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One-Year Follow-Up of COVID-19 Impact on Surgical Education: Clinical Training Restored but Surgical Trainee Emotional Well-Being Still at Risk

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- BACKGROUND:** A previous survey documented the severe disruption of the coronavirus disease 2019 pandemic on surgical education and trainee well-being during the initial surge and systemic lockdowns. Herein, we report the results of a follow-up survey inclusive of the 2020 to 2021 academic year.
- STUDY DESIGN:** A survey was distributed to education leaders across all surgical specialties in summer 2021. We compared the proportion of participants reporting severe disruption in key areas with those of the spring 2020 survey. Aggregated differences by year were assessed using chi-square analysis.
- RESULTS:** In 2021, severe disruption of education programs was reported by 14% compared with 32% in 2020 ($p < 0.0001$). Severe reductions in nonemergency surgery were reported by 38% compared with 87% of respondents in 2020. Severe disruption of expected progression of surgical trainee autonomy by rank also significantly decreased to 5% to 8% in 2021 from 15% to 23% in 2020 among respondent programs ($p < 0.001$). In 2021 clinical remediation was reported for postgraduate year 1 to 2 and postgraduate year 3 to 4, typically through revised rotations (19% and 26%) and additional use of simulation (20% and 19%) maintaining trainee promotion and job placement. In 2021, surgical trainees' physical safety and health were reported as less severely impacted compared with 2020; however, negative effects of isolation (77%), burnout (75%), and the severe impact on emotional well-being (17%) were prevalent.
- CONCLUSIONS:** One year after the initial coronavirus disease 2019 outbreak, clinical training and surgical trainee health were less negatively impacted. Disruption of emotional well-being remained high. Future needs include better objective measures of clinical competence beyond case numbers and the implementation of novel programs to promote surgical trainee health and well-being. (J Am Coll Surg 2022;235:195–209. © 2022 by the American College of Surgeons. Published by Wolters Kluwer Health, Inc. All rights reserved.)

The coronavirus disease 2019 (COVID-19) pandemic has now lasted for more than 2 years. As of January 6, 2022, the US led the world in total cases (58.8 million), deaths (854,000), and total tests (827 million).¹ The pandemic

disrupted the US health system, creating havoc for the delivery of health services, including surgical procedures. In March 2020, the American College of Surgeons (ACS) Division of Education appointed a Special Committee

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Supplemental digital content is available for this article.

Abbreviations and Acronyms

ABS	=	American Board of Surgery
Academy	=	Academy of Master Surgeon Educators
ACS	=	American College of Surgeons
ED	=	Emergency Declaration
PD	=	Program Directors
PGY	=	Postgraduate year

of the ACS Academy of Master Surgeon Educators (Academy) to address educational challenges associated with the pandemic. Initially, the overriding concerns were for the victims of the pandemic, patients needing hospitalization for reasons other than COVID, including surgery, and the healthcare workforce. However, additional concerns regarding the efficacy of medical and surgical training and the safety and well-being of surgical trainees became apparent. The Special Committee hypothesized that surgical education and training would be highly susceptible to disruption by the pandemic, in particular, if there was prolonged curtailment of surgical procedures necessitated by additional surges in COVID cases and resulting hospital capacity needs.

To study the impact, the Committee circulated an initial survey to leaders in surgical education across all surgical specialties between April and June 2020.² In anticipation of the fluid and unpredictable nature of the pandemic, follow-up surveys were conducted in July through September 2020 and in December 2020 to January 2021.³ The results of the initial survey showed that nationwide lockdowns, following the declaration of a national emergency in March 2020, were associated with substantial proportions of respondents indicating severe disruption of educational programs (32%), nonemergency surgical volume (87%), and trainee well-being (27%) because of the lack of personal protective equipment, fear, stress, and isolation. The disruption was greatest in those teaching hospitals that had an ACGME Emergency Declaration (ED), defined as those crossing the threshold beyond which the increase in volume and/or severity of illness created an extraordinary circumstance in which routine care and education delivery must be reconfigured to focus only on patient care.^{4,5}

Programs rapidly transitioned to delivery of an educational curriculum by virtual platforms that maintained educational programming; however, surgical training remained at risk due to reductions in expected minimal case numbers and expected operative experiences of surgical trainees. Thirty-five days after the ACS and other major surgical associations recommended postponement of nonurgent surgical procedures, guidelines for resumption of elective surgical procedures were published by the

ACS, American Society of Anesthesiologists, Association of Perioperative Registered Nurses, and the American Hospital Association.^{6,7} The Centers for Medicare & Medicaid Services published the “Opening Up America Again” guideline.⁸ Hospitals developed processes and procedures to resume nonurgent surgical procedure access. Surgical programs gradually came back online despite what would prove to be an 8-fold increase in COVID-19 infections by the winter of 2020 to 2021.³

During this period, 44% of participants in the follow-up surveys reported full recovery of educational programs with 56% reporting incomplete recovery.³ In December 2020 to January 2021, 23% of participants reported severe disruption of education programs compared with 32% in the initial survey. Although follow-up surveys did not specifically assess restoration of operative volume, qualitative analysis suggested prevalent themes around concern of fewer surgical case numbers and the impact on trainee competence and readiness for graduation. Not surprisingly, given the ongoing pandemic, the severe negative impact on surgical trainee well-being did not improve in the subsequent follow-up surveys.

With these identified concerns, it was clear that additional information concerning the impact on surgical education and training was needed. Hence, the Special Committee designed a new survey to be distributed in July and August 2021 with a primary aim of quantifying the perceptions of leaders in education concerning the continuing impact of the pandemic on residency training, clinical activities, and well-being during the 2020 to 2021 academic year. A secondary objective was to identify the transitions in educational delivery and program adjustments made to preserve clinical training requirements.

METHODS

We surveyed leaders to gain a longitudinal perspective regarding the impact of the COVID-19 pandemic on surgical education in the academic year 2020 to 2021 (July 1, 2020, to June 30, 2021). The electronic survey was developed using the Survey Monkey, Inc. (San Mateo, CA) platform and was determined to be exempt by the American Institutes for Research Institutional Review Board, Washington, DC.

The 46-item survey was distributed between June 21 and August 26, 2021⁹ to general surgery and surgical specialty education leaders in the US and Canada using available email distribution lists that included surgery chairs and program directors (PDs) and the members of the ACS Academy. Individual participation was voluntary, and the data were handled confidentially.

The survey to general surgery and related specialties (Adult General Surgery, Acute Care/Trauma/Burn, Bariatric/Minimally Invasive, Cardiothoracic, Colorectal, Critical Care, Endocrine, Pediatric, Surgical Oncology, Transplant, and Vascular Surgery) was sent via listserv to the Association of Program Directors in Surgery, the Society of Surgical Chairs, and PDs in surgical critical care, pediatric surgery, surgical oncology, thoracic surgery, and vascular surgery with their approval. Similarly, the survey was also sent via listserv to associations representing other surgical specialties (Neurological Surgery, Obstetrics & Gynecology, Ophthalmology, Oral & Maxillofacial, Orthopedic, Otolaryngology, Plastic & Reconstructive, and Urologic Surgery). Both closed- and open-ended questions were used to gather quantitative and qualitative information about the impact of the COVID-19 pandemic on surgical education and training.

Data collected via the online survey were exported for statistical analyses using SAS v9.4 (SAS Inc., Cary, NC). Given the variable email control of the majority of email distribution lists used, the ACGME 2019 to 2020 Data Resource Book¹⁰ was used as a reference to determine the possible number of training programs that served as a surrogate for the total number of surgical chair and PD respondents and was used to impute the survey response rates.

Data analysis consisted of a selected group of key items and subitems that assessed overall impact (7 subitems), including physical safety, physical health, and emotional health; Adaptive Steps (6 subitems); Clinical Change (7 subitems); Operative Volume (4 subitems); and Expected Progression to Operative Autonomy (4 subitems). Responses were described using a 5-level ordinal Likert-type scale, ranging from severe impact⁵ to no impact,¹ except for the binary (Yes/No) Clinical Change items. Responses were dichotomized for analysis as severe disruption (5 or 4 on the Likert-type scale) or moderate or less disruption (3, 2, 1 on the Likert-type scale). Dichotomization of responses was necessary due to very low counts in extreme response categories (eg 1 or 5) that made it inappropriate to apply asymptotic theory to extended chi-square analysis. Therefore, the need to combine response categories precluded the analysis of the interval effect (the group differences in distribution for the average change between the 5-level response categories), and, as a result, we were able to use the same analysis that was used in 2020. In this way, we were able to compare responses throughout the course of the pandemic. The question on surgical trainee well-being included an assessment scale defined as very negative, negative, no impact, positive, and very positive in the following domains:

physical health, emotional health, physical safety, camaraderie, isolation, and burnout. Unique questions were included to estimate the percent decrease in trainee case numbers, trainee promotion, attrition, and fellowship and job placement. The impact of the training level of learners was also reported where the trainee levels were defined as postgraduate year (PGY): PGY 5, Chief Resident or equivalent; PGY 3 to 4, Senior Residents; PGY 1 to 2, Junior Resident; and Fellow (>PGY 5). The location of the primary teaching institution was reported according to US census regions and divisions. The survey respondents reported their Sponsoring Institution ACGME ED during the 2021 academic year and at the time of the survey completion.

To assess changes over time, chi-square analysis was used to compare the proportions of respondents indicating major or severe disruption (4 or 5 on a 5-point Likert Scale) or very negative impact for the key items or subitems in the 2021 survey against the previously reported survey.² Statistical significance was assessed at $p < 0.05$.

RESULTS

COVID-19 cases during the survey period

In the 2021 survey, participants were asked to share their perceptions of the impact of the pandemic during the 2020 to 2021 academic year. [Figure 1](#) shows the timing of the survey relative to the incidence of COVID-19 cases.¹¹ Compared with the 2020 survey there was an 8-fold increase in the 7-day average incidence of COVID-19 cases at the peak in the 2020 to 2021 academic year. The participants reported the greatest proportion of COVID-19 cases by month from July 1, 2020, to March 2021 ([Fig. 2](#)). The curves are similar, showing the greatest incidence in November to December 2020 and January 2021, indicating that the sample of respondents was representative of the national incidence of COVID-19 cases.

Status of COVID-19 vaccine administration

The COVID-19 vaccine was available under FDA emergency authorization during the survey period. As of June 21, 2021, 45.7% of the US population was fully vaccinated to COVID-19 and, as of August 26, 2021, 52.4% was fully vaccinated.¹² This included the majority of physicians, surgeons, residents, fellows, and other healthcare workers; however, according to some reports, up to 30% were reported to be unvaccinated.¹³ The survey period predated widespread enforcement of hospital vaccine mandates and emergency approval for Pfizer, Moderna, and J & J booster vaccines that followed the Delta surge in September 2021.¹⁴

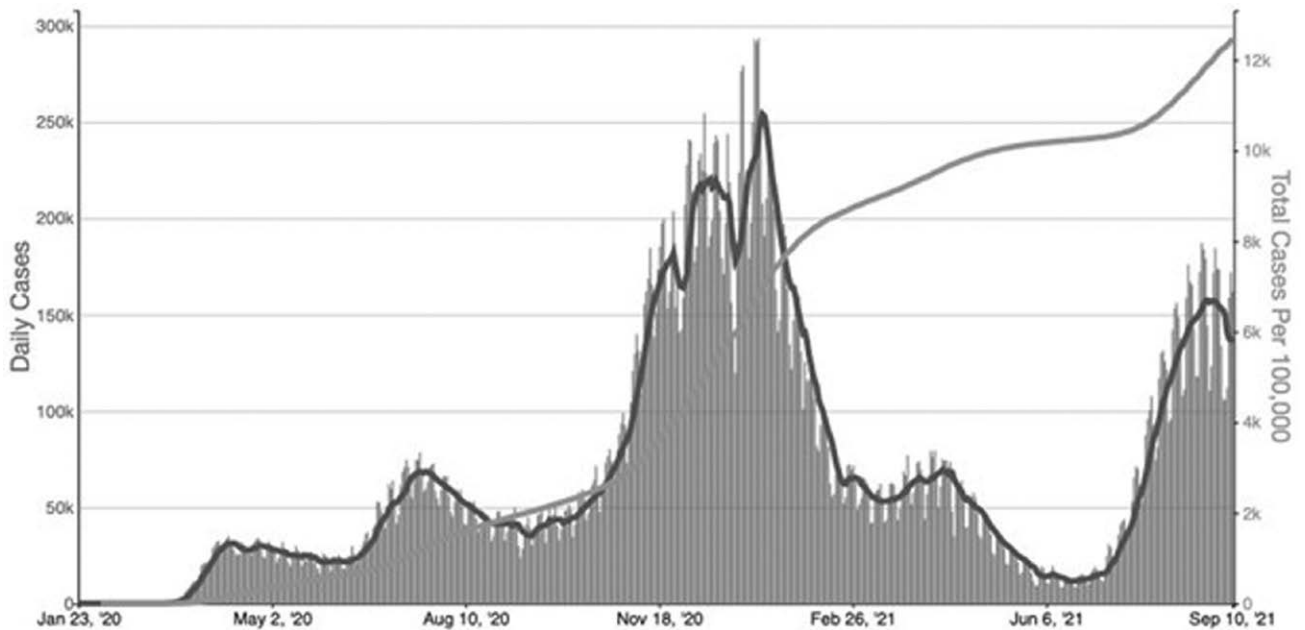


Figure 1. Seven-day average incidence of new COVID-19 infections and cumulative case numbers at the time of Spring 2020 and Summer 2021 surveys. The 2021 survey assessed the pandemic's impact during the 2020 to 2021 academic year (July 1, 2020, to June 30, 2021). An approximate 8-fold increase in average 7-day case incidence was observed in the 2020 to 2021 academic year.¹¹

Response rate

The survey response rate was 17% (372 of 2,245) that was imputed using a derived total survey distribution estimate that included the total membership of Association of Program Directors in Surgery and the other surgical specialties included in the ACGME 2019 to 2020 Data Resource Book¹⁰ representing 2,072 programs, as well as the Society of Surgical Chairs (n=187) and Academy members (n=173). The total number of individuals surveyed was determined to be 2,245 (**Supplemental Table 1**, <http://links.lww.com/JACS/A77>).

The final analytic dataset contained 372 responses. The denominator used in calculating individual survey item proportion analyses excluded survey item nonrespondents, resulting in small changes in denominator representation for individual survey items and subitems. Response rate estimates were 24% (227 of 944) for those indicating general surgery and related specialties, and 13% (145 of 1,128) for those indicating other surgical specialties. The proportion of survey respondents who indicated a primary role of “chair” was (20%; 75 of 368), compared with “PD” (56%; 207 of 368) or “other role” (24%; 86 of 368). Although 41% of the participants indicated that they completed the initial 2020 survey, the survey design to protect the identity of the respondents precludes a one-to-one comparison.

Characteristics of institutions in 2021

Overwhelmingly, the respondents indicated that their primary teaching hospitals were University or University Affiliated: 87% (321 of 371). The following characteristics of the primary teaching hospital were indicated by the participants: Level 1 Trauma Center 27% (99 of 371); Safety Net Designation 9% (32 of 371); greater than 500 bed-capacity 62% (229 of 371); and 11% (42 of 371) an associated Children's Hospital.

Regional distribution

The regional distribution of respondents was Northeast 30% (103 of 338); South 29% (97 of 338); Midwest 27% (92 of 338); and Western 14% (46 of 338). There were 5 respondents from Canada that were included in the overall analysis. Of the 372 respondents, 28 did not report a US region and one skipped the item. These were excluded from the remainder of the analysis because the survey may have been answered by some international members of the Academy.

ACGME emergency declaration

When asked about their institutions' ACGME status in academic year 2020 to 2021, respondents indicated a program emergency declaration (ED) in 28% (94 of 341), no ED in 38% (129 of 341), and 35% (118 of 341) were

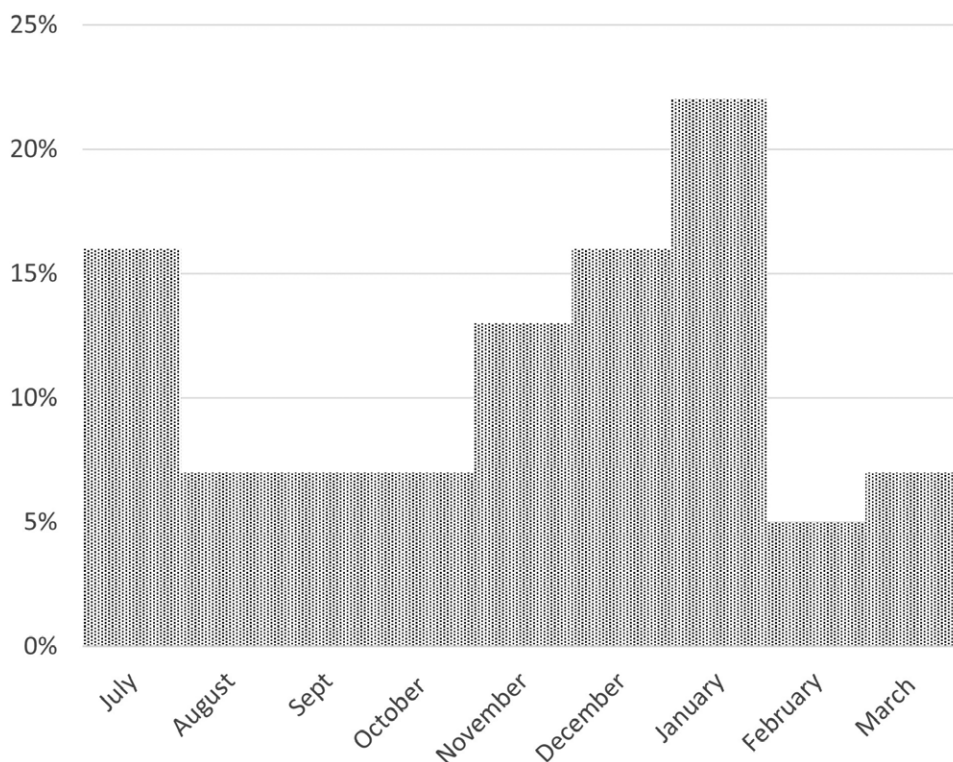


Figure 2. Proportion of respondents (331 of 368) indicating the greatest number of COVID-19 infections experienced by their programs during the months of July 2020 to March 2021 as assessed on the Summer 2021 survey. The relative incidence parallels the national incidence shown in [Figure 1](#), indicating that respondents are representative of the national incidence of COVID-19 infections.

unsure. The survey did not include a question to determine when the emergency status occurred; however, the duration of the ACGME ED extension periods was assessed. We found that ED duration was 30 days in 13% (12 of 94), 30 to 60 days in 18% (17 of 94), 61 to 90 days in 14% (13 of 94), and greater than 90 days in 15% (14 of 94). Forty-two percent (41 of 97) of the respondents were uncertain. Due to this large proportion combined with low counts in duration categories, further analysis of the impact of ED on study parameters was not possible. At the time of survey completion, however, only 8% (26 of 340) of respondents reported that programs were in an ED and 3% (10 of 340) were unsure.

Disruption and recovery of education programs

[Figure 3](#) shows the degree of disruption of education programs since July 1, 2020, as perceived by the respondents. “Major/severe disruption” was reported by 14% (44 of 310) with “moderate disruption” by 38%, “minor disruption” by 42%, and “no disruption” by 5%. At the time of the survey, full recovery was reported by 82% (217 of 266) of respondents to this item. The time to full recovery of education programs during the academic year since

the most severe disruption is shown in [Figure 4](#). Of those reporting full recovery, 35% required 6 months or longer. [Figure 5](#) shows that nearly all respondents indicated that programs transitioned to virtual conferences to maintain delivery of the educational curriculum.

The respondents indicated that the following core competencies “needed further attention,” meaning additional interventions during subsequent training: technical skills 72% (171 of 238), medical knowledge 32% (75 of 238), problem solving 25% (59 of 238), communication skills 23% (54 of 238), professionalism 18% (42 of 238), and other 5% (13 of 238).

Disruption and recovery of clinical activities

“Major or severe disruption” in nonemergency surgery was reported by 38% (117 of 311) compared with 1% (4 of 310) for emergency surgery, 26% (81 of 310) for outpatient clinic, 18% (54 of 308) for essential external rotations, and 28% (84 of 305) for nonessential external rotations ([Supplemental Table 2](#), <http://links.lww.com/JACS/A77>). “Major or full recovery” was reported as follows: nonemergency surgery 82% (254 of 311); emergency surgery 94% (292 of 310); outpatient clinic

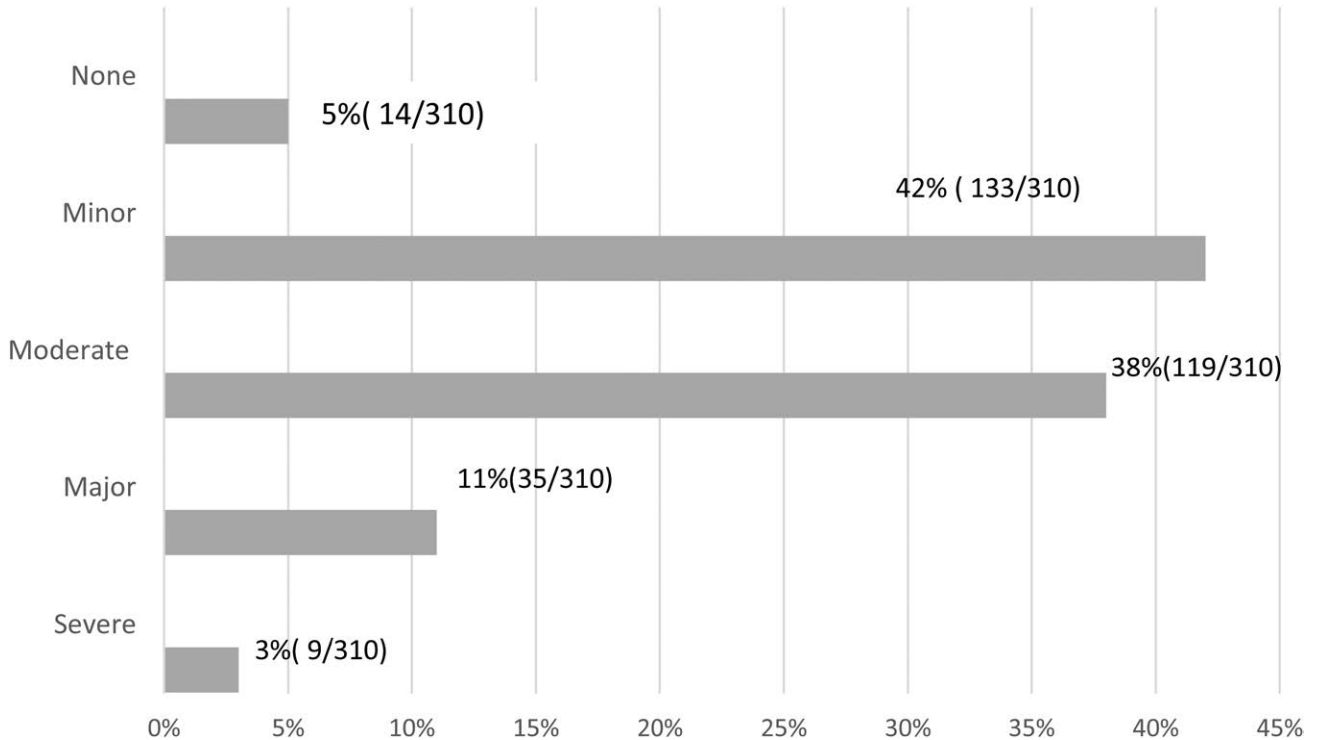


Figure 3. Degree of disruption of surgical education since July 1, 2020, as reported in the Summer 2021 survey.

82% (253 of 308); essential external rotations 82% (250 of 305); nonessential external rotations 74% (222 of 302); **Supplemental Table 3**, <http://links.lww.com/JACS/A77>).

Disruption of operative experience

Minimum case numbers

Table 1 shows the impact on minimum case numbers by training year. The impact on ability to meet minimum case requirements was reported as “major” or “severe” for the following trainee groups: Fellows, 8%; PGY 5, 9%; PGY 3 to 4, 11%; and PGY 1 to 2, 12%.

Cumulative trainee case numbers

Figure 6 shows the percent decrease in cumulative case numbers relative to the experience before the pandemic. Respondents estimated that case numbers were unchanged (18%) or decreased less than 10% (41%). A decrease of 20% in cases was reported by 21% of respondents and decreases of 30% and greater than 30% were reported by 9% and 10% of respondents, respectively.

Expected progression of operative autonomy

Table 2 shows the impact of the expected progression of operative autonomy by training rank. Major or severe

impact was reported as follows: Fellows, 5% (13 of 262); PGY 5, 7% (18 of 270); PGY 3 to 4, 7% (21 of 287); PGY 1 to 2, 8% (23 of 288).

Remediation of deficiencies of in clinical experience

Delayed graduation and promotion were rare, being reported by 2% or less according to academic rank. Changing the rotation schedule was reported as follows: Fellow, 13% (34 of 260); PGY 5, 18% (28 of 259); PGY 3 to 4, 26% (73 of 280); PGY 1 to 2, 19% (54 of 282). Increase in simulation training was reported as follows: Fellow, 11% (28 of 260); PGY 5, 13% (34 of 259); PGY 3 to 4, 19% (54 of 280); PGY 1 to 2, 20% (56 of 282). Increased exposure to telehealth was reported by 10% to 14% and virtual experience by 16% to 17% of respondents. (**Table 3**).

Impact on attrition and job placement

Attrition of trainees was reported as the same as previous years by 75% (222 of 297), as increased by 6% (20 of 308), decreased by 4% (13 of 308), and uncertain by 14% (43 of 308). Disruption of placement of trainees in fellowships was reported as follows: no impact 71% (222 of 297), minor impact 19% (55 of 297), moderate impact 4% (13 of 297), major impact 2% (5 of 297), or severe impact 1% (2 of 297). Disruption of placement of graduate trainees

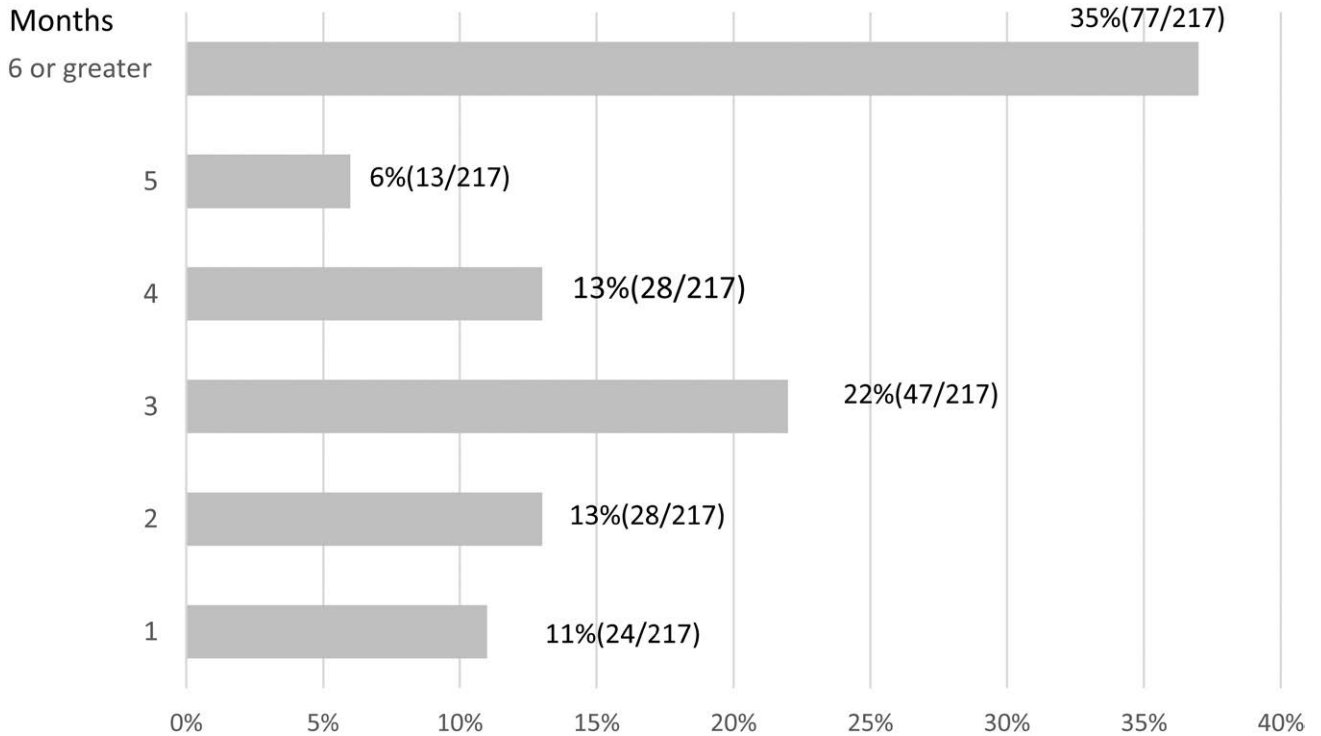


Figure 4. Time to full recovery of surgical education programs. Eighty-two percent of respondents (217 of 266) indicated that programs experienced full recovery. Thirty-seven percent (81 of 217) of recovered programs required 6 or more months to achieve stability.

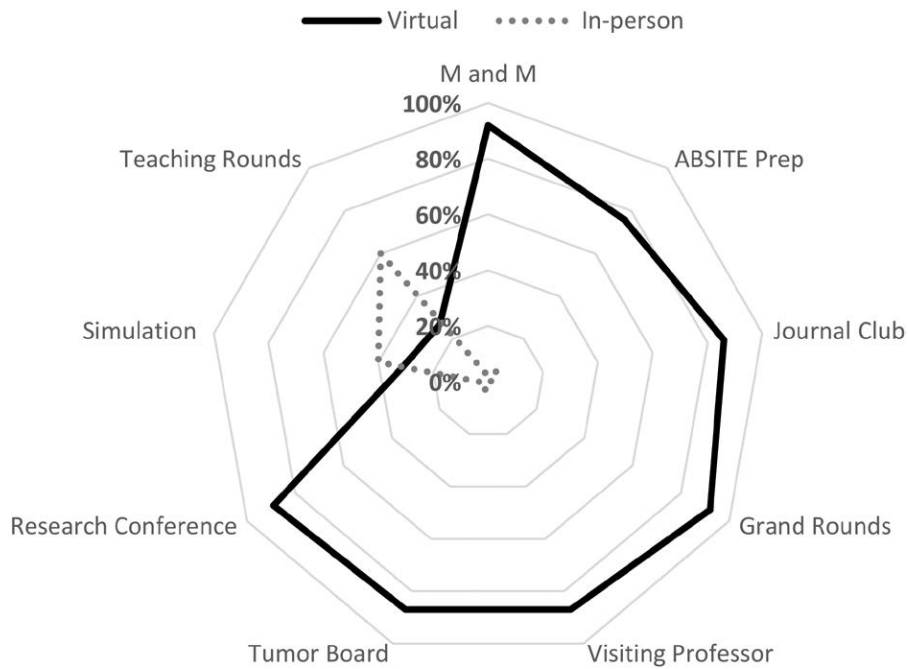


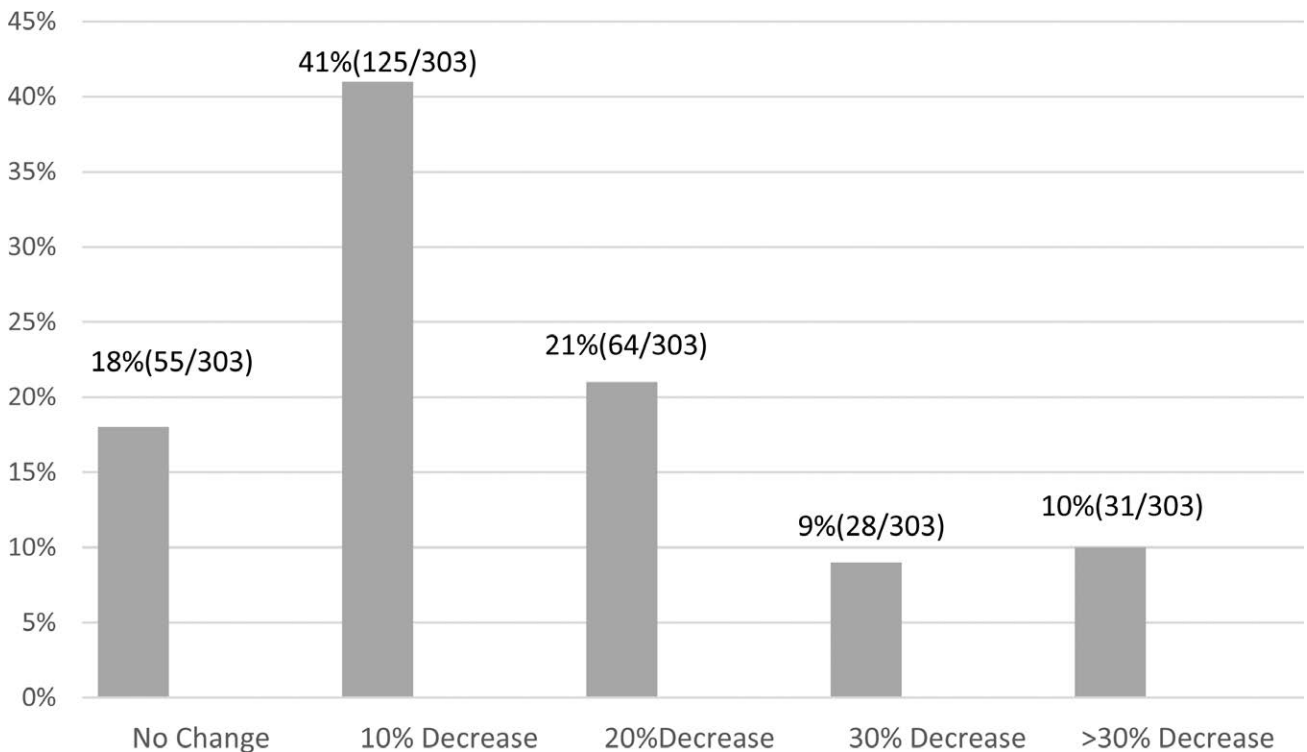
Figure 5. Proportion of specific educational activities reported by participants as in-person or delivered via a virtual platform in the 2020 to 2021 academic year.

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Table 1. Impact on Surgical Trainees' Ability to Meet Minimal Case Numbers by Rank Since July 1, 2020

Variable	None	Minor	Moderate	Major	Severe	Total respondents
Fellow	118 (45)	79 (30)	45 (17)	18 (7)	3 (1)	263
Chief Resident (PGY 5 or equivalent)	96 (36)	91 (34)	58 (21)	20 (7)	5 (2)	270
Senior Resident (PGY 3–4)	80 (28)	100 (35)	76 (26)	26 (9)	7 (2)	289
Junior Resident (PGY 1–2)	82 (28)	110 (38)	65 (22)	28 (10)	6 (2)	291

Data presented as n (%) per summer 2021 survey respondents.
PGY, postgraduate year.

**Figure 6.** COVID-19 pandemic impact on surgical trainee operative case numbers. Respondents' assessment of the change in cumulative surgical trainee case numbers compared with prepandemic trainee operative experience.

into surgical practice was reported as follows: no impact 65% (196 of 301), minor impact 24% (73 of 301), moderate impact 7% (21 of 301), major impact 3% (8 of 301), or severe impact 1% (3 of 301).

Disruption of surgical trainee well-being

Table 4 shows the perceptions of participants that responded to survey items on physical and emotional well-being of surgical trainees. A very negative impact was reported by the participants as follows: physical health 4% (11 of 270), physical safety 3% (8 of 229), and emotional well-being 17% (46 of 270). Respondents also reported a negative or very negative impact on isolation (77%) and burnout (75%) of trainees. Camaraderie was reported as negatively or very negatively impacted by 45% (121 of

267) and positively or very positively impacted by 29% (78 of 267).

Figure 7 shows initiatives to enhance surgical trainee emotional well-being that were reported as being established to a "great extent" compared with "not at all or somewhat" in the 2020 to 2021 academic year (see Supplemental Table 4 at <http://links.lww.com/JACS/A77> for complete data). A minority of the 270 respondents indicated that they enacted initiatives aimed at trainee emotional well-being to a great extent (19% to 33%), compared with initiatives directed at physical well-being (80% to 94%), including providing Personal Protective Equipment 80% (218 of 271), COVID-19 testing 83% (224 of 270), and COVID-19 vaccines 94% (255 of 270).

Table 2. Impact on Expected Trainee Progression of Operative Autonomy by Rank Since July 1, 2020

Variable	None	Minor	Moderate	Major	Severe	Total respondents
Fellow	135 (52)	83 (32)	31 (12)	11 (4)	2 (1)	262
Chief Resident (PGY 5 or equivalent)	116 (43)	98 (36)	38 (14)	15 (6)	3 (1)	270
Senior Resident (PGY 3–4)	101 (35)	102 (36)	63 (22)	18 (6)	3 (1)	287
Junior Resident (PGY 1–2)	100 (35)	114 (40)	51 (18)	20 (7)	3 (1)	288

Data presented as n (%) per summer 2021 survey respondents.

PGY, postgraduate year.

Table 3. Respondents Indicated Using a Variety of Tactics to Address Perceived Shortfalls in Clinical Training

Variable	None	Delay graduation	Delay promotion	Change rotation	Increase simulation	Increase telehealth	Virtual experience	Other	Total
Fellow	179 (69)	4 (2)	1 (0.4)	34 (13)	28 (11)	26 (10)	41 (16)	11 (4)	260
PGY 5	160 (62)	3 (1)	3 (1)	46 (18)	33 (13)	34 (13)	44 (17)	13 (5)	259
PGY 3–4	148 (53)	4 (1)	6 (2)	73 (26)	53 (19)	35 (13)	47 (17)	15 (5)	280
PGY 1–2	153 (54)	1 (0.4)	7 (2)	54 (19)	56 (20)	39 (14)	49 (17)	13 (5)	282

The proportion (number) of respondents using none, or one or more strategies to remediate perceived deficiencies in clinical training is shown according to year of surgical trainee as indicated in the Summer 2021 survey.

Table 4. Respondents' Perception of the Impact of the COVID-19 Pandemic on Surgical Trainee Well-Being in the 2020 to 2021 Academic Year

Variable	Very negative	Negative	No impact	Positive	Very positive	Total respondents
Physical safety	8 (3)	146 (54)	106 (39)	7 (3)	2 (0.7)	269
Physical health	11 (4)	143 (53)	101 (37)	13 (5)	2 (0.7)	270
Emotional well-being	46 (17)	197 (73)	21 (8)	5 (2)	1 (0.4)	270
Camaraderie	22 (8)	99 (37)	68 (25)	63 (24)	15 (6)	267
Isolation	51 (19)	156 (58)	57 (21)	3 (1)	2 (0.7)	269
Burnout	42 (15)	161 (60)	63 (23)	3 (1)	0 (0)	269

Data presented as n (%).

Comparison of 2020 and 2021 surveys

To gain a longitudinal perspective over the course of the pandemic, we completed a comparative analysis of the proportion of participants reporting severe to major disruption in key areas in 2021 with those of the spring 2020 survey.² Table 5 and Table 6 show a comparison of the spring 2020 and summer 2021 final analytic data sets.

Response rates

There were fewer respondents in 2021; 372 compared with 472 in 2020 (Table 5). The response rate was significantly lower in 2021 (17%) compared with 21% in 2020. Contributing to both the lower number of responses and the lower response rate were fewer responses from non-general surgery–related specialties, which accounted for 13% of the respondents in 2021 compared with 22% (239 of 1,105) in 2020 (Table 5). There were fewer responses from chairs in 2021 (20%) compared with 2020 (30%), but the response rates of PDs were similar across surveys.

Characteristics and regional distribution of institutions

The proportion of respondents indicating that the primary teaching hospital was university based or affiliated and hospital bed capacity greater than 500 represented the majority in both surveys. However, there were some differences noted in 2021 compared with the 2020 surveys with fewer ACS Level 1 Trauma Centers 27% vs 81%, fewer safety net hospitals 9% vs 61%, and fewer associated children's hospitals 11% vs 20%. (Table 5). However, the survey periods were equivalent regarding regional distribution and the proportion of programs reporting an ACGME ED (Table 5).

Disruption of education and clinical activity

Major or severe disruption of educational programs was reported by 32% in 2020 compared with 14% in 2021 surveys. The proportion reporting severe disruption in nonemergency and emergency surgery was significantly less in 2021 compared with 2020 and operative volume returned (Table 6).

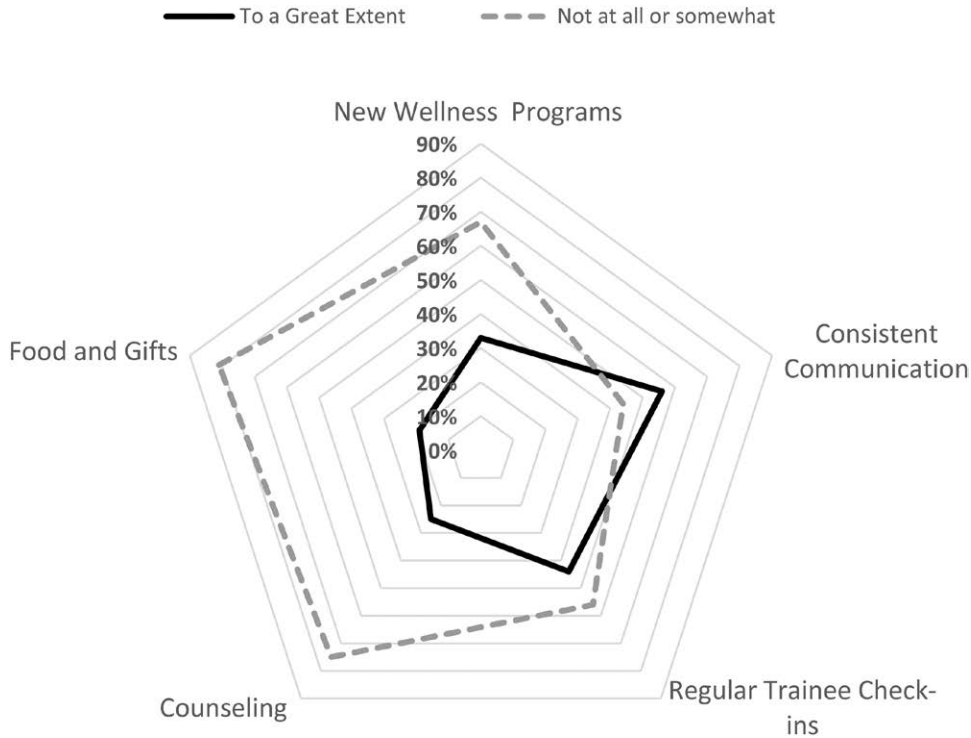


Figure 7. Initiatives directed at surgical trainee emotional well-being as reported by survey participants. A majority reported using described tactics “somewhat” or “not at all” as opposed “to a great extent” with the exception of consistent communication that was used “to a great extent.”

Table 5. Comparison of Spring 2020 and Summer 2021 Survey Respondent Data Including Overall Response Rate, Role of Respondent, Institutional Characteristics, Regional Distribution, and Proportion Affirming ACGME Emergency Declaration

Variable	Spring 2020	Summer 2021	p Value *
Response rate	472/2,196 (21)	372/2,245 (17)	0.001
Role of respondent			0.0115
Chair	141/472 (30)	75/368 (20)	
Program director	253/472 (54)	207/368 (56)	
Other	71/472 (15)	86/368 (23)	
Institutional characteristic			
University/university affiliated	420/472 (89)	321/371 (87)	0.277
Capacity > 500 beds	307/472 (65)	229/371 (62)	0.32
ACS Level 1 Trauma Center†	382/472 (81)	94/371 (25)	<.0001
Safety net hospital	288/472 (61)	32/371 (9)	<.0001
Associated children’s hospital	94/472 (20)	42/371 (11)	0.0008
Regional distribution			
Northeast	121/447 (27)	103/338 (30)	0.72
South	140/447 (31)	97/338 (29)	
Midwest	121/447 (27)	92/338 (27)	
West	65/447 (15)	46/338 (14)	
COVID-19 disruption			
Emergency declaration	135/447 (30)	94/341 (28)	0.34

Data presented as n/N (%).

*Significance determined using chi-square analysis by year.

†In 2020, 92% (434 of 472) of respondents indicated that their primary teaching hospital was an ACS-accredited Trauma Center (Level 1; 81% (382 of 472); Level 2; 8% (38 of 472), Level 3; 3% (14 of 472). In 2021, 31% (115 of 371) of respondents indicated that their primary teaching hospital was an ACS-accredited Trauma Center (Level 1; 25% (94 of 371), Level 2; 3% (11 of 371), Level 3; 1% (5 of 371).

ACS, American College of Surgeons.

Table 6. Comparison of Spring 2020 and Summer 2021 Surveys Assessing the Impact of the COVID-19 Pandemic on Clinical Education Program Parameters and Aspects of Overall Surgical Trainee Well-Being

Variable	Spring 2020	Summer 2021	p Value*
"Major-severe disruption" on clinical education parameters†			
Surgical education			
Education programs	133/415 (32)	44/310 (14)	<0.0001
Clinical activity			
Nonemergency surgery	354/405 (87)	117/311 (38)	<0.0001
Emergency surgery	81/406 (20)	4/310 (1)	<0.0001
Expected minimum case numbers			
Fellow	78/261 (30)	21/263 (8)	<0.0001
PGY 5	114/363 (31)	25/263 (9)	<0.0001
PGY 3–4	158/361 (44)	33/289 (11)	<0.0001
PGY 1–2	162/374 (43)	34/291 (12)	<0.0001
Operative skill progress			
Expected progression of operative autonomy			
Fellow	51/327 (16)	13/262 (5)	0.001
PGY 5	53/387 (14)	18/270 (7)	0.003
PGY 3–4	61/385 (16)	21/287 (7)	0.0008
PGY 1–2	91/387 (24)	23/288 (8)	<0.0001
"Very negative impact" on surgical trainee well-being‡			
Physical safety	64/406 (16)	8/269 (3)	< 0.0001
Physical health	35/406 (9)	11/270 (4)	0.02
Emotional well-being	110/406 (27)	46/270 (17)	0.002

Data presented as n/N (%).

* Significance determined using chi-square analysis by year.

† "Major-Severe Disruption" of surgical trainee's clinical education is shown as the sum of respondents indicating "4" or "5" on a 5-point Likert Scale assessing the pandemic's impact on education programs, clinical activity, expected minimal case numbers, and progress in operative skills.

‡ "Very Negative Impact" on surgical trainee well-being is shown as the sum of respondents indicating "4" or "5" on a 5-point Likert Scale on the Spring 2020 survey and "very negative" on the Spring 2021 survey.

PGY, postgraduate year.

Disruption of surgical trainee well-being

There were significant improvements in physical safety, physical health, and emotional well-being of surgical trainees in 2021 (Table 6). However, a high prevalence of a very negative impact on emotional well-being compared with the physical health domains persisted.

DISCUSSION

The pandemic has been unrelenting and unpredictable. Its impact on surgical education has been driven by the severity of the outbreak and the need for hospital beds to care for the most severely afflicted. As the pandemic progresses, it is apparent that the causative agent, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), continues to mutate and evolve.¹⁵ Liu et al¹⁵ point out that it is likely that further mutations will occur and may impact the efficacy of vaccines, monoclonal antibody therapy, and other treatments. Thus, COVID-19 may be expected to be with us for the foreseeable future. Its

potential impact on surgical education will require continued monitoring and programmatic adjustments as needed.

Herein, we report the results of a 1-year follow-up to an initial 2020 survey. The key findings focus on responsiveness and improvement in surgical education programs, clinical activity, and overall surgical trainee well-being. Essential to this progress were adaptations of curriculum delivery as well as the restoration of clinical activity, underscoring the dependence of surgical education programs on clinical experience. Despite a perceived improvement in surgical trainee physical well-being and safety, the persistence of a very negative impact on surgical trainee emotional well-being is of concern.

Surgical education programs improved as a result of a nearly uniform transition to virtual platforms for the delivery of conferences (Fig. 5). The participants indicated that most core competencies were adequately addressed, with the exception of technical skills that needed further attention. The advantages of video conferences include

diminished risk of spreading the virus, ease of delivery, avoidance of transportation, and increased attendance that will likely remain key components of education delivery in the future. However, video-conferencing limits the spontaneity and socialization of in-person conferences. Thus, not unexpectedly, nearly 70% of respondents indicated that they would transition to hybrid conferences with nearly all moving to in-person teaching rounds and simulation should the COVID-19 case numbers decrease. In fact, many had done so before the Delta and the more recent Omicron surges, and then were forced by the continued necessity for social distancing to resume virtual conferences. The primary lesson learned is that, given the changing nature of the pandemic, educators will need to be flexible and prepared to pivot to virtual curriculum delivery on the basis of the current circumstances. A challenge will be to understand how to make these virtual conferences as meaningful as those in-person.

Telemedicine has been proposed as an adjunct for medical education. In several early focused studies, telemedicine was found to be a useful means for engaging medical students while ensuring the continuity of care for vulnerable patients.^{16,17} In response to COVID-19, a number of electronic health record providers evolved to support more telemedicine capabilities. These technologies have enabled the continuity of care and, importantly, can be adapted to provide clinical experience to trainees.¹⁸ We were surprised that only 10% to 14% of respondents in 2021 (Table 3) indicated that they had used telehealth or telemedicine to maintain clinical experience despite 26% of respondents indicating a major or severe disruption of outpatient clinic experience (Supplemental Table 2, <http://links.lww.com/JACS/A77>). This is in contrast to the observation in a recent report that 90% of surgery PDs reported adoption of telehealth to see clinic patients.¹⁹ In the latter study, it was not clear if the trainees were involved with telemedicine visits. In many medical centers, faculty made use of telemedicine for patient visits, but trainees were not involved. The majority of reports of educational applications of telemedicine have been in undergraduate medical education. It seems that, although faculty used telemedicine, graduate trainees were not involved. The reasons for this are not clear but may relate to access to equipment, billing requirements for teaching physicians, perceived time constraints, or other logistical problems. Telemedicine is here to stay and needs to be incorporated into surgical trainee education during and beyond COVID.

Surgical volume was restored after the initial slowdowns in 2020. Mattingly et al²⁰ reported a rapid return of operative volume during the COVID-19 surge in the winter of 2020 to 2021. The initial shutdown period in March through April 2020 was associated with a decrease in

surgical procedure volume to nearly half of baseline rates.²⁰ The most impacted were procedures involving cataracts (overall decrease 89.5%; 13,564 vs 1,396 procedures), ear, nose and throat cases (overall decrease 70.1%; 36,702 vs 10,945), and musculoskeletal procedures (overall decrease 63.7%; 150,145 vs 53,473). The smallest decrease during the initial shutdown was among transplant surgical procedures (overall decrease 20.7%; 544 vs 398). There was an 8-fold increase in COVID-19 infections in the winter of 2020 to 2021 (Fig. 1). During this surge, the overall rate of surgical procedures rebounded to 2019 baseline rates for the same period of time (797,510 cases in 2019 vs 756,377 cases between week 44, 2020, and week 4, 2021).²⁰ This trend was maintained throughout the peak of patients with COVID-19 in the fall and winter. These findings suggest that, after initial adaptation, health systems appeared to be able to self-regulate and function at pre-pandemic capacity. It follows that with return of operative volume, trainee case numbers would increase.

However, despite the return of overall operative volume, 41% of the participants reported that trainee cumulative case numbers were reduced by greater than 20% during 2021 (Fig. 6). It is important to note that in the survey we did not ask for the numbers of cases or a comparison of case numbers, but rather an overall impression of the participants regarding cumulative case numbers, instilling subjectivity in the responses. Our findings may seem at odds with the most recent national data published by the ACGME in 2020 to 2021. For example, for general surgery, the median total case numbers have not decreased in the past 3 years, but rather increased slightly (increase 0.5% from 2019 to 2021).²¹ However, it is possible that the case numbers reported by the ACGME in 2021 were accrued by the residents before the pandemic, and thus the impact of the pandemic may be obscured. In the future, longitudinal analysis of reported ACGME case numbers by specialty and procedure type may be helpful in understanding the impact of the pandemic on trainee cumulative case numbers.

Although there was a 3- to 4-fold improvement in minimal case numbers relative to 2020, it was reported that 8% to 12% of trainees, depending on PGY year, remained severely impacted (Table 1). This may be due to the lag time in restoring operative volume secondary to logistic considerations, staffing or local variations in the incidence and severity of COVID-19 infections, and individual hospital responses. In the 2021 survey, 82% of participants reported that clinical training and education fully recovered, but more than one-third reported that recovery required 6 or more months. Prolonged decreases in case numbers of this magnitude may make it difficult for PDs to accurately assess a trainee's readiness for promotion or independent surgical practice.

Some certifying boards with case requirements have made accommodations for trainees with reduced case numbers to apply for the certifying examination. For example, the American Board of Surgery will accept a 10% decrease in total cases without the need for further documentation.²² However, based on our findings, a large portion of surgical trainees, more than 40% during the 2020 to 2021 academic year, could exceed the 10% deficit limit. This may require more detailed information and complicate the approval process for some trainees.

With only a partial return of nonemergency surgical cases, it is clear from the survey that programmatic adaptations were required, including flexible surgical trainee rotation scheduling reported by 13% to 26% and additional simulation reported by 11% to 19%, depending on training level. These seemed to maintain clinical training and trainee advancement. First, we found that the perception of the respondents was that the trainees' expected progression toward developing operative autonomy compared with 2020 significantly improved. The items in the survey regarding autonomy were intended to capture information on the necessity of active intervention by the supervising surgeon. In addition, we found that graduation or promotion were rarely delayed, and successful fellowship and job placement was achieved. Nonetheless, further development of competency-based metrics to assess a trainee's readiness for promotion and independent practice are needed. Efforts of the American Board of Surgery and other certifying boards have recently been reprioritized to develop a full suite of entrustable professional activities as well as implementation strategies. Also, professional societies are currently engaged in developing competency-based education and training programs that will yield valuable data from rigorous formative assessments at specific stages of the progression of surgical trainees in the training program. These data should be very helpful in reinforcement and remediation of cognitive and technical skills of the surgical trainees before graduation.

Although trainees themselves are best equipped to express their own perceptions of their individual well-being, this study did not survey resident trainees. This has been the focus of a separate qualitative study conducted and reported by our group.²³ In the current study, reported in this article, we sought the perceptions of surgical education leaders who were likely close to the situation and aware of the impact on the trainees' well-being, as well as their institutional responses. Broad access to Personal Protective Equipment and COVID-19 testing, as well as vaccines, was associated with significant improvements in surgical trainee physical health and physical safety (Fig. 7). Provision of these measures may contribute to improved emotional well-being as well. Contrarily, fewer than one-third of respondents

broadly implemented programs to support trainee emotional well-being (Fig. 7). There was a perceived significant improvement in surgical trainee emotional well-being, although "a very negative impact" persisted, likely secondary to the pandemic-related burnout and isolation potentially compounded by the lack of implementation of effective wellness programs. The prevalence of burnout in surgical residents before the pandemic has been estimated to range between 38.5% and 69%.^{24,25} The majority of these studies focused on general surgical trainees. The rate of burnout in the general population is 28% compared with 53% in surgeons.²⁶ A meta-analysis showed that the aggregate prevalence of burnout was 51%, and a subgroup analysis showed the highest prevalence in radiology (77%), neurology (72%), and general surgery (58%).²⁷ A number of studies have documented the profound negative impact of the pandemic on surgical trainee well-being.²³ The pandemic worsened burnout in most specialties.²⁸

The challenges of maintaining emotional well-being in this pandemic are not unique to healthcare. The National Institute for Health Care Management reported that, from 2019 to 2020, the frequency of anxiety symptoms tripled and depression symptoms nearly quadrupled.²⁸ Compared with 2019, in late June 2020, the proportion of 18- to 24-year-old respondents reporting at least 1 adverse mental or behavioral health symptom increased from 6.5% to 24.3%.²⁹ In addition, more than one-half of employees in all sectors experienced emotional problems. However, there is a growing opportunity to investigate the causes of emotional distress of healthcare trainees, faculty, and staff during a pandemic and potential solutions. Trainee well-being has recently been expanded in the ACGME Common Program Requirements as a subsection of "Learning and Working Environment," stating "Psychological, emotional and physical well-being are critical to the development of the competent, caring and resilient physician and require proactive attention."³⁰ Our findings underscore the important opportunity for more consistent definitions, evaluation of and systematic efforts to establish wellness programs aimed at promoting emotional well-being, as recommended by the National Academy of Medicine.³¹ The National Academy of Medicine and its partnering organizations have created a compendium of online resources aimed at addressing the well-being of healthcare workers.³² Further work that includes the long-term impact of wellness programs and other resources will be needed.

Limitations

The findings of this report must be interpreted within the context of its limitations. The respondents to the surveys of 2021 and 2020 were not identical with regard to

respondent roles and institutional characteristics. These differences must be considered when drawing conclusions from the comparative analysis (Table 5). In addition, the aggregated results did not allow a way to assess changes between survey results within individual programs or institutions. Despite the numbers of respondents, the low response rate and potential of overlap in some programs and institutions are limitations and limit generalizability. Thus, the described changes may not reflect actual changes at the national level but rather changes in the limited pool of respondents to the surveys. On the other hand, the margins of the sample had a profile similar to the national experience based on severity as determined by ACGME ED and the distribution of the incidence in COVID-19 infection in the participants' institutions (Fig. 2). The types of institutions reported in 2021 suggest that the longitudinal perspective of educational leaders is representative of diverse training settings (Table 5).

CONCLUSIONS

1. The majority of respondents reported improvement of surgical education programs 1 year after the initial phase of the pandemic with transition to virtual education platforms. Although in-person conferences may resume, it is likely that virtual components of education delivery will continue to be important for the foreseeable future.
2. Altering rotation schedules or increasing simulation seemed to compensate for deficiencies in expected minimal case numbers and progression of operative autonomy observed in 2020 to 2021, preserving trainee promotion, graduation, and job and fellowship placement.
3. Given the ongoing pandemic and the potential for future disruption of surgical volume, some trainees may experience continued difficulty achieving minimal case numbers. Hence, it is imperative that education leaders in each surgical specialty work diligently to define alternative strategies including improved measures of surgical competence beyond case numbers.
4. Use of telehealth presents new opportunities for surgical education. Future studies might address the basis for its current underutilization by trainees and design systems to promote telemedicine in surgical education.
5. The negative impact of the pandemic on trainee emotional well-being persists in many sectors including healthcare. Collaborative efforts in graduate medical education are encouraged to define best practices to promote surgical trainee emotional well-being and to develop evidence-based solutions that can be implemented at individual sponsoring institutions.

Author Contributions

Study conception and design: Ellison, Spanknebel, Farmer, Matthews, Stain, Nagler
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