediate feedback of in-person interactions critical to pathology and other fields of clinical education. However, pandemic-affected groups reported less-positive views on teaching and supervision by attending physicians because of the supplemental material and digital pathology. A free-text respondent commented that a minority of attending physicians may have used the pandemic as a reason to avoid signing out cases with fellows. This could be due to the unfamiliarity with the technologies and perceived cumbersome online interactions in the beginning of the hybrid model for both attending physicians and the trainees. Furthermore, 1 respondent wrote: “Hybrid education was a necessity. [But] it does not substitute for in-person training.” Increased familiarity with digital meeting solutions will undoubtedly improve the teaching value of virtual sign-out sessions and will hopefully lead to increased adoption of virtual sign-out sessions between fellows and attending physicians. This is evidenced by increased positive views on the use of digital pathology in groups 3 and 4, at which time the virtual option had been widely accepted as a familiar platform. Overall, whether virtual or in person, in anatomic pathology fellowships, one-on-one interaction with teacher and trainee remains crucial.

Virtual attendance options for conferences, presentations, and lectures proved indispensable during the pandemic, as these allowed for the safe participation and continuation of these meetings. Several studies have raised the issues of space limitations and distractions at home because of the presence of other family members and lack of private space as impediments to participation in online pathology education curricula, and actual engagement with the virtual curriculum in this context (eg, participation in conferences) is difficult to measure. In our study, the pandemic-affected fellows did not report any more negative impact of family-related accommodations compared with the other groups, nor were these issues brought up in any of the free-text responses.

Resources and Educational Content

Online supplemental teaching material was available prior to the pandemic. During the pandemic, the volume of online supplemental teaching material increased exponentially, as
many professional societies made resources available to supplement teaching at programs impacted by restrictions.² The perceived utility of online supplemental material was higher in the pandemic-affected groups than in the group that trained before the pandemic. Furthermore, the pandemic-affected groups were more likely than the prepandemic group to report that online supplemental material increased their familiarity with digital pathology. In group 2 in particular (the group experiencing the peak of the pandemic and the implementation of the hybrid program, but also having experience with training prior to the pandemic), there was a significant increase in familiarity because of the supplemental material postimplementation compared with prepandemic. These findings are consistent with the more widespread availability and necessity of online supplemental resources during the pandemic. The fact that views regarding supplemental material were more positive in combined groups 3 and 4 (training after the pandemic peak) compared with group 2 could possibly indicate an improved integration of this material into the curriculum as time passed. However, as some respondents indicated negative effects of the material on the quality of education, the positive views in groups 3 and 4 could be more a reflection of the gradual return to in-person education rather than the material per se, something that was also indicated by free-text responses characterizing the virtual model as a necessity.

Study sets provide an indispensable educational opportunity for pathology trainees. These allow for review of educational cases at a personal pace and time, as well as the distribution of cases for unknown-slide sessions. Advances in digital pathology have facilitated digitization of these study sets, increasing their availability. During the pandemic, case volume decreased in many tertiary centers, particularly with discouragement of elective surgeries. In response to the decreased volume of cases, virtual study sets were an important alternative to compensate for the lack of exposure and prevent educational loss. Many institutions have online, free-access study sets,² and institutions such as the College of American Pathologists distribute virtual slides in addition to physical slides in the context of performance-improvement initiatives. Feedback from the pandemic-affected groups in our current study supports the notion that digitized study sets are valuable to training programs.

Patient Safety and Team Work

Structured case handoff is mandated by the ACGME and helps ensure that information critical to patient care is not lost during the transition of services. When people are not physically present in the same place, as occurred during the pandemic, this transition is dependent on virtual means. The decrease in compliance in this category on the ACGME survey highlights the need for structured handoff procedures in times when communication is hampered by physical distance. Checklists may prove indispensable in this aspect, and are used in many clinical scenarios.¹⁵

Wellness

Wellness has been a focus of the ACGME in recent years, and was a critical issue during the COVID-19 pandemic.⁹,¹⁶,¹⁷ To reduce the risk of burnout among trainees, ACGME surveys specifically ask about the amount of free time fellows have during the period of a month. A worrisome trend was observed in this study, in which survey responses showed that the proportion of fellows reporting that they had 4 or more free days per month was lower in the pandemic-affected groups than in the prepandemic group. Although the hybrid model included structured wellness activities and there were no differences in perceptions of physical and emotional wellness between the prepandemic and pandemic-affected graduates, it is clear that fellows were not receiving the mandated protected time. Contributory to this may also be the realization that many times when one is working from home, the lines between work and personal life may become blurred, with the net result of increased time spent working, even past the usual working hours.¹¹,¹⁷ One unique aspect of pathology training is the tremendous amount of educational component built into the clinical duty. It is unclear if reading and researching about an entity or a case had been accounted for as clinical duty hours, further aggravating the perception of increased work hours at home. On the other hand, 1 of the free-text respondents expressed appreciation of being able to spend time with family. This is similar to what has been previously reported as an advantage of virtual education models,¹¹ highlighting a potential positive aspect of the virtual model regarding wellness.

Overall Impression of the Program and Preparedness for Independent Practice

Fellowship programs ultimately have the task of providing trainees with the knowledge and resources needed to function as attending physicians. No differences were seen between groups in the questions relating to how prepared the fellows felt for their role as attending physicians or their overall confidence as attending physicians. Additionally, the data indicated that all groups had a positive overall perception of the fellowship, indicating that this was seemingly unaffected by the COVID-19 pandemic and the implementation of the hybrid training model. On this subjective level, it seems that the hybrid model was at least as effective as traditional in-person training. A more in-depth way of evaluating the success of a fellowship program would be to examine the results of standardized tests, namely the results of board examinations. Not all fellowships require these. However, the board passing rates for specialties requiring board examinations were unchanged throughout the course of the COVID-19 pandemic and the implementation of the hybrid training, further supporting its effectiveness and in line with similar studies examining virtual education and its impact on standardized tests.¹¹,¹³,¹⁸

CONCLUSIONS

Taken together, our findings reported here reveal a positive perception by the participants and support the effectiveness of the hybrid virtual and in-person anatomic pathology fellowship training model that was implemented during COVID-19. However, whether these positive findings were the result of a truly effective program or secondary to an understanding that this was to be a temporary solution to the pandemic is unknown. Careful examination of the findings of this and similar studies¹¹,¹³,¹⁸ can identify areas of improvement for potential future implementations of similar programs or be informative for meaningful integration of digital pathology into training curricula.

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