Exploring the Experience of the Surgical Workforce During the Covid-19 Pandemic

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Objective: To explore the impact of the Covid-19 pandemic on the stress levels and experience of academic surgeons by training status (eg, housestaff or faculty).

Background: Covid-19 has uniquely challenged and changed the United States healthcare system. A better understanding of the surgeon experience is necessary to inform proactive workforce management and support.

Methods: A multi-institutional, cross-sectional telephone survey of surgeons was conducted across 5 academic medical centers from May 15 to June 5, 2020. The exposure of interest was training status. The primary outcome was maximum stress level, measured using the validated Stress Numerical Rating Scale-11 (range 0–10).

Results: A total of 335 surveys were completed (49.3% housestaff, 50.7% faculty; response rate 63.7%). The mean maximum stress level of faculty was 7.21 (SD 1.81) and of housestaff was 6.86 (SD 2.06) ($P = 0.102$). Mean stress levels at the time of the survey trended lower amongst housestaff (4.17, SD 1.89) than faculty (4.56, SD 2.15) ($P = 0.076$). More housestaff (63.6%) than faculty (40.0%) reported exposure to individuals with Covid-19 ($P < 0.001$). Subjects reported inadequate personal protective equipment in approximately a third of professional exposures, with no difference by training status ($P = 0.557$).

Conclusions: During the early months of the Covid-19 pandemic, the personal and professional experiences of housestaff and faculty differed, in part due to a difference in exposure as well as non-work-related stressors. Workforce safety, including adequate personal protective equipment, expanded benefits (eg, emergency childcare), and deliberate staffing models may help to alleviate the stress associated with disease resurgence or future disasters.

Keywords: COVID-19, coronavirus, surgery, surgeon, stress, workplace, workforce

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On March 11, 2020, the World Health Organization declared the Coronavirus Disease 2019 (Covid-19) pandemic.[1] In the following 4-month period in 2020, Covid-19 killed over 100,000 people in the United States (US).[2] The disease has presented healthcare systems in the US and across the globe with unprecedented challenges and demands, overwhelming the capacity of intensive care units and morgues.[3–7] For the surgical workforce in the United States, the experience immediately changed the practice of surgery.

On March 18, 2020, in a historic move, the Centers for Medicaid and Medicare Services formally recommended the delay of all elective surgical procedures due to severe shortages of personal protective equipment (PPE) (eg, standard surgical masks), ventilators, critical medications, and medical personnel.[8] Surgical volume diminished to emergent and urgent cases only. Surgeons called to operate in this setting were faced with limited PPE and decision-making with insufficient data on exposure risks for both patients and healthcare providers.[9] The near 80% decline in operative volume resulted in surgeon availability for redeployment to makeshift intensive care units, emergency room tents, and other unfamiliar settings, to care for Covid-19 patients.[6,10,11] Simultaneously, many surgeons waited on the sidelines unsure of their role, cast aside from their previously essential role in healthcare, and unable to offer care to their surgical patients with non-emergent needs.[9]

Surgical faculty and housestaff fill different roles within their organizations, often shouldering different responsibilities due to differences in skill sets and reporting structures. As such, in this study, we sought to better understand the experience and stress levels of surgeons in academic medical centers within the United States, paying particular attention to training status. We sought to explore the impact of the early months of the Covid-19 pandemic on both housestaff and faculty to better inform healthcare leadership around proactive workforce management during periods of disease resurgence and future public health disasters.

METHODS

A multi-institutional, cross-sectional survey study of the surgical workforce was conducted at the Brigham and Women's Hospital, New York – Weill Cornell Medical Center, the University of Michigan, the Hospital of the University of Pennsylvania, and the University of California, San Francisco. The five academic medical centers were deliberately chosen for their geographic diversity and availability of robust resources to conduct a labor-intensive workforce study during the pandemic. Research team members from all institutions met weekly through video conference to maintain consistency across sites in survey practices. The Institutional Review Board (IRB) at the University of Pennsylvania approved the study protocol and agreed to additionally be the IRB of record using the Streamlined, Multisite, Accelerated Resources for Trials (SMART) IRB Reliance Platform for four of the five sites (IRB Protocol #8943009). The study protocol was also approved by the IRB of Weill-Cornell Medicine (IRB Protocol #20–04021776-02).

Data on Covid-19 disease burden were obtained for the United States overall and for the county of each study site using publicly

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available daily cumulative confirmed case totals, available for download from USAFacts, a not-for-profit online resource for government data.[12] Given the anxiety associated with the burden of disease in the population surrounding each hospital, we considered the epidemiologic incidence of disease in the surrounding county. The Covid-19 daily incidence was calculated for each day between January 22, 2020, and June 5, 2020, by subtracting the prior days' cumulative total from the current days' cumulative total. For each county, the peak daily incidence and the date of the peak were determined by identifying the highest number of new confirmed cases in a single day. The study period daily incidence was calculated as the mean of the daily incidences for each day of the study period (May 15, 2020–June 5, 2020). The calculated incidences were normalized to county population using 2019 United States Census estimates, also available from USAFacts.[12] Study sites were subsequently designated as high and low incidence groups during the peak and during the study period. "High" sites were defined as above those with an incidence above the United States' overall incidence for the relevant time period, and the remainder of sites were designated as "Low."

Surgical housestaff and faculty practicing at the sponsor institution within the Department of Surgery at each of the five study sites were eligible for inclusion. Eligibility varied slightly by site due to the differences in the organizational structure of each institution. The survey instrument was designed by the study team to be used in the context of a phone interview, iteratively revised, and piloted at each site before the conduct of the study. Concepts from the lay press and medical literature unique to disasters were used to inform survey design.[13,14] The final survey included 25 potential items. Branching logic was used to minimize the survey burden. Stress levels were assessed using the validated self-reported stress measure, the stress numerical rating scale-11 (Stress NRS-11).[15] Subjects reported their maximum stress level, defined as the highest level of stress experienced during the pandemic, and their current stress level, defined as the level of stress at the time of survey completion (range from 0, lowest, to 10, highest). The survey included items on basic demographics, training status, domestic status and support, and workplace and personal experiences specific to the Covid-19 pandemic. See supplemental digital content for the survey instrument.

Research coordinators at each site were trained on survey conduct using a recorded instructional video presentation, a frequently asked questions document, and a one-hour video conference to resolve remaining questions and standardize procedures. Local coordinators contacted each eligible subject by phone or by email to gauge interest in voluntary participation in the study. Subjects were contacted a maximum of three times before being classified as a nonresponder. After obtaining verbal informed consent for study participation, a 10- to 15-minute structured interview was conducted using the survey instrument. Survey results were collected using REDCap,[16,17] an encrypted web-based database, hosted at the University of Pennsylvania.

The primary outcome was maximum self-reported stress level by surgeon level (housestaff or faculty). Secondary outcomes included self-reported stress level at the time of survey completion, as well as stressors.

Descriptive statistics and univariate analyses were performed using chi-square tests and ANOVA as appropriate. Subset analyses were performed by site high-low Covid-19 incidence status during the peak and study period time frames. All statistical analysis was performed using STATA (Version 15.1, StataCorp).[18] Figures were generated using GraphPad Prism version 8.2.1 for Windows (GraphPad Software, San Diego, California, USA, www.graphpad.com).

RESULTS

This study was conducted across five academic medical centers, with a mean of 106.8 [standard deviation (SD) 40.1] surgical housestaff and 86.2 (SD 18.2) surgical faculty eligible to participate at each site. Between May 15 and June 5, 2020, a total of 529 surgeons were contacted and 337 consented to participate, resulting in a 63.7% overall response rate. There were 335 complete surveys included in final analysis, 165 housestaff (49.3%) and 170 faculty (50.7%). Housestaff were significantly younger than faculty, with a mean age of 31.0 (SD 2.8) as compared to 47.6 (SD 9.0) for faculty ($P < 0.001$). The mean number of postgraduate years of the housestaff was 3.4 years (SD 2.1). Gender distribution differed significantly between housestaff and faculty; 47.9% of housestaff were female, compared to 33.5% of faculty ($P = 0.008$). The majority (70.0%) of faculty and the minority (18.8%) of housestaff had children ($P < 0.001$). Self-reported specialty distribution varied significantly with the majority of housestaff (77.6%) designated as general surgery, as opposed to a small minority (4.7%) of the faculty. The most common specialties among faculty were colorectal surgery (n = 21); trauma, acute care, and surgical critical care surgery(n = 19); surgical oncology (n = 12); plastic and reconstructive surgery (n = 11). A substantial majority of both housestaff (90.3%) and faculty (88.8%) experienced a decrease in operative caseload and were notified of potential redeployment (81.8% of housestaff and 79.2% of faculty). There was no difference in redeployment rates between housestaff (26.7%) and faculty (26.5%) ($P = 0.968$). See Table 1. The mean overall reported maximum stress level was 7.04 (SD 1.95, scale from 0 to 10), significantly higher than the mean reported stress level at the time of survey completion of 4.37 (SD 2.03) ($P < 0.001$).

Peak Stress Level

The overall peak daily incidence of the United States was 11.40 cases per day per 100,000 population. Based on this, all study sites were classified as high peak incidence sites. See Table 2. The overall mean maximum stress level was 7.04 (SD 1.95). Housestaff had a mean maximum stress level of 7.21 (SD 1.81), trending slightly higher than that of the faculty, 6.86 (SD 2.06) ($P = 0.102$). See Table 3. No comparisons were able to be made between high and low peak incidence sites, as all study sites were classified as high.

Current Stress Level

The overall mean study period daily incidence of the United States was 6.69 cases per day per 100,000 population (SD 0.81). Based on this, three study sites were classified as high study period incidence sites, and the remainder were classified as low. See Table 2.

The overall mean current stress level was 4.37 (SD 2.03). Housestaff had a mean current stress level of 4.17 (SD 1.89), which trended lower than the mean current stress level for faculty of 4.56 (SD 2.16) ($P = 0.076$). See Table 2. Current stress level did not differ significantly between high study period Covid-19 incidence sites (mean 4.19, SD 1.99) and low study period Covid-19 incidence sites (mean 4.49, SD 2.06) ($P = 0.177$). In high study period Covid-19 incidence settings, the mean current stress score for housestaff was 4.45 (SD 1.97) and for faculty was 4.55 (SD 2.17) ($P = 0.732$). In low study period Covid-19 incidence settings, the current stress score for housestaff (mean 3.73, SD 1.68) was significantly lower than for faculty (mean 4.59, SD 2.15) ($P = 0.012$). See Figure 1.

Covid-19 Exposures

Significantly more housestaff (63.6%) than faculty (40.0%) reported known exposure to individuals with Covid-19 ($P < 0.001$). The vast majority of reported COVID-19 exposures were in the professional setting (97.7%). Subjects reported to have had perceived

TABLE 1. Population Characteristics and Professional Experience

Population Characteristics	Total	Housestaff	Faculty	*P*-value
Survey respondents, N (%)	335 (100.0)	165 (49.3)	170 (50.7)	
Age, mean (SD)	39.4 (10.7)	31.0 (2.8)	47.6 (9.0)	<0.001
Female, N (%)	136 (40.6)	79 (47.9)	57 (33.5)	0.008
Children, N (%)	150 (44.8)	31 (18.8)	119 (70.0)	<0.001
Specialty, N (%)				<0.001
General surgery	136 (40.6)	128 (77.6)	8 (4.7)	
Plastic and reconstructive surgery	34 (10.1)	23 (13.9)	11 (6.5)	
Colorectal surgery	21 (6.3)	0 (0.0)	21 (12.4)	
Trauma, acute care, and surgical critical care	20 (6.0)	1 (0.6)	19 (11.2)	
Surgical oncology	14 (4.2)	2 (1.2)	12 (7.1)	
Other	110 (32.8)	11 (6.7)	99 (58.2)	
Professional experience, N (%)				
Operative caseload				0.590
Increased	1 (0.3)	0 (0.0)	1 (0.6)	
Decreased	300 (89.6)	149 (90.3)	151 (88.8)	
Stayed the Same	34 (10.1)	16 (9.7)	18 (10.6)	
Notified of potential redeployment	198 (80.5)	99 (81.8)	99 (79.2)	0.604
Redeployed	89 (26.6)	44 (26.7)	45 (26.5)	0.968

TABLE 2. Covid-19 Incidence by Study Site

Location	County	Peak Date	Peak Incidence	Study Period Incidence, mean (SD)
United States (overall)	N/A	4/24/2020	11.40	6.69 (0.81)
Brigham and Women's Hospital (Boston, MA)	Suffolk	4/24/2020	**122.53**	**16.83 (15.76)**
Hospital of the University of Pennsylvania (Philadelphia, PA)	Philadelphia	4/9/2020	**36.17**	**9.62 (3.17)**
University of California, San Francisco (San Francisco, CA)	San Francisco	5/22/2020	**13.84**	3.60 (3.10)
University of Michigan (Ann Arbor, MI)	Washtenaw	6/5/2020	**48.15**	3.62 (9.37)
New York - Weill Cornell Medical Center (New York City, NY)	New York	4/15/2020	**106.55**	**7.01 (3.15)**

(1) All incidences are reported as new cases per day per 100,000 population. (2) Incidences considered to be in the ''high'' group for the time period are indicated in bold.

TABLE 3. Stress Level, Covid-19 Contact, and Stressors by Professional Status

Stress Level, mean (SD)	Total	Housestaff	Faculty	*P*-value
Maximum	7.04 (1.95)	7.21 (1.81)	6.86 (2.06)	0.102
At time of survey	4.37 (2.03)	4.17 (1.89)	4.56 (2.15)	0.076
COVID-19 exposure, N (%)				
Yes, had exposure	173 (51.6)	105 (63.6)	68 (40.0)	<0.001
Professional exposure	169 (97.7)	102 (97.1)	67 (98.5)	0.553
Perceived inadequate PPE	60 (35.5)	38 (37.3)	22 (32.8)	0.557
Community exposure	16 (92)	12 (11.4)	4 (5.9)	0.557
Both	12 (6.9)	9 (8.6)	3 (4.4)	0.293
Tested for COVID-19	83 (24.8)	45 (27.3)	38 (22.4)	0.297
Positive	11 (13.3)	8 (17.8)	3 (7.9)	0.140
Negative	70 (84.3)	37 (82.2)	33 (86.8)	
No Disclosure	2 (2.4)	0 (0.0)	2 (5.3)	
Stressors				
Total no. of stressors (all respondents), mean (SD)	4.61 (2.05)	4.30 (1.83)	4.92 (2.21)	0.006
Stressors (all respondents), N (%)				
Financial	119 (35.5)	51 (30.9)	68 (40.0)	0.082
Becoming seriously ill	241 (71.9)	125 (75.8)	115 (58.2)	0.126
Infecting elderly family members	200 (59.7)	104 (63.0)	96 (56.5)	0.221
Infecting my partner	252 (75.2)	122 (73.9)	130 (76.5)	0.592
Practicing outside of my specialty	156 (46.6)	84 (50.9)	72 (42.4)	0.117
Facing ethical concerns due to limited healthcare resources	221 (66.0)	112 (67.9)	109 (64.1)	0.468
Other	128 (38.2)	58 (35.2)	70 (41.2)	0.257
Stressors (respondents with children), N (%)				
Infecting my children	128 (85.3)	30 (96.8)	98 (82.4)	0.043
Orphaning my children	75 (50.0)	17 (54.8)	58 (48.7)	0.545

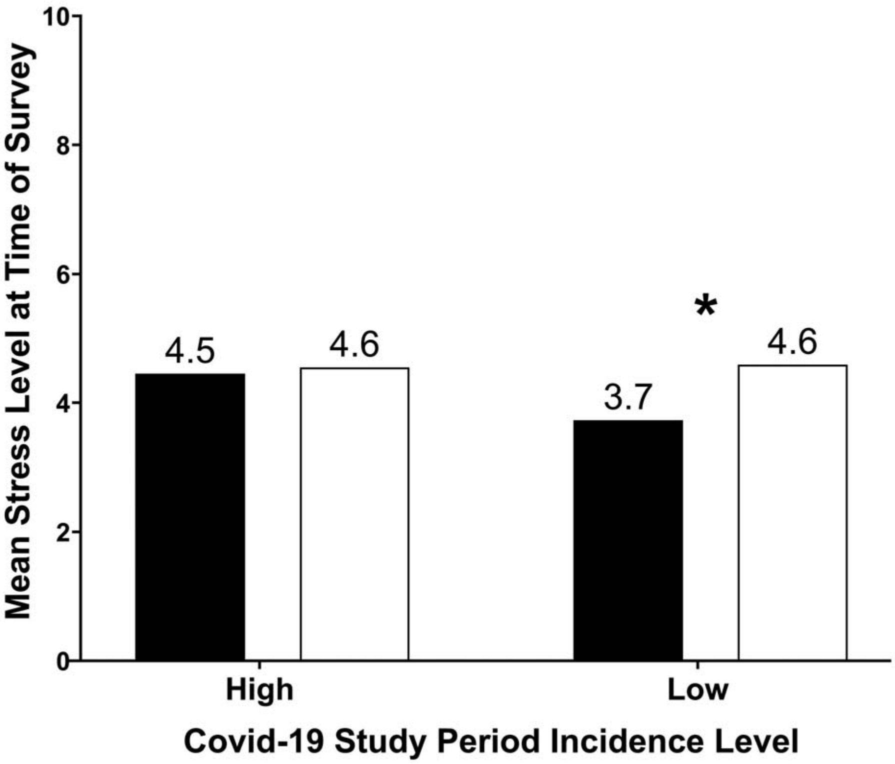

FIGURE 1. Study period stress levels of housestaff and faculty by high and low Covid-19 incidence groups. Covid-19 incidence groups were determined by the Covid-19 daily incidence in the study site counties during the study period. Asterisk (*) indicates *P*-value <0.05.

inadequate PPE in approximately a third of professional exposures, and there was no difference between housestaff and faculty (37.3% for housestaff, 32.8% for faculty) ($P = 0.557$). Covid-19 testing of 27.3% of housestaff and 22.4% of faculty was reported. Of those tested, 13.3% reported testing positively and there was no difference between housestaff and faculty ($P = 0.140$). See Table 3.

Stressors

Overall, study respondents reported a mean of 4.51 (SD 2.05) stressors out of 9 possible choices. Housestaff reported a mean of 4.30 (SD 1.83) stressors and faculty reported a mean of 4.92 (SD 2.1) stressors ($P = 0.006$). The majority of respondents reported being stressed about becoming seriously ill (71.9%), infecting elderly family members (59.7%), infecting partners (75.2%), and facing ethical concerns regarding limited healthcare resources (66.0%). There was a trend toward a greater proportion of faculty having financial stress when compared to housestaff (40.0% vs 30.9%) ($P = 0.082$). Among survey respondents with children under the age of 18, 85.3% were concerned with infecting their children and 50.0% were concerned with orphaning their children. When compared to faculty with children (82.4%), a greater proportion of housestaff with children (96.8%) reported that infecting their children was a stressor ($P = 0.043$).

DISCUSSION

This is the first multicenter study to explore the personal and professional experience of surgeons during the Covid-19 pandemic. Surgeons faced with a high incidence of Covid-19 experienced the greatest stress during the early months of the pandemic, regardless of faculty or housestaff status. Although the numeric stress levels did not differ significantly between housestaff and faculty, faculty experienced a greater total number of stressors when compared to the housestaff. Additionally, the experience of housestaff and faculty differed as did the factors underlying the reported stress. In the months that followed, there was a trend towards higher stress levels among faculty when compared to the housestaff, which was pronounced in the sites with lower Covid-19 incidence during the study period.

Almost 90% of surgeons witnessed a reduction in operative volume. Despite the limited opportunity to deliver surgical care, the majority of surgeons remained clinically active and experienced professional contact with Covid-19 patients. The housestaff, in particular, had the greatest exposure (60%). This is consistent with a survey of program directors across specialties in New York City that reported the majority of resident physicians were impacted by Covid-19, either through infection, quarantine due to exposure, or redeployment.[19] In keeping with the longstanding legacy of surgical housestaff commitment to patient needs and refuting concerns over the professionalism of our youngest surgeons,[20] all surgeons cared for patients in the perceived absence of adequate PPE. It is important to recognize that we could not determine whether or not individuals had adequate PPE according to the Centers for Disease Control guidelines, due to changing PPE standards during the study period. As such, we examined only the perception of adequacy of PPE. The perception of inadequate PPE was uniform across housestaff and faculty, as were the Covid-19 reported infection rates. Unfortunately, the pandemic has revealed that physicians may be faced with uncertainty regarding the safety of the working environment. Faculty and housestaff alike have shown their commitment to patient care despite these challenges.

The most novel findings from this study pertain to the stress levels of housestaff and faculty in a high intensity specialty when challenged with a global pandemic. Regardless of training status, the majority of surgeons were faced with a significant increase in their stress levels early in the pandemic. And then, despite the ongoing peak within some locations, average reported stress levels at the time of survey completion were lower amongst housestaff than faculty, a finding consistent with the fact that housestaff reported fewer stressors on average. This emphasizes the fact that exposure to Covid-19 was not the only stressor induced by the pandemic. Further, this finding was most significant in study sites with low incidence at the time of the survey, which may reflect the ability of housestaff to resume more normal work patterns while faculty were faced with a reduced annual operative volume that might have implications on financial stability.

There are many reasons why the faculty and housestaff experiences differed. Surgical trainees at academic medical centers may have been better equipped than their surgical faculty to face these challenges, due in large part to their relative lack of specialization and proximity to both general medical rotations as students, and to ICU rotations as residents.[21] The current generation of residents has also trained in an era where wellness and burnout prevention are common topics of discussion, and could be better-equipped to face and address the additional mental health challenges brought on by the pandemic.[22,23] Covid-19 was noted to have an increasing risk of mortality with increasing age, presenting senior surgical faculty—particularly those with comorbidities—with a higher threat of death from infection than their younger surgical trainees.[24] Finally, a greater proportion of faculty reported having children, a baseline stressor known to affect surgeons due to the difficulties with work-life balance,[25,26] which remain exacerbated by the effect of the pandemic on access to childcare and schooling.[27]

There are several limitations to this study. First, the phone interview platform for surveys was selected due to perceived high email volumes during the pandemic and the desire to introduce human contact in a time of social distancing, but a consequence of this choice was that many study subjects were familiar with their interviewers. This may have introduced bias into their responses. Follow-up surveys will be conducted via an anonymous online platform and will likely reveal any previously undisclosed topics without the same bias. Second, there is recall bias from asking study subjects to remember their peak stress level. As the pandemic was not the only public or private disruption during the study time period, the stress levels reported during the study time period might be not be solely attributed to Covid-19 alone. Baseline stress levels were not assessed as the pandemic was ongoing at the time of initiation of the study. However, it is interesting to note that even though the peak date of some sites was during the study period, mean surgeon stress at the time of the study period had already declined significantly from the reported maximum. Finally, this study only examined workforce issues in academic medical centers and the findings may not be applicable to the community setting, particularly as those hospitals face different financial challenges and do not typically have surgical trainees.

The finding that surgeons experienced stress during the Covid-19 pandemic is not surprising; at the time of this publication, more than 250,000 American lives have been lost, with new cases and deaths every day.[28] This comes at an immense toll for healthcare workers. By capturing the specific stresses felt by surgeons across the training spectrum, we found that the housestaff and faculty experienced the pandemic differently. This provides an opportunity to plan for the remainder of the ongoing pandemic using strategies identified from the literature and our data. First, there is evidence to suggest that coordinated confidential peer support programs may be helpful for healthcare workers facing workplace stress, both in general and in times of crisis.[29] Second, consistent with recent publications, we suggest that the expansion of safe childcare services by hospitals for faculty and housestaff would be likely to significantly aide in the reduction of stress for those with dependent children.[30] Further, given the high rates of perceived inadequate PPE in our study, institutional prioritization of the supply chain and a clear delineation of the required elements of PPE is essential. Clinical leadership should provide evidence and the rationale behind PPE recommendations to build trust and alleviate one element of the anxiety surrounding workplace safety. Finally, for high-risk surgeons, lower-risk redeployment opportunities including telehealth could allay fears of illness while empowering surgeons to make a productive contribution to patient care.

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