

Frontline Reporting from the Epicenter of a Global Pandemic: A Survey of the Impact of COVID-19 on Plastic Surgery Training in New York and New Jersey

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Background: Since the first documented case of coronavirus disease of 2019 (COVID-19), the greater New York City area quickly became the epicenter of the global pandemic, with over 500,000 cases and 50,000 deaths. This unprecedented crisis affected all aspects of health care, including plastic surgery residency training. The purpose of this study was to understand the specific impact of the COVID-19 pandemic on plastic surgery residencies.

Methods: A survey of all plastic surgery residency training programs in the greater New York City area was conducted. The impact to training during the peak months of infection (March and April of 2020) was evaluated using resident education as measured by case numbers, need for redeployment, and staff wellness as primary outcome variables.

Results: A total of 11 programs were identified in the region, and seven programs completed the survey, with a response rate 63.6 percent. When comparing productivity in March and April of 2019 to March and April of 2020, a total decrease in surgical volume of 64.8 percent (range, 19.7 to 84.8 percent) and an average of 940 (range, 50 to 1287) cancelled clinic visits per month were observed. These decreases directly correlated with the local county's COVID-19 incidence rates ($p = 0.70$). A total of 83 percent of programs required redeployment to areas of need, and correlation between local incidence of COVID-19 and the percentage of residents redeployed to non-plastic surgical clinical environments by a given program ($\rho = 0.97$) was observed.

Conclusion: As the first COVID-19 wave passes the greater New York area and spreads to the rest of the country, the authors hope their experience will shed light on the effects of the ongoing COVID-19 pandemic, and inform other programs on what to expect and how they can try and prepare for future public health crises. (*Plast. Reconstr. Surg.* 149: 130e, 2022.)

On January 21, 2020, the Centers for Disease Control and Prevention confirmed the first U.S. case of coronavirus disease of 2019 (COVID-19), the disease caused by severe acute respiratory syndrome coronavirus

2 (SARS-CoV-2).¹ By March of 2020, the World Health Organization designated COVID-19 as a pandemic and the United States declared a national emergency.²⁻⁴

At the time of this writing, there have been more than 5 million cases of COVID-19 and nearly 164,000 related deaths reported in the United States.⁵ Nearly one-fifth of the cases and a quarter

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of the deaths have been from the greater New York City area (defined as the states of New Jersey and New York).^{5,6} The population density, socioeconomic diversity, and size of the region, combined with the virus's ease of transmission, led to unparalleled rates of COVID-19 infections and deaths. It is no surprise then that the greater New York City area quickly became the national, and eventually, the global epicenter of the COVID-19 pandemic. Factors including population density, socioeconomic diversity, size, and role as an international travel hub are hypothesized to have contributed to the greater New York City area becoming the national, and eventually global, epicenter of the COVID-19 pandemic.

Early in its course, the pandemic impacted health care policy both nationally and locally—the American College of Surgeons and Centers for Medicare & Medicaid Services issued national guidelines for postponing elective and nonurgent operations given the shortage of physicians and personal protective equipment.^{7–9} In line with these guidelines, doctors including trainees were called on to serve in critically needed roles—including coming out of retirement, graduating medical school early, and temporarily working in other specialties and practice environments.¹⁰

Elective and nonurgent operations are a cornerstone of academic plastic surgery and critical experiences for residents. Although residency training has been impacted by regional disasters before (hurricanes Katrina and Sandy) and medical outbreaks (SARS epidemic), no event in recent history has impacted residencies on such a large scale.^{11–13} With the sudden freeze of many procedures essential to the practice of plastic surgery, and the reallocation of residents to serve in nonplastic surgery capacities, residency education is likely to be impacted, including potentially falling short of Accreditation Council for Graduate Medical Education–mandated graduation requirements.¹⁴ We observed a significant decrease in plastic surgical volume at our institution and sought to further delineate the overall impact on all plastic surgery training in the epicenter of the COVID-19 pandemic. In addition, we hoped to shed light on how programs can prepare and adapt to this evolving pandemic and future public health crises.

METHODS

Survey Design and Implementation

After obtaining institutional review board approval (no. 2020-11441), a survey to assess the impact of the COVID-19 pandemic on plastic

surgery training programs in the greater New York City area was developed. Training programs were identified through the American Council of Academic Plastic Surgeons and included both integrated and independent programs.¹⁵ The survey was developed using an online tool (SurveyMonkey, Inc., San Mateo, Calif.) and distributed by means of e-mail to plastic surgery residency program directors. The survey was available between May 3, 2020, and June 25, 2020, and weekly reminder e-mails were sent to encourage participation.

The impact of COVID-19 on plastic surgery training programs was evaluated based on four broad outcome measures: program and institutional policy, clinical volume, staff wellness and resource allocation, and educational opportunities. (See **Appendix, Supplemental Digital Content 1**, which shows the COVID-19 questionnaire, <http://links.lww.com/PRS/E793>.)

Program and Institutional Policy

Local and institutional policies, timelines for cancelling and restarting operations, and the use of telemedicine were evaluated. Elective operations were defined as nonemergent surgery that can be delayed and are not life- nor limb-threatening, such as face lift or body contouring. In contrast, emergency surgery was defined as surgery that must be performed without delay to avoid permanent disability or death, such as limb replantation and fasciotomy. Urgent surgery was defined as a procedure that can be safely delayed for 1 to 2 weeks, such as breast reconstruction and flexor tendon repair.

Clinical Volume

Clinical volume was evaluated using two metrics: surgical case volume and clinic visits. Data from March and April of 2020 were compared to data from March and April of 2019. Additional information regarding use of telemedicine and availability of in person appointments was obtained.

Staff Wellness and Resource Allocation

Staff wellness and resource allocation were evaluated through policies on diagnostic testing, sick leave and return to work, overall deployment and reallocation of staff, availability and use of personal protective equipment, and measures to reduce exposure to the virus.

Educational Opportunities

Educational opportunities were assessed by the number of educational conferences made

available during the pandemic as compared to before the pandemic. Possible impact on residents' ability to meet Accreditation Council for Graduate Medical Education graduation requirements was assessed, in addition to opportunities missed because of COVID-19 and any compensatory measures taken by programs.

Statistical Analysis

Results were reported in aggregate and anonymously to maintain respondent confidentiality. Demographic information was collected from corresponding program websites. Averages and ranges were used to determine spread of the data. Statistical analyses were conducted using STATA Version 16.0 software (StataCorp LLC, College Station, Texas). Continuous variables were analyzed using Spearman's correlation for nonnormally distributed data. Significant results are noted with Spearman's ρ , which measures strength of association, where $\rho = 1$ indicates a perfect positive correlation.

RESULTS

Of 11 plastic surgery residency programs in the greater New York City area, seven programs completed the survey (63.3 percent response rate). Absent or incomplete data were omitted from analyses. There exists significant heterogeneity among programs, with the smallest training program with three residents and the largest with 21, and associated variety in clinical and surgical volume. The plastic surgery resident body from the greater New York City area represents 10.2 percent of the total national plastic surgery resident body, whereas the residents represented by the respondents in this survey formed 7.1 percent of all plastic surgery residents nationwide (or 66.2 percent of the regional resident body).¹⁶ The respondents consisted of five integrated programs (71 percent), one independent program (14 percent), and one program with both (14 percent). Ninety-three percent of the trainees represented were integrated plastic surgery residents, and the programs were for the vast majority located in an urban setting (86 percent) (Table 1).

Policy and Clinical Volume

During the pandemic months of March and April of 2020, 100 percent of surveyed programs used telemedicine for routine and long-term patient follow-up (e.g., body contouring, sacral decubitus ulcers). All programs used a mix of in-person and telemedicine for recent postoperative

Table 1. Demographics

Characteristic	Descriptive Statistic (%)
No. of programs	7 (100)
Integrated	5 (71)
Independent	1 (14)
Both	1 (14)
Location	
Urban (county population >250,000)	6 (86)
Suburban (county population >100,000–250,000)	1 (14)
Residents	106 (100)
Integrated	93%
Independent	7%

follow-up (defined as <4 weeks postoperatively), and criteria for an in-person visit included concerns for wound infection, presence of drains, free flap surgery, and so forth. Although all programs managed patient complications (e.g., exposed implants, wound dehiscence) with in-person visits, 28.6 percent also used telemedicine to triage and manage these patients; 14.3 percent continued seeing new consultations in the ambulatory setting and 85.7 percent exclusively used telemedicine to interact with new patients. No programs used telemedicine for in-patient consultations.

As of May 31, 2020, 57 percent of programs needed approval of the department chairman or division chief to proceed with surgery, 43 percent required approval from a hospital committee, and 14 percent reported decisions based on published guidelines and/or individual surgeon judgment. Twenty-nine percent of programs reported not having formal institutional guidelines for approved surgical procedures during the pandemic (Table 2). Although all respondents performed emergent operations, 28.6 percent

Table 2. Policy (as of May 31, 2020)

Policy	Descriptive Statistic (%)
Means of suitability for operative intervention determination*	
Individual surgeon judgment	1 (14)
Hospital committee	3 (43)
Chief/chair	4 (57)
Published guidelines	1 (14)
Did your institution issue specific guidelines regarding surgical procedures?	
Yes	5 (71)
No	2 (29)
Types of operations performed during the pandemic*	
Emergent	7 (100)
Urgent	2 (29)
Elective	0 (0)

*Values can add up to over 100% because responses are not mutually exclusive

also continued to perform urgent operations and none performed elective operations. Fifty percent of respondents performed inpatient operations only, whereas 50 percent performed both inpatient and ambulatory operations. The timeline for resuming elective surgery varied, correlating with the phase of reopening as outlined by state government. April 27 was the earliest a program restarted elective surgery, and as of May 31, 57 percent still did not have a definite timeline for restarting elective procedures.

The mean number of cancelled operations from March to April of 2020 was 146 cases per program (range, 35 to 332). The percentage of cancelled or rescheduled cases ranged between 19.7 and 84.8 percent, calculated as a year-on-year volume comparison (Table 3). The average percentage of cases cancelled in the region was 64.8 percent (19.7 to 84.8 percent) (Fig. 1). During this time, an average of 940 clinic visits per month per program were cancelled (range, 50 to 1287). The reduction in surgical volume correlated with the incidence of COVID-19 in that program's county ($\rho = 0.70$).

Staff Wellness and Resource Allocation

Eighty-three percent of programs redeployed attending physicians and residents during the pandemic, divided among various clinical environments. This represented 77 percent of surveyed residents and 67 percent of surveyed permanent

faculty. The percentage of residents redeployed was correlated to the incidence of COVID-19 in that program's county ($\rho = 0.97$).

Furthermore, 83 percent of programs deployed residents to intensive care units, representing 23 percent of all redeployed residents. Fifty percent redeployed residents to medical and surgical floors, representing 14.8 percent of all redeployed residents. Fifty percent of programs redeployed residents to the emergency department, representing 14.8 percent of redeployed residents, and 17 percent of programs deployed residents to COVID-19 screening sites, representing 3.3 percent of all redeployed residents. In addition to non-plastic surgical clinical areas, 17 percent of programs allocated residents to telemedicine, or approximately 10 percent of all residents. In comparison, 50 percent of programs deployed attending physicians to the intensive care unit, representing 50 percent of surveyed attending physicians. Seventeen percent of programs deployed attending physicians to the emergency department, representing 17 percent of surveyed attending physicians. Thirty-three percent of programs deployed attending physicians to COVID-19 screening sites, representing 17 percent of attending physicians, and 33 percent of programs deployed attending physicians to general medical/surgical floors, representing 33 percent of surveyed attending physicians (Table 4). All programs with midlevel providers such as nurse practitioners and physician assistants redeployed these staff. No program provided additional training to residents, midlevel providers, or attending physicians before redeployment.

Eighty-three percent of programs reported access to adequate personal protective equipment every shift, and all programs required personal protective equipment to be reused (Table 5). All surveyed programs used personal protective equipment,

Table 3. Clinical Volume (as of May 31, 2020)

	Year 2019	Year 2020	% Reduction
Total no. of operations performed			
March	644	353	45.2
April	717	74	89.7

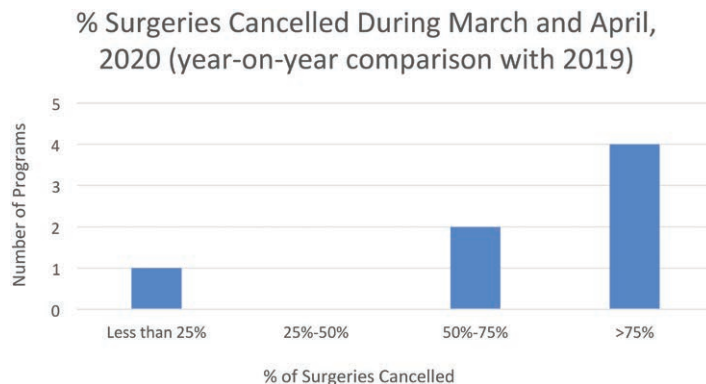


Fig. 1. Year-on-year comparison of operations cancelled because of COVID-19 (March and April of 2019 versus 2020).

Table 4. Staff Deployment

Staff Allocation during COVID-19	Residents		Attending Physicians	
	% of Programs	No. (% of Total)	% of Programs	% of Total
Overall	83%	77%*	83%	67%*
Areas of re-deployment†				
ICU	83%	14 (23%)	50%	50%
ED	50%	9 (14.8%)	17%	17%
COVID-19 screening sites	17%	2 (3.3%)	33%	17%
General medicine/surgery floor	50%	9 (14.8%)	33%	33%
Telemedicine	17%	6 (9.8%)	—	—
Off-service	—	7 (12.3%)	—	—
Not redeployed	17%	23%	17%	33%
By resident training level‡				
Juniors only	17%	—	—	—
Seniors only	0%	—	—	—
All residents	67%	—	—	—
No residents redeployed	17%	—	—	—

ICU, intensive care unit; ED, emergency department.
 *Although residents were deployed to cover one clinical environment at a time, our survey indicated that attending physicians were redeployed to cover multiple different clinical environments during the same period.
 †Values can add up to over 100% because responses are not mutually exclusive.
 ‡Juniors, postgraduate years 1–3; seniors, greater than postgraduate year 4.

telemedicine, rescheduling of operations and clinic appointments, screening for symptoms on presentation, limiting visitors, and preoperative COVID-19 testing to minimize risk of infection to staff. Similarly, all programs offered COVID-19 polymerase chain reaction testing to residents and attending physicians. As of May 31, one-third of the institutions did not have antibody testing capabilities, one-third had antibody tests that were unavailable to staff, and one-third had antibody tests available to staff. Fifty percent of programs reported at least one attending physician contracting coronavirus, whereas 67 percent reported at least one sick resident during the months of March and April of 2020. Eleven percent of the total resident body contracted COVID-19 during March and April of 2020 alone. The incidence of viral infection among residents correlated with deployment rates to an intensive care unit setting, and the average recovery time was 3.1 weeks. There was one reported case of anxiety attacks related to COVID-19 in a resident that required an extended leave of absence.

Educational Opportunities

All programs continued educational activities during the pandemic, with equal proportions

Table 5. Resources and Educational Activities during COVID-19

Resources	% of Programs*
Resources	
Types of personal protective equipment	
N95	100
Surgical mask	100
Face shield	83
Surgical gowns	67
Nonpermeable overalls	67
Sources of PPE	
Hospital	100
Government	0
Donations	50
Privately sourced	33
Educational activities	
Lectures	100
M&M conference	83
Journal club	100
Grand rounds	67
Research meetings	67
Relative frequency of educational conferences	
Increased	33
Decreased	33
Unchanged	33
Policies enacted to offset missed educational opportunities	
Make-up rotations	33
Online conferences	33
Extension of residency	33
No specific plan	50

PPE, personal protective equipment; M&M, morbidity and mortality.
 *Values can add up to over 100% because responses are not mutually exclusive.

reporting increased, decreased, and unchanged frequency of conferences. All programs reported missed education opportunities, with 33 percent planning makeup rotations and additional online conferences. Fifty percent of programs did not have a specific plan in place to address missed opportunities, and one resident required extending residency to address missing case numbers (Table 5).

Table 6 charts the confirmed COVID-19 case and death rate for the counties with a plastic surgery program in the greater New York City area at the time of writing. The percentage of cancelled and rescheduled cases correlated with the density of COVID-19 infections and deaths (Fig. 2 and Table 6),¹⁷ with the greatest percentage of cancelled cases being in New York City.

DISCUSSION

From the months of March through May, the greater New York City area had the highest COVID-19 incidence and death rate in the country.^{5,18–20} Despite its relatively small geographic area, the region comprises 10.2 percent of the national plastic surgery resident body, and the

Table 6. COVID-19–Related Case and Death Rate by County in the Greater New York City Area, as Determined by Geographic Location of Plastic Surgery Residency Programs

County	State	Confirmed Cases (per 100,000)	Deaths (per 100,000)
Albany	N.Y.	695.6	35.7
Bronx	N.Y.	3367.5	336.0
Kings	N.Y.	2338.2	277.8
Monroe	N.Y.	516.7	33.0
Nassau	N.Y.	3088.6	161.0
New York	N.Y.	1755.7	190.0
Queens	N.Y.	2909.1	313.4
Suffolk	N.Y.	2809.9	134.2
Westchester	N.Y.	3608.5	147.4
Camden	N.J.	1412.3	82.3
Essex	N.J.	2325.0	220.4
Passaic	N.J.	3342.2	202.2

*From <https://covid.cdc.gov/covid-data-tracker/#county-view>. Accessed November 26, 2021.

impact on plastic surgery residency in this region likely has important implications and prognosis for the rest of the country. Although survey responses were limited to the greater New York City area, other areas of the country are experiencing the pandemic now in ways similar to what

was experienced in the greater New York City area during the first wave of infections and believe that our experiences and insight have utility now to inform and guide programs about what they can expect in the coming weeks and months.

We examined the impact of COVID-19 on plastic surgery training and found an average of 64.8 percent of operative cases cancelled during March and April of 2020. The majority of this reduction occurred in April, when almost 90 percent of all scheduled procedures were cancelled, coinciding with the peak of infections and deaths.^{6,18,21} Even within the region, there was heterogeneity in the effects of COVID-19. The hospital systems that saw the greatest decrease in operative volume, largest percentage of staff redeployment, and longest time to restart of elective operations were those that served communities with the highest infection and death rates, coinciding with geographic proximity to the pandemic’s epicenter of New York City, which had over one-third of the entire region’s COVID-19 cases and deaths.⁶ Our study indicated that despite not receiving special training, 83 percent of programs donated time

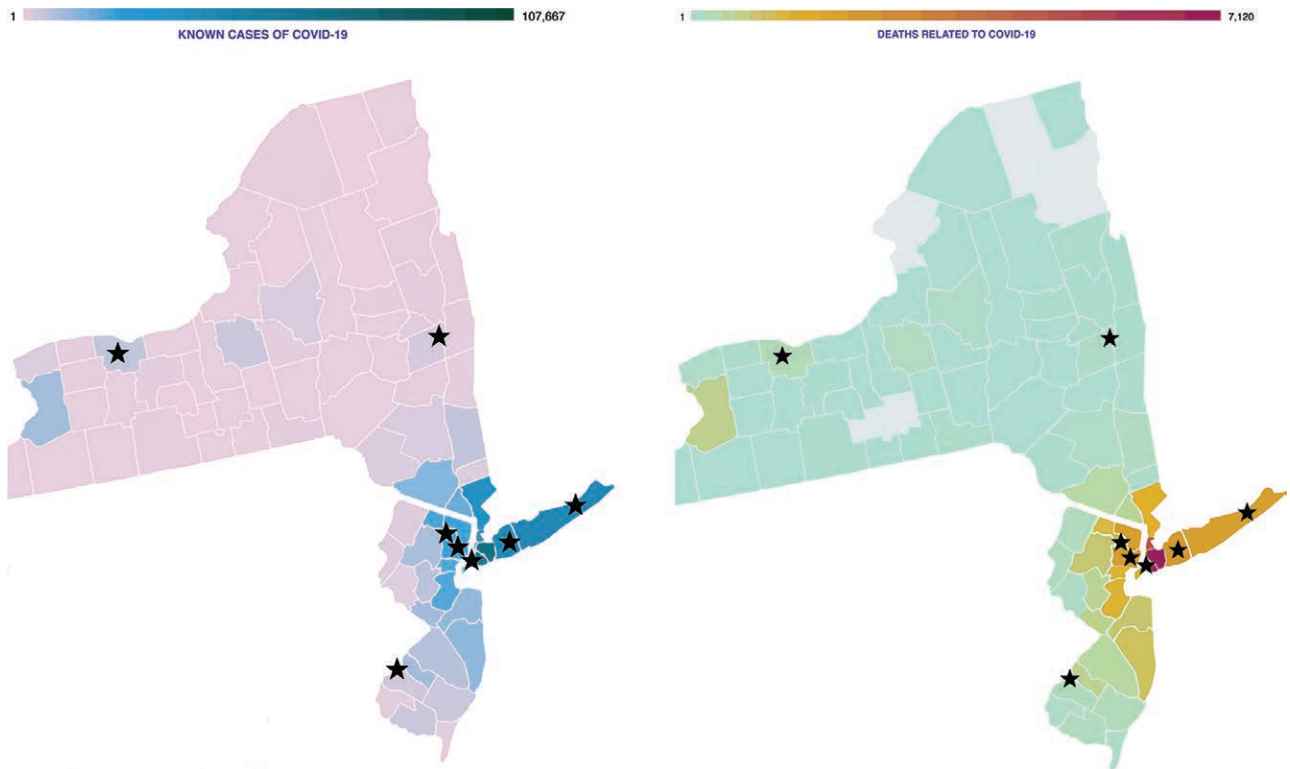


Fig. 2. COVID cases (left) and deaths (right) in the greater New York City area, as of June 30, 2020, with stars denoting location of plastic surgery residency programs. Color bar above represents the relative value. (USA FACTS. Coronavirus locations: COVID-19 map by county and state. Available at: <https://usafacts.org/visualizations/coronavirus-covid-19-spread-map/>. Accessed June 30, 2020.) (Note: only one star was used for New York City, given space constraints on the map, but it is meant to represent all four residency programs in the city.)

and resources to assist COVID-19 patients across various clinical environments, related to the local incidence of infections and need for resource reallocation.

The pandemic impacted staff mental and physical well-being, with 50 percent of programs reporting at least one sick attending physician and 67 percent at least one sick resident, both correlated with rates of redeployment to zones of COVID-19 exposure, such as the intensive care unit ($\rho = 0.82$). Interestingly, although all programs noted an official sick leave policy for COVID-19 consistent with state and national guidelines of at least 3 days since resolution of fever and at least 10 days since the first appearance of symptoms,³ the average recovery time for residents was 3.1 weeks. In an otherwise relatively young and healthy population, this is likely because of increased and repeated exposure in the line of duty, correlating with a larger inoculum, shown to worsen clinical course, combined with greater physical stress from the demands of surgical residency work hours.²² One program even noted a COVID-19–induced psychiatric crisis requiring a prolonged leave of absence. As more plastic surgery residents around the country start facing similar COVID-19 pressures, analogous events should be expected.

During the pandemic, virtual tools became the norm, as webinars and video conferencing replaced national symposiums and meetings. Sixty-seven percent of programs reported either increased or unchanged frequency of educational conferences, and the same percentage reported using the additional time for dedicated research-related activities. In addition, all programs adopted telemedicine in the ambulatory setting as an alternative to in-person clinical visits. These video conferencing resources will likely remain integral to academic plastic surgery moving forward. Programs not already using virtual conferences and telemedicine should consider doing so to facilitate learning and patient care despite social distancing and staff redeployment.^{14,23}

According to 2019 data from the American Society of Plastic Surgeons, 18.2 million cosmetic procedures and 5.9 million reconstructive procedures were performed in the United States during the previous year—representing \$16.7 billion in revenue.²⁴ Of note, all elective procedures were cancelled in New York from March 23 to April 29, and from March 27 to May 26 in New Jersey to contain and minimize exposure to SARS-CoV-2.^{21,25–28} Although the average number of cases cancelled per program in the region was 146, this burden was disproportionately felt by senior residents,

who spend a larger proportion of time operating. One program even noted extending residency to allow a resident to obtain the necessary case numbers to graduate. Projecting our findings to the national level, our specialty may end up losing over \$3 billion, 3 million cosmetic procedures, and 750 thousand reconstructive cases because of the pandemic—impacting surgical training in ways unparalleled by any recent natural or economic disaster. In the context of continuing clinical restrictions and social distancing policies, the average program will have to perform an extra 24 operations and 783 clinic visits per month over the next 6 months to address this backlog, while ensuring safety and avoiding provider burnout. Similar disruptions could affect programs nationwide, and as plastic surgery residency is structured and time sensitive, interruption of normal training could have significant impact on resident development. Although March and April are not common months for plastic surgery subinternships, we noted a cancellation of all elective medical student rotations during this period. Given the uncertainty surrounding the length and impact of the pandemic, and to ensure safety of students and rotators, we anticipate subinternships and electives to be cancelled and the upcoming application cycle to become predominantly virtual.

COVID-19 and future pandemics will inevitably affect physical, emotional, and mental health of health care workers—although it is too early to gauge the complete impact of the current pandemic, our study showed that providers are not immune, and in fact bear additional responsibilities from their duty to serve on the front lines. Consequently, it is important for programs to find ways to support staff, with strategies including rotating the workforce to minimize exposure, deploying the full spectrum of staff, mixing in-person with remote clinical responsibilities, continuing to emphasize education, and providing appropriate time to recover and decompress. Our own institution provided additional mental health counseling, a one-time monetary stipend, perks including free daycare and parking, assistance with groceries, and a combination of hospital-catered and community-donated meals to assist residents during this time. Although many of these benefits are temporary, there will certainly be a permanent impact of this current pandemic on plastic surgery residencies. This includes ubiquitous use of virtual conferencing technology, preoperative screening for surgical patients, and likely continued use of masks and personal protective equipment.

Although the nature and impact of any future public health crisis is unknown, plastic surgery residencies can prepare by proactively creating an environment of transparency. With clear guidelines and consistent communication, such as scheduled all-staff conference calls and virtual meetings, programs can alleviate stress and confusion for its trainees. In addition, increased experience in critical care with dedicated rotations during residency will provide residents confidence in caring for acutely critical patients, and a robust research infrastructure using remote conferencing can help maintain productivity during periods of reduced clinical and surgical volume. Lastly, built-in and protected elective time will provide a buffer for residents to make up lost surgical cases and missed education opportunities.

This study has several limitations. Although rates of COVID-19 infections are publicly available, there is a delay in capture and reporting of this information. In addition, the retrospective nature of our data, sensitivity related to sharing individual institutional data, and inaccuracies in self-reporting may lead to an overestimation or underestimation of the impact of the pandemic. Although we were able to obtain a relatively large response rate, our data could be affected by non-responder bias and institution-specific circumstances affecting results. Also, although our survey captures the initial phase of the COVID-19 crisis, the long-term effect on plastic surgery residencies is unknown and further studies will be needed to determine this. However, the preliminary evidence suggests that there is likely to be a tangible and lasting impact in terms of cases and overall training. Surgical training is time sensitive and structured, and even 3 to 4 months of disruption can affect a trainee's development, even if surgical volume rebounds in the subsequent periods. Future long-term studies will likely provide additional clarity.

CONCLUSIONS

Academic medical centers were hotspots for the care of patients with COVID-19 and will be de facto battlegrounds during any future pandemic. COVID-19 had a significant impact on plastic surgery residency training in the greater New York City area during the months of March and April of 2020. It reduced operative and clinical volume, forced programs to reallocate staff and resources, promoted telemedicine and virtual conferences, and negatively affected overall mental and physical health of staff. As the first COVID-19 wave passes the greater New York City area and spreads nationwide,

we hope our study will help shed light on the ongoing situation and inform other programs on what to expect and how they can continue to contribute. Although the new normal is still unknown, plastic surgeons and residency programs should not shy away from becoming leaders, innovators, and volunteers in any future public health crises.

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