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Stress and the Surgical Resident in the COVID-19 Pandemic

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OBJECTIVE: The COVID-19 pandemic has drastically transformed the healthcare community and medical education across the United States. The aim of this study was to evaluate the impact of COVID-19 on the surgical resident training experience, assess possible sources of stress or anxiety among surgery residents, and examine how patterns of anxiety vary by resident rank.

DESIGN: We developed and disseminated a survey, which included the Generalized Anxiety Disorder 7-Item Scale (GAD-7), to all general and integrated plastic surgery residents in their clinical years of training at the University of California, San Francisco. Statistical analysis of the survey responses was performed using the Kruskal-Wallis or Wilcoxon rank sum test. Post-hoc analysis was performed using the Bonferroni-corrected Dunn test. Survey data were combined with aggregated duty hour information and operative case numbers from select hospitals for March and April of 2019 (historical baseline) and 2020.

RESULTS: The overall survey response rate was 73.7% (n = 73). With an estimated operative volume reduction of 63.3% for general surgery cases, over 90% of residents expressed concern about the decline in operative exposure. While the senior residents tended to work more shifts, they were not more likely to have higher risk perception scores for contracting COVID-19 nor higher anxiety levels about the possibility of contracting COVID-19. They were, however, significantly more likely to have high GAD-7 scores (≥ 10) when compared to interns ($z = -2.82$, $p\text{-adj} = 0.014$). Overall, residents were more concerned about the general health of loved ones than about their own risk of contracting COVID-19 ($U = 3897.5$, $p < 0.01$).

CONCLUSIONS: While the work-related experiences of residents varied across a number of factors during the pandemic, residents tended to report similar sources of

anxiety. Moving forward, surgical residency training programs will need to develop ways to optimize available surgical experiences and address the unique resident anxieties that an infectious pandemic presents. (J Surg Ed 000:1–9. © 2020 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: Surgical education, COVID-19, Resident well-being, Surgical trainee, Distance learning, Infectious pandemic

COMPETENCIES: Practice-Based Learning and Improvement, Medical Knowledge, Patient Care

INTRODUCTION

Surgical residency is a formative time in training and is based upon the principles of graduated responsibility and autonomy.¹ Residents progress annually with advancement of their roles within patient-care teams and participation in increasingly complex operative cases.² These training years are characterized by long work hours and unpredictable schedules, and they are often a transitional period during which trainees are away from family and partners. Studies demonstrate a high prevalence of perceived stress and burnout among surgical trainees, as well as high rates of attrition.³⁻⁵ Even within training programs, clinical experiences and exposures vary across service rotations and hospital sites. Educational opportunities may be challenging to regain if lost, which makes the graduate surgical training curriculum particularly vulnerable to disruptions.

On February 25, 2020, San Francisco was one of the first cities in the United States to respond to the COVID-19 pandemic, declaring a state of emergency. Along with 5 other counties in the Bay Area, San Francisco County issued a shelter-in-place mandate on March 17, 2020, directing people to remain in their houses, closing schools, parks and restaurants.⁶⁻⁸ Prior to the shelter in place order, the University of California, San Francisco

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(UCSF) began its response to the COVID-19 pandemic with the development of a COVID-19 Surge Planning Taskforce and implementation of protocols that significantly impacted all aspects of UCSF Health.⁹ These changes included travel bans, transition to remote meetings and conferences, cancellation of all nonurgent surgical procedures, and reduction of the in-hospital workforce to include only members necessary for essential provision of patient care. This plan was developed with 2 things in mind—reducing the inpatient census to accommodate a potential surge of COVID-19 patients and creating a staff pool that could be redeployed from surgery to care for COVID-19 patients.¹⁰

Over the past month, San Francisco has been fortunate to avoid the COVID-19 surge experienced by other parts of the country.^{11,12} Therefore, the UCSF Department of Surgery has not needed to redeploy any of its faculty, trainees, or staff to care for COVID-19 patients. However, the changes that were needed to prepare for the pandemic have significantly impacted surgical training. It is likely that some of these changes will be durable for the foreseeable future, and many of the missed learner experiences may not be recoverable. These unprecedented changes, along with the stresses inherent in the COVID-19 pandemic, create a climate where stress and anxiety are exacerbated among surgical residents.

We hypothesized that the COVID-19 pandemic and the resultant surge planning required to prepare for it would have a marked impact on the surgical resident training experience and that the inflexible realities of this time would have a significant emotional toll on surgical residents across different ranks and hospital sites. The goal of this study was to gather information in order to develop a thoughtful, resident-centered approach to adapting the surgical training program to the COVID-19 era.

METHODS

Setting and Study Population

This study took place within the Department of Surgery at the University of California, San Francisco—a large, public academic institution. UCSF general and plastic surgery residents rotate at 7 different hospital locations during the course of their training—3 UCSF hospitals, a Veteran's Affairs Medical Center, a County/Level I Trauma Hospital, and 2 other nonaffiliated, private hospitals.

Invited survey participants included all clinical general and plastic surgery residents at UCSF (n = 99). The plastic surgery residency program was included as the

division of Plastic and Reconstructive Surgery is within the Department of Surgery, and their program's curriculum has substantial overlap with the general surgery program during the first 3 years of residency. Because we were interested in the impact of COVID-19 on clinically active surgical residents, general and plastic surgery residents in protected research years were excluded from the survey. The structure of the surgery residency program includes a first-year resident (intern) pool comprised of categorical general and plastic surgery interns, nondesignated preliminary interns, and interns from other programs that require general surgery rotations within their curriculum (i.e., orthopedic surgery, otolaryngology, ophthalmology, urology, oral maxillofacial surgery, interventional radiology, integrated vascular surgery, and neurosurgery). The junior resident group included general and plastic surgery residents in their second and third years of residency. The senior resident group included general surgery residents in the fourth and fifth (chief) years of clinical training, and plastic surgery residents in the fourth, fifth, and sixth (chief) years of training.

Survey

We created a 30-question survey using focus groups of surgical residents and faculty, as well as review of literature from the severe acute respiratory syndrome (SARS) epidemic. We then piloted our preliminary questions in a small group of residents to test for relevance. The Qualtrics Labs online platform was used to develop and administer the final survey instrument. The last portion of the survey contained a previously validated tool for measuring overall anxiety, called the Generalized Anxiety Disorder 7-item scale or "GAD-7," which was originally designed to rapidly screen for clinically significant anxiety.^{13,14} Respondents were eligible for a \$10 Amazon gift card if they chose to provide their names at the end of the survey to allow for longitudinal follow-up. Participation was voluntary, and all responses were de-identified and confidential. The survey remained open for a total of 12 days. Only the first question of the survey, which acquired consent to participate, was mandatory; all other questions were optional. The study was deemed exempt by the UCSF institutional review board.

Ancillary Data

To evaluate the effectiveness of resident schedule changes in minimizing unnecessary hospital exposure, we compared average weekly resident duty hour data from March 15th to April 15th, 2020 (aggregated by hospital) with pre-COVID-19 baseline data for the exact same dates in 2019.

To quantify the potential impact of the institutional COVID-19 surge plan on the resident operative experience, we tabulated the number of operations performed for select resident rotations at the UCSF hospitals between March 15th to April 15th for 2019 (baseline) and 2020 (pandemic). The services audited included: acute care surgery, elective foregut and abdominal surgery (complex abdominal wall and minimally invasive surgery), colorectal surgery, surgical oncology, endocrine surgery, and pediatric surgery. The procedure was only included if a UCSF resident was documented in the Epic operative log as participating in the case. We used the change in operative volume at UCSF as a proxy measure of operative volume changes throughout all hospital sites. We then correlated the pandemic's impact on operative volume with the level of resident concern about decreased case numbers.

Statistical Analysis

All responses were collected within the Qualtrics portal and then analyzed using RStudio¹⁵—an open access programming platform for statistical computing. Because many of the responses were ordinal and not normally distributed, a Kruskal-Wallis test with a significance level of $p = 0.05$ was used to compare distributions of answers across groups (i.e., across hospital sites or across resident groups). If the Kruskal-Wallis test was significant, post-hoc analysis was performed using the Bonferroni-corrected Dunn test to analyze one-to-one differences between groups. The Wilcoxon rank sum test with continuity correction and a significance level of $p = 0.05$ was used to assess differences in population distributions when only 2 populations were being compared. Prevalence ratios were calculated using unconditional maximum likelihood estimation (Wald), and corresponding p -values were calculated using Fisher's exact method.

RESULTS

Survey Respondent Data

The overall survey response rate was 73.7% ($n = 73$). Of note, the intern pool was substantially larger than any other residency year and primarily consists of residents from other surgical subspecialties and nondesignated, preliminary residents. This group constituted most of the nonresponders. When evaluating only the categorical general and plastic surgery residents, the response rate increased to 90.1%. Given the exceptional response rate, the demographics of the underlying population were well-reflected in the respondent pool, allowing for generalization. The first-year residents made up the

largest proportion of respondents at 43.8% (Table 1). The junior residents accounted for 28.8% of the respondents. The senior residents filled out the remaining 27.4% of the respondent population. Because each question within the survey was optional, there is slight variation in the total number of responses for some outcome variables. However, the average rate of completion for the questions within the survey was 99.0%.

Resident Work Hours

In the survey, one shift was defined as a 12 to 14-hour period. The average weekly duty hours for residents during the 2019 reference period compared to the 2020 study period (both March 15th to April 15th) demonstrated a reduction, on average, of 19.7 hours per resident ($\sigma = 17.5$ hours). This decrease in hours resulted from deliberate alterations to rotation staffing and scheduling in an attempt to limit potential resident work-related exposure to COVID-19. The survey distribution corroborates this reduction in work hours for the majority of residents, but certainly not all of them. Nearly 46%

TABLE 1. Demographic Information of Survey Respondents

Variable	Number of Responses (%)
Gender	
Female	41 (56.2)
Male	31 (42.5)
Prefer not to say	1 (1.4)
Residency level	
Intern	32 (43.8)
Junior resident	21 (28.8)
Senior resident	20 (27.4)
Relationship status	
Married/in a relationship & living together	44 (60.3)
Married/in a relationship & NOT living together	12 (16.4)
Single	15 (20.5)
Separated	1 (1.4)
Widowed	0 (0)
Prefer not to say	1 (1.4)
Number of people living in the home with you	
Alone	18 (24.7)
1	43 (58.9)
2	5 (6.8)
3	5 (6.8)
4+	2 (2.7)
Children living in the home	
No	70 (95.9)
Yes	3 (4.1)
Immunocompromised or elderly living in the home	
No	68 (93.2)
Yes	5 (6.8)

TABLE 2. Distribution of Responses for the Average Shift Number per Week, Risk Perception, and Anxiety About the Possibility of Exposure to COVID-19 Stratified by Resident Group

Independent Variable	Resident Year			Total Number All Residents (%)
	Intern	Junior Resident	Senior Resident	
Average number of shifts/week				
0 shifts	1	1	1	3 (4.2)
1-2 shifts	3	3	1	7 (9.7)
3-4 shifts	8	2	2	12 (16.7)
5 shifts	6	7	4	17 (23.6)
6 or more shifts	13	8	12	33 (45.8)
Risk perception of contracting COVID-19				
Unlikely	2	3	4	9 (12.5)
Neither likely nor unlikely	15	3	7	25 (34.7)
Likely	10	11	6	27 (37.5)
Very likely	4	4	3	11 (15.3)
Anxiety about the possibility of exposure to COVID-19				
Not stressed or anxious at all	3	0	1	4 (5.5)
Slightly stressed or anxious	14	13	11	38 (52.1)
Moderately stressed or anxious	15	7	7	29 (39.7)
Extremely stressed or anxious	0	1	1	2 (2.7)

of residents reported working an average of 6 shifts per week (Table 2), which corresponds to approximately the same number of hours per week that they were working prior to the pandemic.

Operative Educational Experience

Direct comparison of historical operative case volumes (March and April, 2019) with case volumes during the pandemic (March and April 2020) revealed an expected but profound decrease in the number of surgeries. Overall, there were 178 fewer cases performed during the 2020 pandemic period compared to the reference period, which represents a 63.3% reduction in expected operative case numbers for residents that month. While the variation in case numbers between the 2 main UCSF sites was substantial (Table 3), the degree of resident concern over the decreased operative load did not vary significantly by rotation site or resident group (Fig. 1). The vast majority of residents indicated some level of concern regarding the loss of operative experience.

COVID-19 Risk Perception and Anxiety-Related Responses

When looking at the overall distribution of responses stratified by resident year, the highest proportion of residents working 5 or more shifts per week occurred in the senior resident group. For perceived risk of contracting COVID-19, the junior resident group had the highest proportion of “likely” or “very likely” responses. Although the majority (54.8%) of interns felt that their risk of contracting COVID-19 was unlikely or neutral, they were the group with the highest proportion of moderate or extreme anxiety responses regarding the possibility of contracting COVID-19 (Table 2). No significant difference in risk perception scores for contracting COVID-19 ($\chi^2 = 7.07$, $p = 0.22$) was identified among the residents working different numbers of shifts in the hospital. The distribution of scores for risk perception and for anxiety were similar across resident groups (intern, junior resident, and senior resident). We also examined the relationship between perceived likelihood of contracting COVID-19 with anxiety levels around

TABLE 3. Case Number Breakdown by Hospital Site and Year

Hospital Site	2019 (Baseline)		2020 (Pandemic)		Comparison	
	Number of Cases	Average Number of Minutes per Case	Number of Cases	Average Number of Minutes per Case	Absolute Difference in Case Number	Percent Change in Case Number
Mission Bay	151	172.8	75	229.1	-76	-50.3%
Parnassus	130	198.4	28	200.7	-102	-78.5%
Total	281	184.6	103	221.4	-178	-63.3%

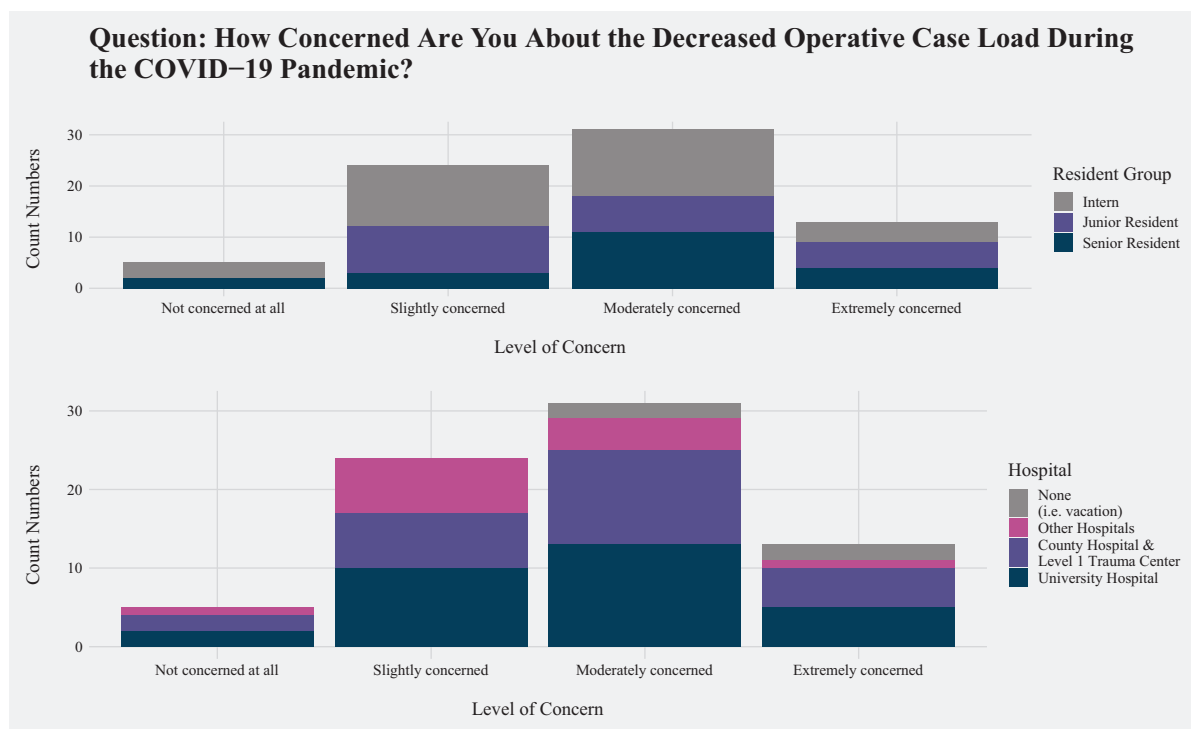


FIGURE 1. Residents endorse concern over decreased operative case load regardless of resident rank or current hospital site.

the possibility of exposure to COVID-19 and found no significant variation across groups ($\chi^2 = 0.32$, $p = 0.96$). In other words, respondents who believed their risk of contracting COVID-19 was high were not more likely to report high anxiety levels regarding their possibility of contracting COVID-19.

When asked about sources of anxiety related to their potential contraction of COVID-19, residents overwhelmingly reported “risk to loved ones” (84% of respondents) as the most anxiety-provoking aspect of their potential contraction of COVID-19, followed by “risk to patients” (55% of respondents). “Risk to self” was the third most frequent answer (47% of respondents). In the context of the COVID-19 pandemic, 84% of residents endorsed moderate or extreme anxiety regarding the general health and well-being of loved ones who do not live with them. The median response for anxiety about the possibility of exposure to COVID-19 was “slight anxiety” whereas the median response for anxiety about the well-being of loved ones was “moderate anxiety.” The distribution of responses was significantly shifted toward higher responses for anxiety for loved ones than for anxiety regarding personal risk ($U = 3897.5$, $p < 0.01$).

Based on support-related responses, many residents felt generally well-supported during the pandemic (Fig. 2). However, despite the overall positive ratings for level of support, there was a substantial number of residents ($n = 10$) with GAD-7 scores that met criteria for moderate

or severe generalized anxiety (total score ≥ 10). When dichotomizing the GAD-7 scale into low and high scores (low = 0-9, high = 10-21), there were significant differences across resident groups (intern, junior, and senior resident) ($\chi^2 = 7.96$, $p = 0.02$). Post-hoc comparisons revealed significantly higher GAD-7 scores for senior residents compared to interns ($z = -2.82$, $p\text{-adj} = 0.014$) (Fig. 3). In fact, the senior residents were 10.11 times more likely to have a high GAD-7 score than the interns (95% CI: 1.31-77.68, $p < 0.01$). Residents who were in a relationship and living with their significant other were also more likely to have high GAD-7 scores when compared to residents who were either not in a relationship or not living with their significant other (20.9% vs. 3.6%, respectively), but these results were not statistically significant ($p = 0.08$).

DISCUSSION

This study illustrates that while the COVID-19 pandemic and the educational program changes necessitated to address it are impacting surgical trainees in different and sometimes unpredictable ways, many surgical residents share common anxieties. Although work hours differed among residents, their risk perception scores and anxiety about personal exposure to COVID-19 were not associated with time spent in the hospital. In the context of training-specific concerns, residents remained worried

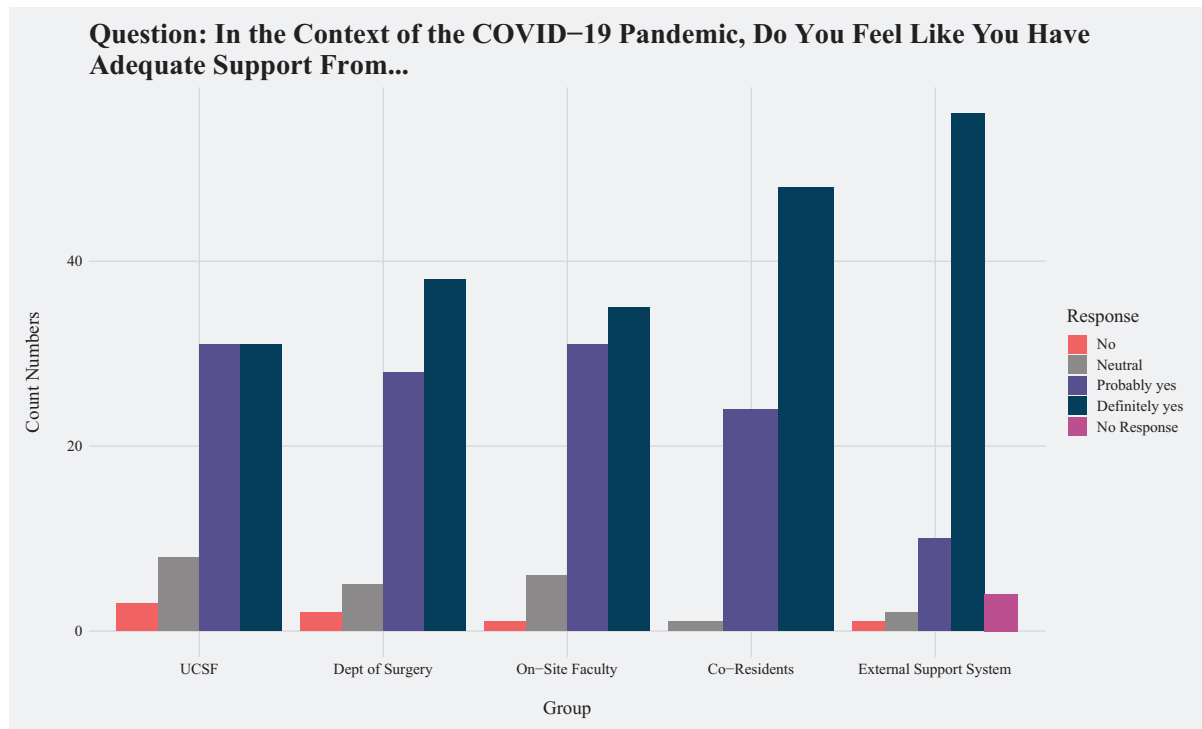


FIGURE 2. The majority of residents feel supported during the pandemic with the most positive ratings for co-residents and external support networks

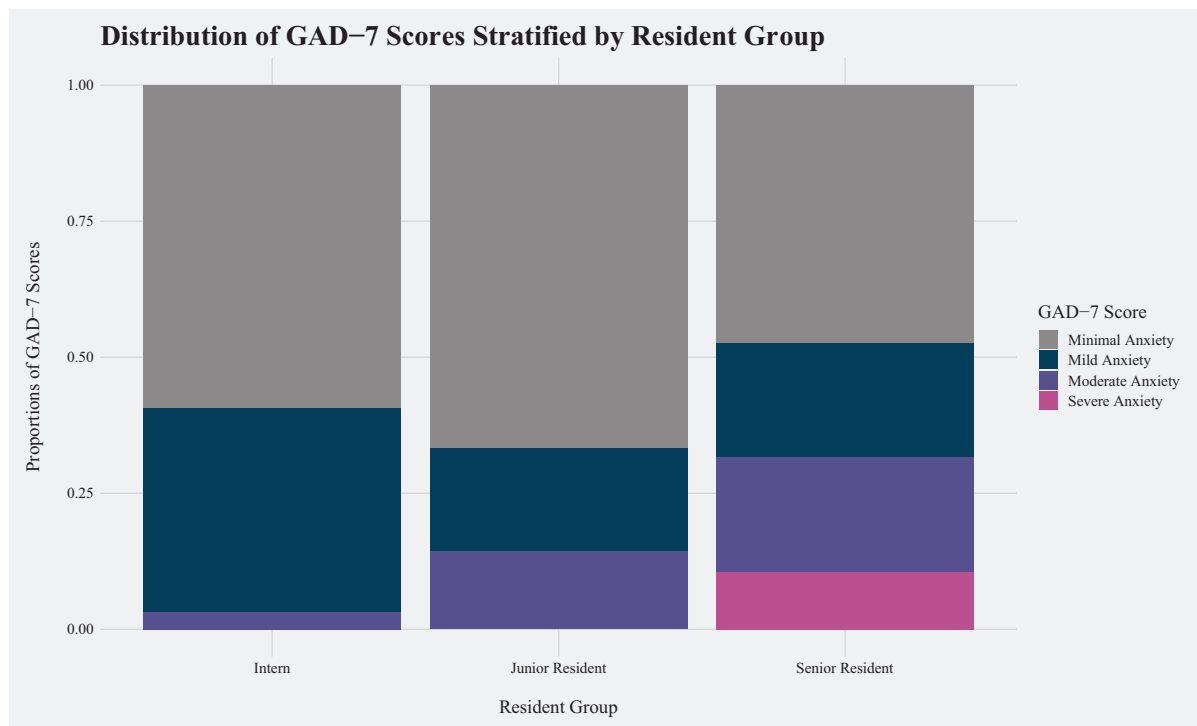


FIGURE 3. Senior residents are significantly more likely to have high GAD-7 scores (moderate or severe anxiety) when compared to interns.

about the decreased operative volume regardless of the case numbers at their current rotation site, suggesting that some of the concern was related to the uncertain future beyond the immediate surge. On a more personal level, surgical resident anxieties seemed to focus on concern for others—specifically, for loved ones whom they are not able to directly care for during this time. They were also anxious about the risk they could pose to loved ones and patients should they become unknowingly infected with COVID-19. While senior residents expressed similar levels of anxiety around COVID-19 as the other resident groups, generalized anxiety scores were significantly higher in the senior resident group—suggesting that some of their anxiety was possibly related to uncertainty around a time of impending transition in their professional development as opposed to the immediate COVID-19 surge planning.

Despite the short time course of the COVID-19 pandemic in the United States, some perspective articles and preliminary studies have been published detailing initial challenges encountered with surgical education during the COVID-19 pandemic.¹⁶⁻¹⁸ The authors posit initial suggestions for adapting surgical learning to the new socially distanced landscape, including pooling of educational resources across institutions and free access to online surgical video libraries.¹⁸ But there has been little investigation or quantification of the emotional toll that these pragmatic but abrupt changes have generated among surgical trainees. While the healthcare community is navigating through uncharted waters, prior experience with the SARS epidemic provides the closest comparison for contextualization and insight into potential downstream effects. Unfortunately, only a handful of papers were published about the impact of SARS on medical education.^{19,20} Lim et al. delineated several strategies that can be utilized for continuing the mission of medical education in the context of an epidemic—including leveraging virtual formats.²¹ One Hong Kong study described the reduction in colorectal surgery cases during the SARS epidemic, but long-term consequences could not be assessed at the time of publication.²² To our knowledge, no studies have assessed the longitudinal impact of infectious epidemics on the education of surgical trainees. Surgical trainees need operating room exposure to gain the experiential, procedural knowledge that informs technical competency. While virtual reality and video conferences can reliably reproduce certain aspects of in-hospital medical education, they fall short of the mark for instilling technical expertise within procedural specialties.

Our survey and case volume analysis illustrate that the in-hospital experience of residents during the COVID-19 pandemic can vary tremendously by hospital site. For instance, surgical residents in some hospitals continued

to participate in complex cancer operations, while residents on elective general surgery services witnessed their operative volume virtually disappear. Despite the contrasting experience among residents, almost all of them endorsed some level of concern about the decreased operative volumes regardless of the hospital in which they were working. The American Board of Surgery has responded to the nationwide case reduction with “Hardship Modifications” that include adjusted case requirements for graduating chief residents, but these modifications fail to address the long-term impact that COVID-19 may have upon resident education.²³

Our plastic and general surgery residents are distributed across San Francisco at several hospital sites—all with different patient demographics and organizational structures. This situation creates marked scheduling challenges due to different restrictions and levels of flexibility at each particular hospital. The variability in work hours reported within the survey reflects this complexity and, at times, inflexibility. We hypothesized that increased time in the hospital might drive higher risk perception and anxiety scores due to the increased opportunity for exposure to COVID-19. In the end, resident anxiety about exposure to COVID-19 was not related to how much time they worked in the hospital. Resident risk perceptions for contracting COVID-19 also did not correlate with subsequent ratings of anxiety about the possibility of exposure to COVID-19. In fact, all negative and neutral respondents on the risk perception scale (“unlikely” and “neither likely nor unlikely”) reported slight to moderate levels of anxiety about the possibility of COVID-19 exposure. Conversely, some residents who thought infection with COVID-19 was “likely” or “very likely” subsequently reported having no anxiety about the possibility of exposure. Simply put, risk perception does not reliably translate to subsequent anxiety scores.

Even when residents reported anxiety about COVID-19, responses indicated that their anxiety did not necessarily stem from their own risk of harm. On the contrary, respondents reported anxiety about the risk they would then pose to loved ones and patients, first and foremost, followed by risk to themselves. The higher ratings of anxiety about the well-being of physically distant loved ones reinforces this theme of anxiety rooted in concern for others. The distribution of responses was significantly skewed towards higher anxiety levels for loved ones when compared to the distribution of responses for anxiety about self-contraction of COVID-19.

Last, we found that while COVID-19 associated anxiety was evenly distributed among resident training levels, higher GAD-7 scores were disproportionately found among senior residents. Although this is a single institution study, senior residents have unique circumstances and

stressors during this time that may account for our findings. First, senior residents serve as the leaders of their surgical teams and thus carry the highest burden of responsibility. They likely feel that some of their teammates' anxieties rest on their shoulders. Additionally, the senior years of surgical training incorporate a large volume of operative experience to solidify the foundations of surgical knowledge and promote the transition from resident to junior attending or fellow. Unlike junior residents, senior residents do not have additional years of training remaining to make up adversely impacted areas of operative exposure. Therefore, reduction in case volume may lead to increased anxiety among senior residents that they will not be prepared for the next segment of their career. Further, although not statistically significant, those residents who were in a relationship and living with their significant other tended to have higher GAD-7 scores. Because senior residents are more likely to be married and cohabitating with a significant other, their higher GAD-7 scores may reflect some anxiety about the risk of giving COVID-19 to a partner. While the presence of children or elderly people in the home was not more common among our senior residents, it may be an important contributor to anxiety in other surgical trainee populations.

While our findings are interesting, there are important limitations that should be considered. Because surgical residency programs are relatively small in comparison to other groups (i.e., internal medicine), we were constrained in our ability to make statistical claims about trends noted within the survey responses. These results reflect the anxieties and concerns among general and plastic surgery residents within a single institution and may not necessarily be generalizable to other surgical residencies. Last, we had no prior GAD-7 scores for residents that would allow for within subject comparisons to isolate the effects that the COVID-19 pandemic has had on generalized anxiety levels. As a result, we cannot definitively state that the high anxiety levels observed in some residents stemmed directly from repercussions of the COVID-19 pandemic. Given the high levels of burnout already documented among surgical residents,²⁴⁻²⁷ surgical training programs may benefit from ongoing monitoring with validated scoring instruments for anxiety, like the GAD-7. The implementation of wellness programs and resilience training can further address this issue.^{5,28-31}

In conclusion, we found that resident work-related experiences during the COVID-19 pandemic have varied substantially across resident groups and hospital sites, yet these differences did not reliably predict subsequent anxiety levels. While we may have only scratched the surface of possible sources of anxiety for surgical residents, a repeated theme centered on a perceived inability to protect and/or care for loved ones during the pandemic. Though COVID-19 represents a healthcare

crisis, its impact on surgical trainees extends far beyond the walls of the hospital. It is important for residency programs to be aware of these outside stressors such that they can work to ensure adequate support for residents during such an unprecedented and stressful time.

The repercussions of the COVID-19 pandemic will likely be far-reaching into the future. It is imperative that healthcare systems and graduate surgical education training programs flex to adapt to this new reality.

CONFLICTS OF INTEREST

Dr. Caitlin Collins's research is funded through a training grant from the National Institute of Diabetes and Digestive and Kidney Diseases. Dr. Julie Ann Sosa is a member of the Data Monitoring Committee of the Medullary Thyroid Cancer Consortium Registry supported by GlaxoSmithKline, Novo Nordisk, Astra Zeneca and Eli Lilly. She receives institutional research funding from Exelixis and Eli Lilly. Dr. Elizabeth Wick receives institutional research funding from the Agency for Healthcare Research and Quality. No other authors have financial or personal interests to declare that could undermine or perceive to undermine the objectivity, integrity, and value of the publication.

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SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.jsurg.2020.07.031.