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Financial and educational impact of the COVID-19 pandemic in an academic hospital-based tertiary cytopathology practice

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KEYWORDS

Covid-19;
Coronavirus;
Cytology;
Economic recovery;
Educational;
Academic

Background The ongoing COVID-19 pandemic has led to a dramatic shift in volumes and practice patterns for hospitals around the globe. We analyzed its effect on the cytopathology subspecialty practice and resident education at our institution.

Design Specimen volumes were analyzed for the cytology practice for 2019 and 2020. Patient registration and elective and scheduled surgery volumes were also included in the analysis for 2020. The impact of innovative concepts, such as virtual teaching, on resident teaching was evaluated using a survey consisting of 5 multiple choice questions with 4 possible responses each.

Results The total number of specimens decreased by 28% in March 2020 ($P < 0.00001$), with a continuing decline in April (66% decrease year-over-year, $P < 0.00001$), followed by recovery in May and return to baseline within June 2020. Specimen volumes continued to show an upward trend thereafter. Improved specimen volumes correlated with patient registration and surgical volumes. The majority of residents considered virtual teaching conferences (75%) and self-study sets (58%) as beneficial and did not view absence of one-on-one microscope learning (58%) as significantly affecting their education.

Conclusion The recovery curve for our cytopathology service was V-shaped, essentially the most ideal response to an economic downturn. The majority of residents viewed virtual teaching conferences and self-study sets favorably and did not regard absence of one-on-one microscope learning as adversely affecting their education.

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Introduction

The novel coronavirus SARS-CoV-2 is responsible for the COVID-19 pandemic: A respiratory-borne illness, which began in Wuhan, China, in 2019 and has since spread across the globe.¹ Easy transmission via respiratory droplets led to a dangerous and deadly spread of the virus, causing countries and institutions around the world to scramble for mitigation measures. Rapidly escalating cases worldwide and in the United States impacted the varied measures taken by governments, health care systems, and academic institutions to deal with unprecedented circumstances. Since the inception of the COVID-19 predicament, an average of 55% decrease in revenue and 60% decrease in patient volume has been reported by medical practices.² The dramatic shift in pathology specimen volumes as a result of the pandemic has affected pathology practices and training of pathology residents and fellows.³⁻⁶

The primary measures in addition to hand sanitization and mask wearing was the institution of “social-distancing” guidelines. The exact social distancing guidelines varied from state to state and country to country, but in essence led to cancellation of any large gatherings affecting travel, restaurants, sporting events, and so forth. Health care institutions had to make drastic changes as well, including cancelation of all elective procedures, restrictions on visitors, travel restrictions for staff, and daily temperature checks. This also included canceling all indoor gatherings including conferences, multidisciplinary tumor boards, lectures, one-on-one sign-out at the microscope, and so on. Overnight, most residency and fellowship programs had to determine alternatives that would keep everyone safe but also allow education and patient care to proceed in the best possible way. Continuing conferences in our cytopathology division evolved with using teleconferencing tools such as Zoom (Zoom Video Communications, Inc, San Jose, CA), WebEx (Cisco WebEx, Milpitas, CA), and Microsoft Teams (Microsoft Corporation, Redmond, WA). To limit one-on-one teaching at the microscope, we moved to sequential preview of slides, as well as microscope cameras and projection to another screen during sign-out. Overall case volumes also decreased and, to compensate for that, we introduced mini teaching sets, which could be reviewed by trainees at their own pace, followed by informal feedback later.

To the best of our knowledge, there has been no published literature exclusively focusing on the educational and financial impact of the COVID-19 pandemic in an academic hospital-based tertiary cytopathology practice. The aim of our study was to summarize our experience at a hospital-based academic cytopathology practice that was affected by the COVID-19 pandemic.

Methods

An exempt status was obtained from the hospital’s institutional review board.

To assess the financial impact of the pandemic, overall specimen volume and revenue generated was analyzed for the cytology practice for financial years 2019 and 2020. Variables such as patient population, intake area, and financial accounts were included in the analysis when comparing years 2019 and 2020. The data were divided into monthly segments further subdivided into gynecologic cytology specimens, nongynecologic cytology, and fine-needle aspirate (FNA) specimens. Institutional, state, and national guidelines were incorporated into the study as well as stimulus strategies to ease the effect of the pandemic.

We also collected data on patient registrations as well as elective and non-elective surgical procedure scheduling at our institution and affiliated hospitals to better understand the correlation of hospital policies with our tertiary cytopathology specimen volume. These data were obtained from an institutional request to the cost manager and the chief financial officer of the hospital. This data was a part of their routine data-gathering efforts and did not involve access to any protected health information.

To assess the impact of novel concepts affecting resident and fellow education, such as virtual teaching, compliance with social distancing, and institutional/state/national guidelines on resident teaching, a voluntary anonymous survey questionnaire was sent to all Accreditation Council for Graduate Medical Education (ACGME) pathology residents and fellows at our institution via Google Forms ($n = 16$). The questionnaire (Fig. 1) was composed of 5 single-best-answer questions and 1 graded question with 5 components, to better understand the impact of the changes due to the pandemic. The 5 single-best-answer questions included in the survey inquired about “impact on education” of: 1) Zoom-based didactics, 2) decreased FNA procedure attendance, 3) decreased one-on-one microscope learning, 4) introduction of self-study cytology unknown case sets, and 5) lower daily sign-out volume. One question with 5-graded responses inquired about contribution of various factors on resident education as shown in the attached survey. We also reviewed our program’s cumulative resident in-service exam (RISE) scores in cytopathology section for the years 2019, 2020, and 2021 to assess the impact of implementation of changes during the pandemic on resident education via a more objective metric. All statistical analyses were performed using the χ^2 test and P value < 0.05 was considered statistically significant.

Results

Financial impact and recovery

Overall specimen volume

The overall cytopathology specimen volume (Fig. 2A) decreased 28% in March 2020 compared with March 2019 ($P < 0.00001$), with a continuing decline in April (66% decrease year-over-year [YoY], $P < 0.00001$). Patient

volume began recovering in May 2020 and returned to baseline within the month of June 2020. Annual cytopathology practice volumes for financial year 2020 decreased by 5.22%, with FNA subspecialty volumes decreasing by as high as 23.56%; compared with 2019. The gross revenue for year 2020 was 17% lower compared with 2019. A stimulus measure provided by the Coronavirus Aid, Relief, and Economic Security (CARES) Act 2020 helped to offset an additional 2% of economic loss, bringing the net revenue decrease for year 2020 to 15%. Based on the specimen volume in June 2020, the projected annual volume deficit for the practice was -22.33% ; however, the actual YoY volume deficit for financial year 2020 was -5.22% .

Gynecologic specimens

The subdivided specimen populations showed a similar pattern with a few notable differences. The gynecologic specimens (Fig. 2B) showed a decline in March through April, with recovery by June 2020. However, the YoY specimen volume actually increased by 10.02% (projected increase of 4.97%) despite the effect of the COVID-19 pandemic.

Nongynecologic specimens

The non-gynecologic specimens (Fig. 2C) showed a similar downward trend, and recovery trend, although the volume was consistently lower from June (point of maximum recovery) through December 2020, compared with similar duration in 2019. The YoY specimen volume decrease was 21.46%.

FNA specimens

FNA specimens (Fig. 2D) showed a decline similar to the other specimen subdivisions, although differed in recovery. FNA specimens showed a delayed recovery with return to baseline in July 2020 compared with June 2020 for the remaining services; and lower specimen volumes for the remainder of financial year 2020 compared with the same period in 2019. The final YoY volume decrease was the most of all services at 23.56%.

Impact of the tertiary hospital setting

To study the impact of operating within a tertiary hospital, we analyzed total monthly patient registrations, scheduled and elective surgery volumes for adults, pediatric age groups, outpatient procedures, and interventional radiology-based procedures (only cumulative data shown; Figs. 3A, B).

All-cause patient registrations (Fig. 3A) showed a similar trend to overall cytopathology specimen volume with a few notable differences. Hospital patient registrations started declining in February 2020, prior to institution of strict lockdowns and hospital visitor restrictions (March 2020); and thus preceded the decline in overall cytopathology specimen volume decline by one month. The patient registrations also showed a likely compensatory increase in

Effect of COVID-19 on Cytopathology Education
Please answer these specifically in relation to impact on your training in cytopathology

* Required

Zoom-based didactics *

Better pre-COVID
 No change
 Better post-COVID

Decrease in FNA procedures attended *

Better pre-COVID
 No change
 Better post-COVID
 N/A

Decrease in one-on-one scope learning due to social distancing guidelines *

Helped my education
 No change
 Harmful

Self-study cytology unknown case sets *

Helped my education
 No change
 Harmful
 N/A

Lower daily volume of cases at sign-out *

Helped my education
 No change
 Harmful
 N/A

Contribution to learning *

	Poor	Fair	Satisfactory	Very good	Excellent	N/A
Level of skill/knowledge from surgical pathology rotations prior to starting cytology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Previewing cases with fellow	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sign-out with attending	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Self-assessment quiz/modules	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
On-site assessment/procedure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Submit

Figure 1 Resident survey questionnaire.

October to December 2020, which does not reflect a similar change in the cytopathology specimen volume.

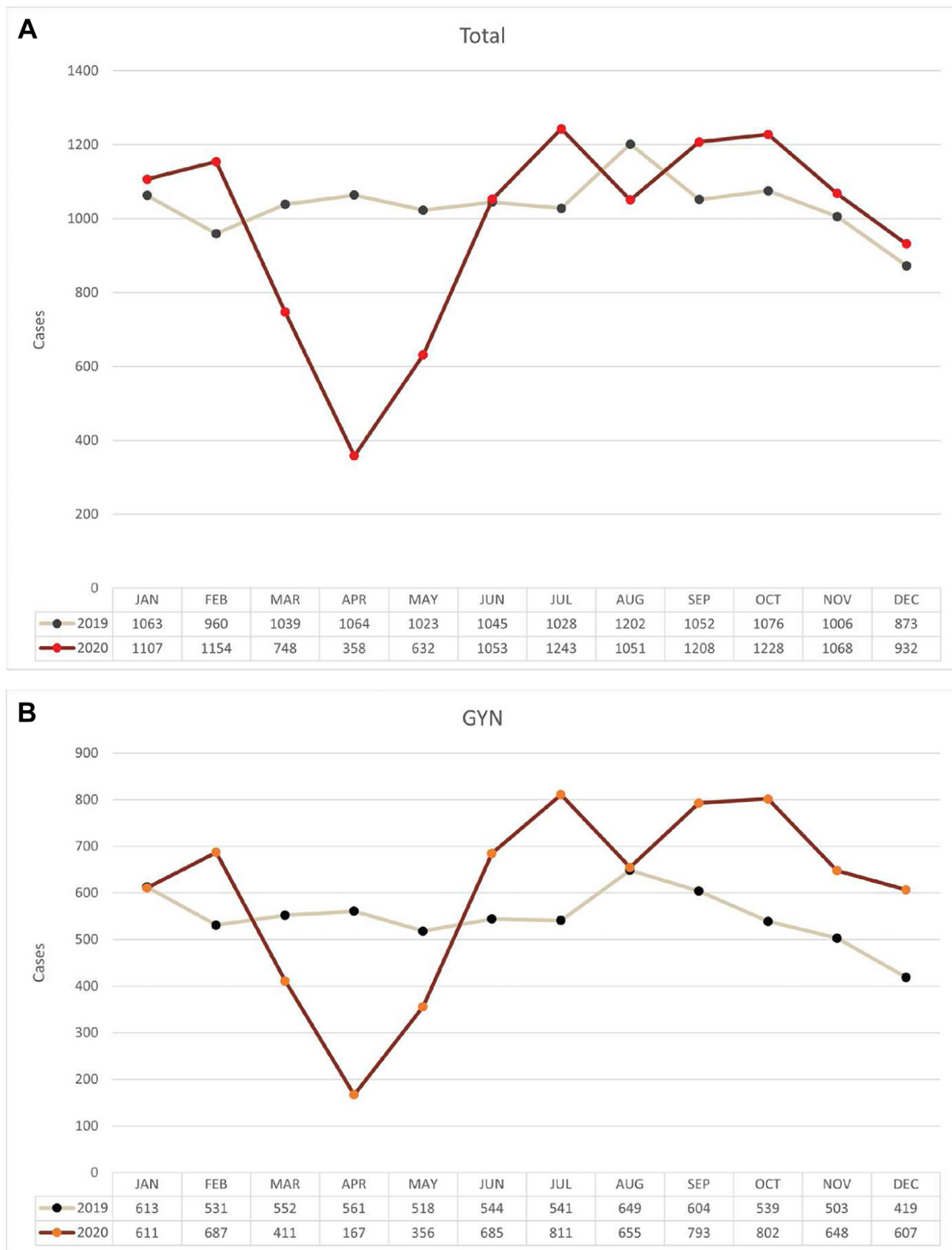


Figure 2 Cytopathology practice volumes, comparing financial year 2019 (tan) and 2020 (red) for overall specimens (A), gynecologic specimens (B), nongynecologic specimens (C), and fine-needle aspiration specimens (D).

The FNA specimen volumes, however, most closely approximate the cumulative monthly surgical volume (both scheduled as well as elective procedures; Fig. 3B). Both show a protracted recovery curve with return to baseline volume in July 2020. The volume curves from July through December 2020 also closely approximate each other.

Educational impact

Sixteen ACGME residents and fellows were polled to assess the impact of COVID pandemic protocols on education. Twelve responses (75%) were recorded. A category of not applicable (N/A) was added for certain questions to allow

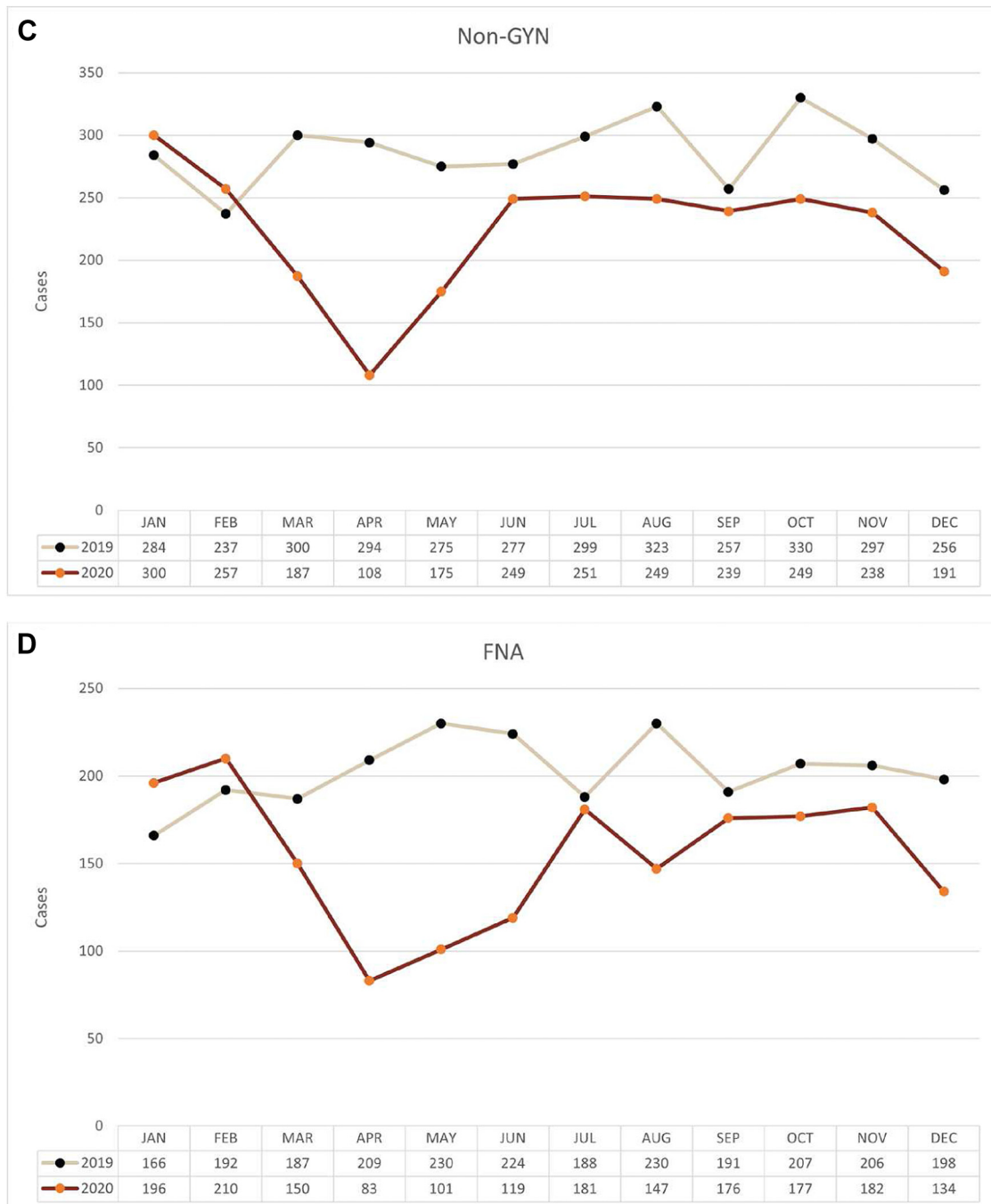


Fig. 2 (continued).

those trainees to participate in the survey who did not specifically work in the department of cytopathology during lockdown but attended didactics and other cytopathology educational activities.

One of the earliest changes to prevent large gatherings in closed indoor spaces was to transition didactic sessions, multidisciplinary conferences, and meetings to an online teleconference platform such as WebEx/Zoom/Teams. A total of 67% (n = 8) of trainees reported a beneficial impact

on their education due to transition to Zoom/WebEx based didactic session, 25% (n = 3) reported no change, and 8.3% (n = 1) reported preference for in-person didactics (Fig. 4A).

We also increased the number of slide-based self-study sets to compensate for the decrease in specimen volume in the cytopathology practice. Fifty-eight percent (n = 7) reported a beneficial effect of these additional slide sets (Fig. 4B) and 17% (n = 2) reported no change. Interestingly, 33% (n = 4)

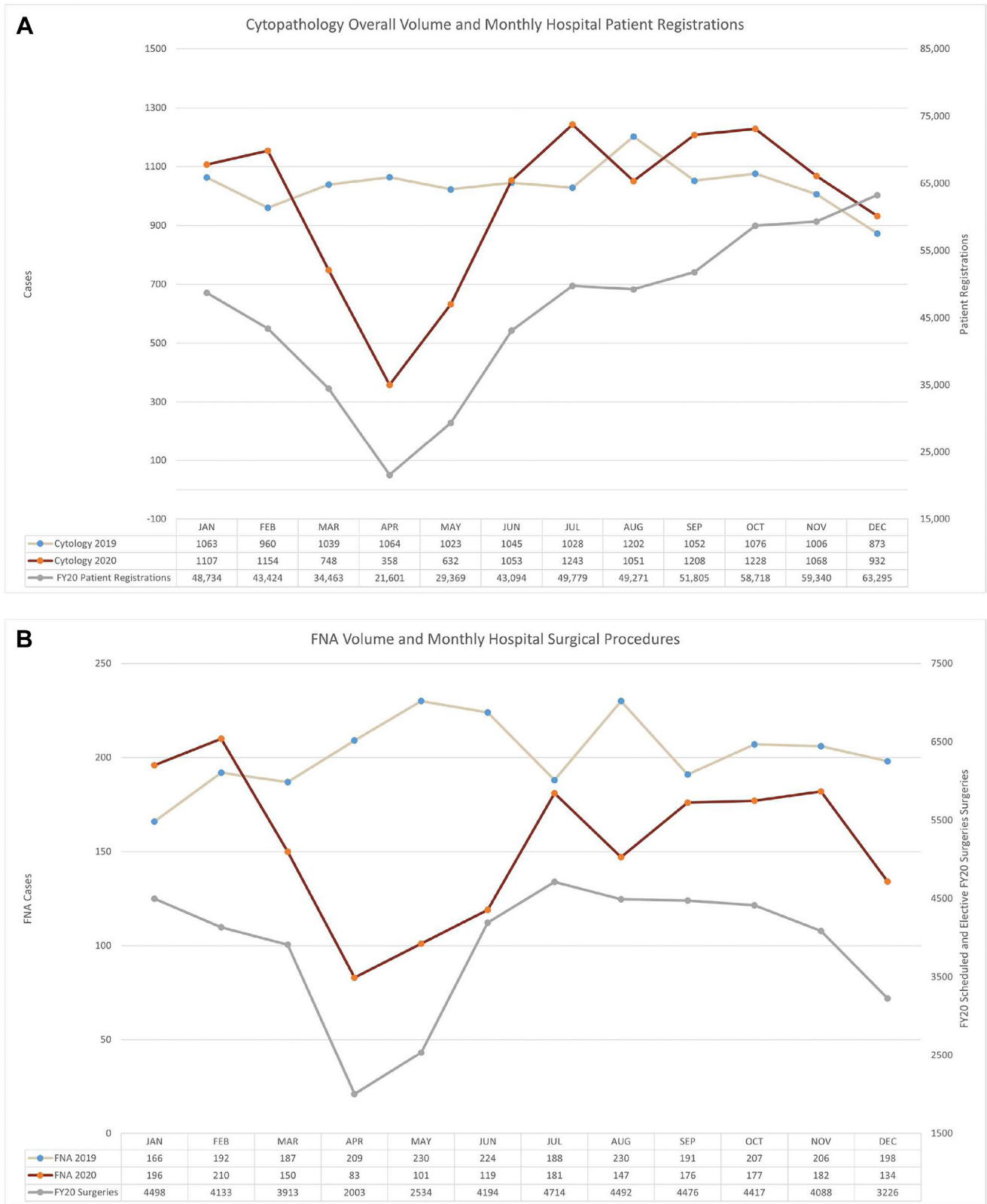


Figure 3 (A) Cytopathology overall specimen volume (left x-axis) for financial years 2019 (tan) and 2020 (red) plotted against monthly hospital patient registrations (gray, right x-axis). (B) FNA-specimen volume (left x-axis) for financial years 2019 (tan) and 2020 (red) plotted against monthly hospital surgical procedure volume (gray, right x-axis).

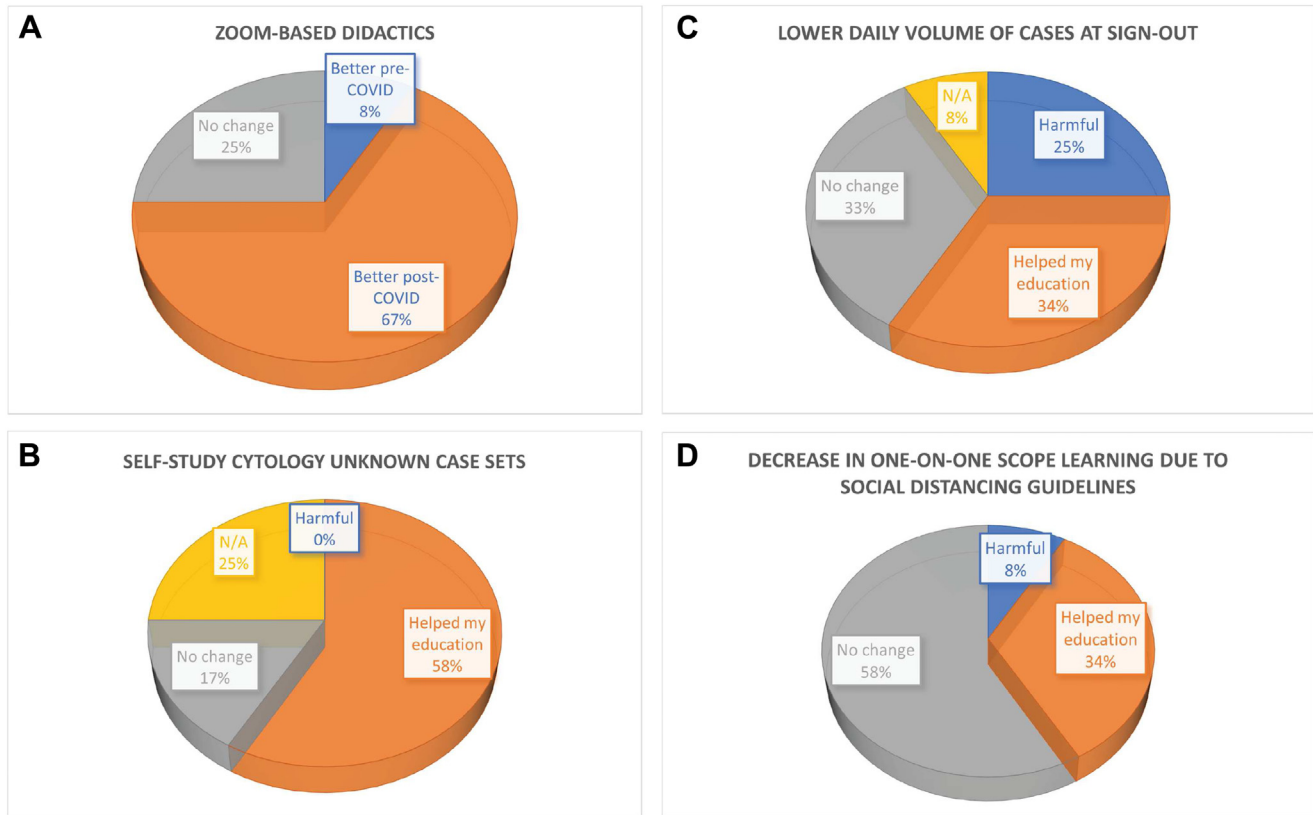


Figure 4 Single-best-answer resident survey responses (A-E), and one 5-component graded survey question response (F).

of the trainees found the decreased volume of cases helpful towards learning the subject matter while 25% ($n = 3$) found it detrimental and 33% ($n = 4$) reported no change due to the change in case-volume (Fig. 4C).

There was also a need to decrease one-on-one resident/fellow teaching at the microscope, which was found to be harmful by 8% ($n = 1$), helpful by 33% ($n = 4$), and not a significant change to educational objectives by 58% ($n = 7$) of the respondents (Fig. 4D). To be compliant with institutional gathering policy, trainees were also not allowed to attend FNA procedures, which was reported as a detriment by 17% ($n = 2$), helpful by 8% ($n = 1$), no change by 33% ($n = 4$), and was not applicable for 43% ($n = 5$) of respondents (Fig. 4E).

Aside from single-answer poll questions, trainees were also asked to grade 5 factors on a scale from 1 (poor) to 5 (excellent) and the contribution of these factors towards their education (Fig. 4F). Impact of these factors reported as excellent in order of magnitude is case sign-out with attending cytopathologist on service, case preview with ACGME-fellow on service, use of self-assessment modules, participation in onsite assessment of specimens, and knowledge of anatomic pathology from general surgical pathology rotations.

Review of our program's cumulative RISE scores in cytopathology section revealed an increase in 10 points between the year 2019 and 2020. Following the implementation of novel concepts in resident training and

education, the cumulative scores in the cytopathology section in 2021 were the same as 2020.

Discussion

The ongoing COVID-19 pandemic has brought many challenges that have affected academic medical centers. Overall analysis of effect of COVID-19 on health care systems and resident education will take time to fully evaluate. A recent survey of medical management associations has suggested that 97% of practices experienced a detrimental financial impact related to the coronavirus.² Although a similar impact has been seen in pathology practices, there are very few studies or reviews focusing on educational and financial impact of the COVID-19 virus on laboratory medicine.^{3-5,7,8} Monroig-Bosque et al shared their institutional experience on the training of pathology residents during early months of the COVID-19 pandemic.⁴ Based on their program's experience they concluded that redeploying pathology trainees to clinical laboratory services provided unique learning opportunities and also resulted in optimization of patient care.

In the current study we have shown that our annual cytopathology practice volumes for financial year 2020 decreased by 5.22% compared with 2019. Increase in gynecologic specimen volume (10.02%) compensated for decrease in nongynecologic (21.4%) and FNA (23.6%) in 2020 compared

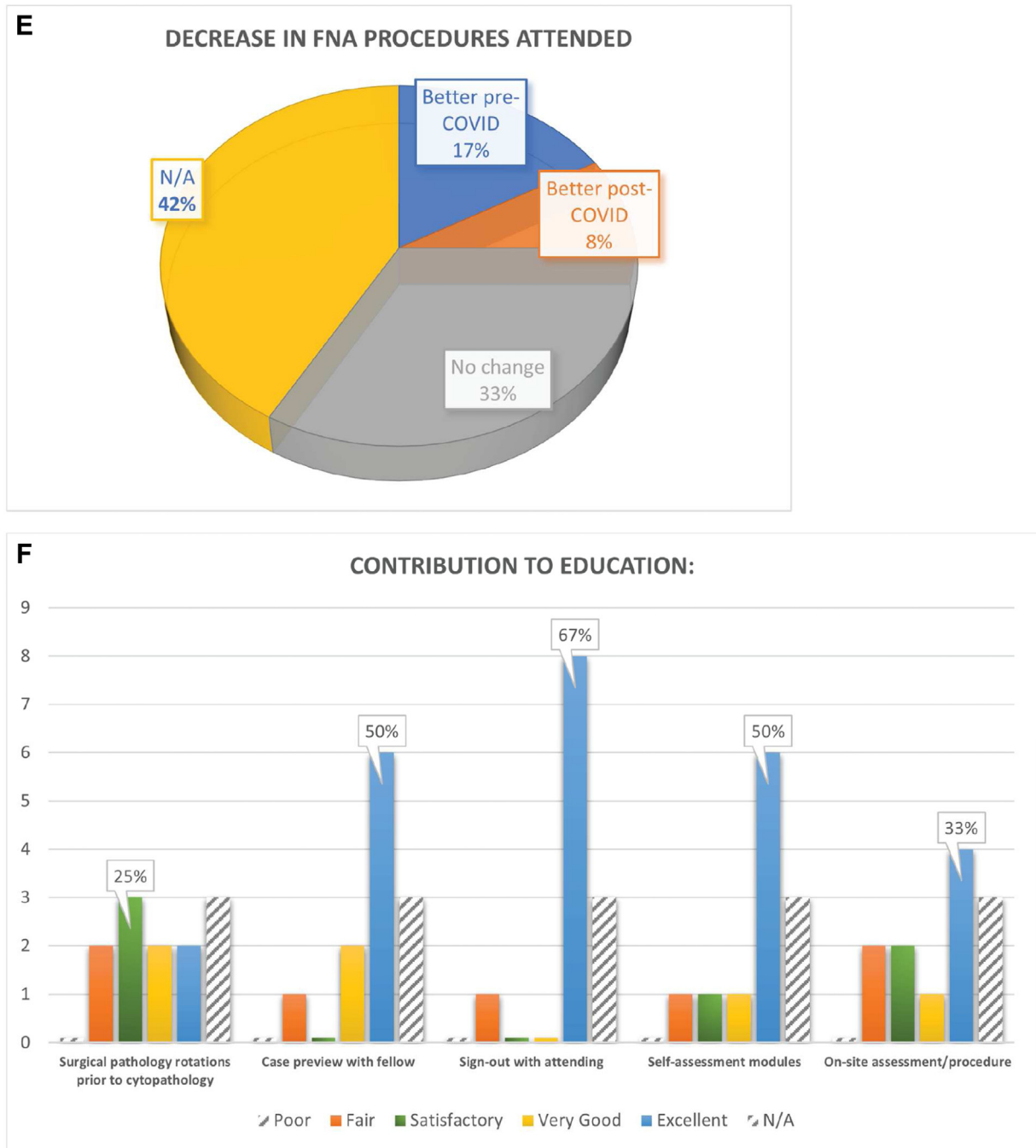


Fig. 4 (continued).

with 2019, resulting to overall reduction of cytopathology volumes to 5.2%. This positive gynecologic specimen delta could in part be represented by addition of a new patient intake account and financial contract in January 2020. The increase is well reflected prior to the pandemic lockdown, with higher gynecologic specimen collection in February 2020 compared to February 2019 (increased by 29.4%; $P = 0.001321$).

In compliance with state-mandated and our own institutional policies, there was a significant reduction in monthly patient registrations, scheduled and elective surgery volumes

for adults, pediatric visits, outpatient procedures, and interventional radiology-based procedures during early phase of pandemic (March to April 2020). This resulted in a significant drop of cytopathology specimen volumes during the same period (28% to 66%). Based on the overall cytopathology volume in the month of June the projected reduction for 2020 volume was 22.33%. However, the annual cytopathology practice volumes for financial year 2020 decreased by 5.22%, with FNA subspecialty volumes decreasing by as high as 23.56% compared with 2019. This overall annual decrease,

however, was much lower than the projected deficit, and the strongest effect on FNAs was due to restrictions in operating room scheduling, time-delay for the required COVID rule-out testing, and triage process for most efficient allocation of hospital resources. Our data also show an abrupt and significant decrease in patient volume, mostly due to stringent initial guidelines and restrictions instituted by our hospital and the state government in response to the pandemic.

Our financial recovery was a V-shaped curve, which is essentially the most ideal economic response to a downturn. Monroig-Bosque et al showed similar recovery in their gynecologic cytology, nongynecologic cytology, surgical pathology, and neuropathology volumes for the time period of January through May 2020 during the coronavirus pandemic.⁴ Moving from the most ideal to least ideal scenario, financial recovery can take many shapes that can be described as a V-shaped curve, U-shaped curve, W-shaped curve, L-shaped curve, and the newly hypothesized K-shaped curve.^{14,15} The curves are an informal shorthand to plot gross domestic product. A V-shaped curve is the most ideal response to a recession, one where the economy suffers a sharp but brief period of economic decline with a clearly defined trough, followed by a strong and sustained recovery. A U-shaped curve is a longer lasting recession with a widened trough, and a slower return to growth. In a W-shaped recession, the economy falls into recession, recovers with a short period of growth, then falls back into recession before finally recovering. An L-shaped depression occurs after a severe recession with a lack of return to baseline growth. The K-shaped/2-stage recession is a recovery hypothesized for the coronavirus 2020 pandemic where the recovery is divergent with parts of society experiencing more of a V-shaped recession, while other parts of society experiencing a slower more protracted L-shaped recession.

Based on the specimen volume in June 2020 the projected annual volume would have resulted in a volume deficit for the cytopathology practice of 22.33% and contributed to greater than 50% loss of revenue, which is similar to that reported in most practices since the beginning of the pandemic.² However, V-shaped recovery of cytopathology specimen volumes resulted in 17% gross revenue loss for year 2020 compared with 2019 and the stimulus measure CARES Act helped to offset an additional 2% of economic loss, bringing the net decrease in gross revenue to 15%.

Our study shows a V-shaped recovery that was aided by implementation of guidelines at the hospital, state, and national levels. The presence of excellent laboratory policies prior to the pandemic, such as universal precautions, use of N95 masks, and use of biosafety cabinets for aerosolizing procedures, allowed the staff to rapidly adapt to the changing needs of the pandemic and avoid further hardship. We were also able to avoid staffing problems or furloughing employees. This was aided by the stimulus measures such as the issuance of a Paycheck Protection Program loan under the HHS CARES act and billing assistance by our institutional governing board, which further allowed full retention of technical and administrative staff during the pandemic.

Of the categories of nongynecologic, gynecologic, and FNA specimen, the most significant decline was noted in FNA specimen volume. We believe that the reason for slower recovery and more significant decline in FNA specimens was connected to the complexity of acquiring most FNA specimens. This included dependence on availability of procedure room, availability of ultrasound or computed tomography equipment and skilled staff, as well as competing triage demands for the same equipment/rooms/staff by other surgical procedures; this was further compounded by COVID-19 restrictions imposed in the hospital setting. A similar requirement may also explain the higher YoY decline in nongynecologic cytology specimens compared with gynecologic cytology—most of which can be collected quickly, in an outpatient noninvasive setting; and do not compete with the same hospital resources as the other specimen types.

Unprecedented challenges dealing with the ongoing COVID-19 pandemic affected pathology training programs all over the United States. In our program we routinely have interactive cytology didactics and unknown conferences requiring trainees and faculty to assemble in a conference room. Maintaining physical distancing with this approach during the pandemic was not possible. Switching to virtual conferences to ensure everyone's safety without compromising cytopathology education of trainees during difficult times was well received by the majority of residents. In fact, it helped increase resident attendance at the conferences as it allowed them to attend virtually from different hospitals where they were posted. Similar to our practice, Monroig-Bosque et al advocated virtual meeting tools as a cardinal means of education of pathology trainees during the COVID-19 pandemic.⁴ The experience of other non-pathology programs has also been alike.⁷⁻¹³

The majority of residents did not view the loss of one-on-one microscope training as adverse when offset by the use of real-time video displays and supplemented by self-study sets. Reduced volumes during the pandemic allowed residents to spend more time on study sets, to learn the morphologic skills and diagnostic criteria at their own pace. Under normal circumstances the caseload in cytology service may preclude residents to go over study sets in detail. Mini quizzes were administered during their rotation to ensure that the residents were developing the right skill sets. Although residents were not able to attend FNA procedures, they were able to give an input on rapid onsite assessment by reviewing real-time images via telecytopathology. While not being able to attend or perform superficial FNA was a concern for some residents, we hoped that the 3-month resident rotations in cytopathology, distributed over different years of training, would provide ample opportunities when they returned for their second or third rotations at a time when the pandemic was better controlled.

Review of our program's cumulative score for the cytopathology section of RISE (2021) following the introduction of novel concepts for resident education revealed no change when compared to RISE score for the year 2020. Although RISE performance does not provide a wholesome overview of

resident training, we believe that review of the cumulative program scores reveals that the implementation of changes in resident training in cytopathology during pandemic did not adversely affect the resident education. While this study-set is limited by responses from 12 AP/CP residents, the trainees studied are evenly distributed from PGY-1 through PGY-4. However, given the smaller number of trainees surveyed, this may not accurately reflect the experience across all training programs, or across residents pursuing AP-only residency track.

Overall, our study informs policymaking. Our data show a sharp and significant decrease in patient volume, mostly due to stringent guidelines set by the state and national governments and our institution in response to the pandemic. The recovery curve was V-shaped, essentially the most ideal economic response to a downturn. The recovery efforts were also helped by stimulus measures such as the HSS provider relief CARES act, avoiding any potential loss of employees and a quick return to full workload and workforce. Most surveyed residents welcomed the innovative practices introduced for their training and education. An overwhelming majority of residents considered virtual teaching and self-study sets review as beneficial and did not view absence of one-on-one scope learning as adversely affecting their education. While we are still working under some pandemic regulations, we foresee long-term incorporation of most of the novel concepts introduced during this pandemic.

Conflict of interest

The authors declare no conflict of interest.

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