

Restructuring of a General Surgery Residency Program in an Epicenter of the Coronavirus Disease 2019 Pandemic: Lessons From New York City

Jackly M. Juprasert, MD, MS; Katherine D. Gray, MD; Maureen D. Moore, MD; Lama Obeid, MD; Alexander W. Peters, MD; David Fehling, MA; Thomas J. Fahey III, MD; Heather L. Yeo, MD, MHS, MBA, MS

 Supplemental content

On March 1, 2020, the first case of coronavirus disease 2019 (COVID-19) was confirmed in New York, New York. Since then, the city has emerged as an epicenter for the ongoing pandemic in the US. To meet the anticipated demand caused by the predicted surge of patients with COVID-19, the Department of Surgery at NewYork-Presbyterian Hospital/Weill Cornell Medicine developed and executed an emergent restructuring of general surgery resident teams and educational infrastructure. The restructuring of surgical services described in this Special Communication details the methodology used to safely deploy the necessary amount of the resident workforce to support pandemic efforts while maintaining staffing for emergency surgical care, limiting unnecessary exposure of residents to infection risk, effectively placing residents in critical care units, and maintaining surgical education and board eligibility for the training program as a whole.

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Author Affiliations: Department of Surgery, NewYork-Presbyterian Hospital/Weill Cornell Medicine, New York (Juprasert, Gray, Moore, Obeid, Peters, Fehling, Fahey, Yeo); Department of Population Health Sciences, Weill Cornell Medicine, New York, New York (Yeo).

Corresponding Author: Heather L. Yeo, MD, MHS, MBA, MS, Department of Surgery, New York-Presbyterian Hospital/Weill Cornell Medical Center, 525 E 68th St, PO Box 172, New York, NY 10065 (hey9002@med.cornell.edu).

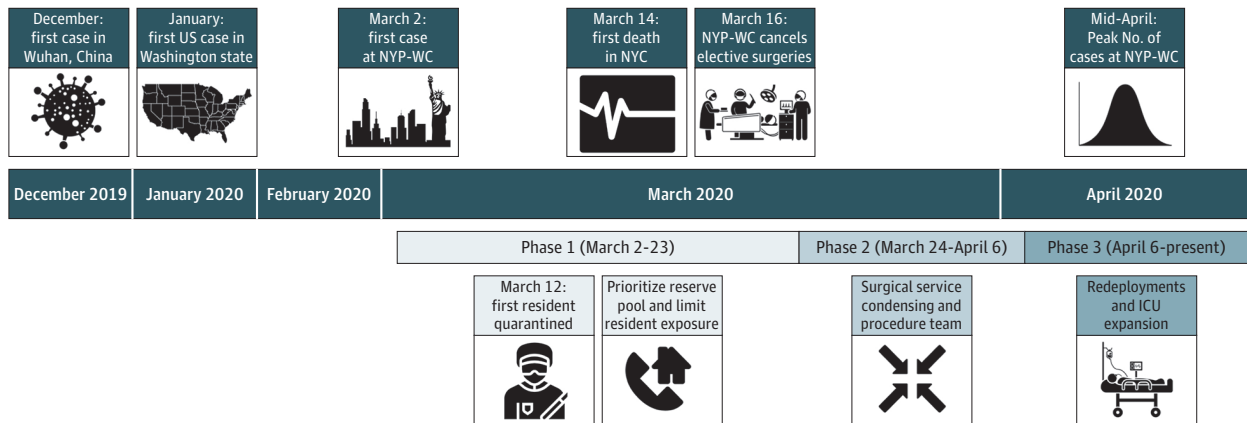
On March 1, 2020, the first case of coronavirus disease 2019 (COVID-19) was confirmed in New York City (NYC) and rapidly emerged as the nation's epicenter with more than 366 000 (22% of the US) confirmed cases and 29 000 (30% of the US) deaths as of May 27, 2020 (Figure 1).^{1,2} At the peak in mid-April, NewYork-Presbyterian Hospital/Weill Cornell Medicine (NYP-WC) was treating 474 patients who had tested positive for COVID-19, with 237 (50.0%) admitted to the intensive care unit (ICU) and 212 (44.7%) requiring mechanical ventilation.

Owing to the exponential rise in critical care needs,³⁻⁵ NYC hospitals sought to quickly restructure existing systems to expand critical care capacities while limiting clinical care in non-

essential areas. Plans to restructure surgery programs have been previously described,⁶⁻⁸ but the experience of a region as profoundly affected as NYC has yet to be reported. This restructuring had a particularly pronounced effect on surgery departments and training as elective cases were suspended.^{9,10} On March 16, 2020, in response to the US Centers for Disease Control and Prevention recommendations in consensus with multiple surgical societies such as the American College of Surgeons and an order from the New York State governor, NYP-WC announced that elective surgeries would be postponed.¹¹

General surgery training in NYC was uniquely affected by decreased operative training opportunities lost during the 2019-

Figure 1. Relevant New York City (NYC) Coronavirus Disease 2019 Pandemic Timeline, December 2019 to April 2020



ICU indicates intensive care unit; NYP-WC, New York-Presbyterian Hospital/Weill Cornell Medicine.

Box. Key Concepts and Phases of Implementation

Key Concepts

Physical Separation

- Isolated computer workstations
- No in-person handoffs
- Bedside consults only if necessary

Surgical Service Organization

- Condense services owing to lower surgical volume
- Increase number of team members
- Preserve functionality if member becomes ill or quarantined

Reserve Pool

- Nonvoluntary off-site time rotations
- Use residents on dedicated research time

Implementation

- Transparency
- Resident involvement in scheduling
- Daily virtual meetings with program director
- Weekly virtual meetings with department chair

Phases

Phase 1: Prioritizing Reserve Pool and Limiting Resident Exposure

- Limit resident exposure
- Nonvoluntary off-site time rotation
- Reserve pool to activate residents if others are quarantined
- Removed midlevel residents
- Removed redundancy in junior residents seeing consults

Phase 2: Surgical Service Condensing and Procedure Team

- Condensed surgical services
- Increased crosscoverage of teams
- Procedure team implementation

Phase 3: Redeployments and ICU Expansion

- Conversion of ORs and PACUs to ICU beds
- Residents redeployed internally to ICUs
- Residents redeployed externally to nonsurgical ICUs
- Research residents redeployed
- Procedure team expanded

Abbreviations: ICU, intensive care unit; OR, operating room; PACU, postanesthesia care unit.

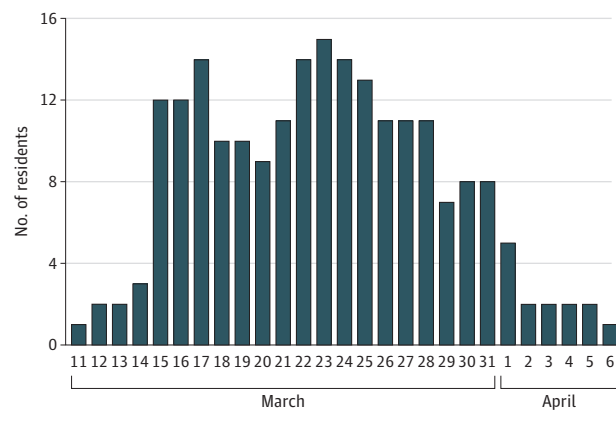
2020 academic year. However, given the significant critical care training that general surgery residents routinely receive, these residents became poised to aid in the pandemic response primarily managing COVID-19 ICUs.

This article details the reassignment of general surgery residents and the restructuring of surgical services at NYP-WC, an 862-bed quaternary referral center in Manhattan, New York, with 8 categorical general surgery residents per class with 16 on dedicated research years. The focus of our efforts was to safely deploy the necessary volume of the resident workforce to support pandemic efforts, while maintaining staffing for emergency surgical care, limiting unnecessary exposure of residents to infection risk, effectively placing residents in critical care units, and maintaining surgical education (Box).

Evolution of Changes

Because of the rapidly changing environment between the first patient who tested positive for COVID-19 on March 2 and the peak num-

Figure 2. Number of Residents Quarantined by Date



ber of cases in mid-April, the residency underwent dramatic changes that can be summarized into 3 phases.

Phase 1: Prioritizing Reserve Pool and Limiting Resident Exposure

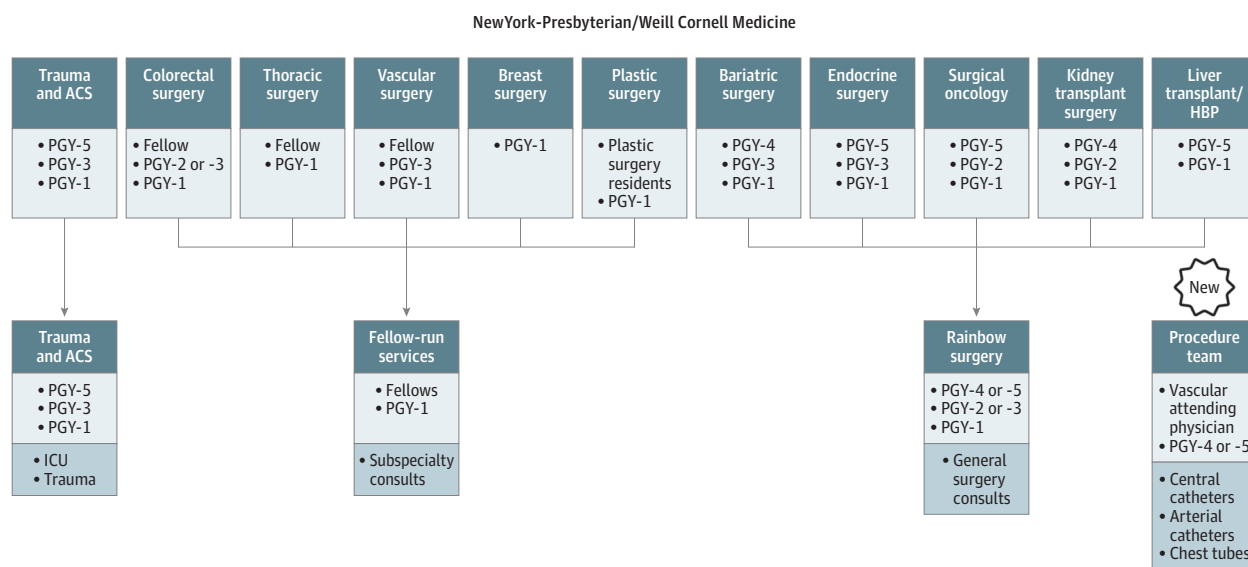
The first phase started at the beginning of the outbreak on March 2 until week 3 of the response (Figure 1). The goal of this phase of restructuring served the dual function of (1) limiting the number of residents exposed to patients with COVID-19 and (2) creating a reservoir of residents on nonvoluntary off-site time to activate as a reserve workforce should residents become quarantined comparable with previously published restructuring plans.⁶⁻⁸

During this phase, elective case volume was limited but ongoing. This changed on March 16, when elective cases were postponed, and resident team coverage changed to weekend structure, where each team was responsible for 2 services with teams alternating weekly. This preexisting weekend structure was used because it already incorporated a familiar crosscoverage system that also allowed residents to be placed on nonvoluntary off-site time, making them available to be activated if other residents became ill and were quarantined while also limiting potential exposure. During this phase, a large number of residents were quarantined, and this reservoir pool was heavily used. At the peak, 15 residents were quarantined on March 23 (Figure 2). In accordance with New York State Department of Health guidelines, residents were quarantined empirically if they developed symptoms, had known exposure to a patient who tested positive for COVID-19, or tested positive themselves, but after the March 31 guideline revision, essential personnel who had tested positive were permitted to return to work if they were asymptomatic, isolated for 7 days after illness onset, and afebrile for 72 hours.¹²

An additional measure to limit exposure was abolishing the junior resident consult role. This was important because most consults were in the emergency department, which was inundated with patients with COVID-19. This also expedited consult disposition, thereby reducing burdens on emergency department clinicians and reducing the time patients without COVID-19 remained in the emergency department.

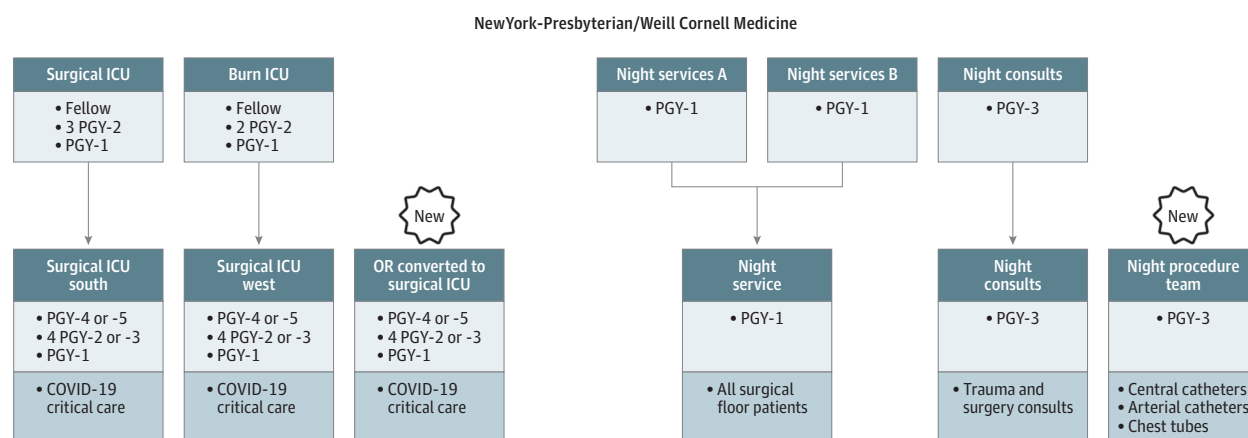
In response to institutional physical distancing guidelines, patient handoff, which was previously conducted in person was to be done over the telephone. Intra-team and inter-team communication

Figure 3. Restructuring House Staff Coverage of Surgical Services



ACS indicates acute care surgery; HBP, hepatobiliary surgery; ICU, intensive care unit; PGY, postgraduate year.

Figure 4. Restructuring House Staff Coverage of Surgical ICUs and Night Float



COVID-19 indicates coronavirus disease 2019; ICU, intensive care unit; PGY, postgraduate year.

was also performed over the telephone or via text messaging to limit potential transmission.

Phase 2: Surgical Service Condensing and Procedure Team

The next phase extended from March 24 to week 4 of the response and was prompted by the increased number of patients with COVID-19 requiring critical care in conjunction with a further decrease in surgical volume such as those faced by other programs.^{7,8} On March 24, NYP-WC was treating 95 admitted patients who had tested positive for COVID-19 with 41 (43.1%) in the ICU and 38 (40.0%) requiring mechanical ventilation, which progressively increased through this phase. During this time, 3 main changes were made at the residency level: (1) surgical services were condensed (Figure 3), (2) surgical ICU (SICU) coverage increased (Figure 4), and (3) a resident-led procedure response team was established. Exter-

nal redeployments of surgical residents to nonsurgical ICUs also began during this phase. Methodology for this restructuring required that teams first be evaluated for ongoing surgical volume necessitating the assignment of residents, and the subsequent restructuring was enacted in a stepwise fashion as volume changed.

Prior to the pandemic, most surgical teams consisted of a fellow or chief resident (postgraduate year [PGY]-4 and -5), a resident (PGY-2 and -3), and an intern (PGY-1). Operative cases during phase 2 were limited to emergency surgeries. Therefore, services were completely consolidated into trauma or acute care general surgery teams (Figure 3). For more details on individual surgical services, see the eAppendix in the Supplement. Fellows and integrated subspecialty residents (ie, plastic surgery) acted as the senior resident of their respective subspecialties if available. Trauma and critical care faculty retained coverage of acute care surgery during

the day, but general surgery faculty covered call at night to allow the critical care faculty to concentrate on ICU oversight. The Hospital for Special Surgery, a neighboring affiliated hospital specializing in orthopedic surgery and rheumatologic conditions where faculty have clinical appointments and residents have privileges, began accepting surgery patients for transfer who had tested negative for COVID-19 to serve as both overflow and to reduce exposure risk to these patients.

Previously, the SICU was staffed by 3 PGY-2 residents alternating 24-hour in-house calls every 3 days supervised by a critical care fellow during the day. In response to the pandemic, the SICU increased from a 14-bed unit to a 20-bed COVID-19 unit. To accommodate the increased critical care volume and heightened acuity of patients, an additional PGY-2 resident was added, which allowed 24-hour in-house calls to alternate every 4 days. An additional intern and 24-hour senior or fellow coverage was implemented overnight as well. These changes also helped mitigate anticipated fatigue.

Finally, a procedure team, similar to others previously described, consisting of 12-hour shifts of senior residents (PGY-3 or higher) led by the vascular surgery faculty during the day and acute care general surgery faculty at night, was established.^{7,13} This team was available hospitalwide to place central venous catheters, arterial catheters, temporary vascular access, feeding access, or chest tubes. The protocol outlined that this team would be consulted after intubation. To reduce exposure to the aerosolized virus, the team would wait 30 minutes before placing central venous, arterial, and enteral feeding access. This also allowed all invasive procedures to be performed in an expeditious manner by trained personnel as well as offloading procedural responsibilities of ICU clinicians to allow them to focus on ventilator and management decisions. Owing to institutionwide redeployments resulting in ICU coverage from different specialties with varying critical care training, this team was designed to mitigate potential issues arising from ICU personnel with less procedural experience.

Phase 3: Redeployments and ICU Expansion

The final phase concentrated on maximizing critical care capacity and spanned from April 6 to week 6 of the response. At the peak in mid-April, the entire NYP health care system was treating a total of 2529 patients who had tested positive for COVID-19, 766 (30.3%) of which were admitted to the ICU, and 762 (30.1%) required mechanical ventilation. During this time, NYP-WC had a total of 474 patients (18.7%) with COVID-19 admitted with 237 of 776 (31%) requiring ICU care and 212 of 762 (28%) requiring mechanical ventilation. The SICU and burn ICU were both transitioned to 20-bed COVID-19 ICUs. An additional 14-bed ICU was created from outpatient operating rooms, which was staffed by the surgery department.¹⁴ To accommodate this increased volume, general surgery residents on dedicated research time obtained emergency credentialing for clinical privileges and were redeployed for both ICU and floor service coverage similar to previously described plans.⁶

During this phase, the clinical focus was for symmetric high-quality resident coverage of all 3 surgically staffed ICUs (a total of 54 ICU beds at peak). Each unit was designed to operate with parallel staffing, with 1 fellow and attending physician call pool to ensure the delivery of high-level care. Each ICU was designated an acuity level, with 1 unit having 20 high-acuity patients, 1 unit having 20 midacuity patients, and the final unit with 14 low-acuity patients. Residents were rotated through the units both to reduce fatigue and

to bring the more experienced residents to the surge units, which in general had less experienced nursing and support staff.

Residents across all departments were also redeployed by the Graduate Medical Education office via a centralized mechanism to meet staffing needs across the hospital. While most general surgery residents were redeployed internally as detailed above, others were redeployed to nonsurgical ICUs as well as 2 off-site NYP hospitals.

Educational Curriculum

Prior to the pandemic, the general surgery curriculum was composed of multiple teaching conferences, including both service-specific and departmentwide lectures. At our institution, grand rounds and the morbidity and mortality conference are held on Monday, Surgical Council on Resident Education–based didactics on Wednesday, and faculty-led case-based board preparation lectures on Thursday mornings. In response to institutional physical distancing guidelines, the delivery mechanism of the curriculum was changed to protect the faculty and resident workforce. Similar to other institutions,^{7,8} we adopted the use of a web-based audio and video conferencing platform with recording capabilities. The morbidity and mortality conference was postponed as a direct consequence of the decreased surgical volume. Many of the previously scheduled grand rounds speakers were postponed owing to travel restrictions, which provided the opportunity to create a COVID-19–based lecture series. This included presentations from critical care and infectious disease faculty as well as basic science researchers to further the understanding of pathophysiology and treatment of patients with COVID-19. Journal club topics started including newly and rapidly emerging COVID-19 literature. In addition to the weekly Surgical Council on Resident Education–based general surgery curriculum, the didactic and board preparation lectures also included management of critically ill patients with COVID-19. The use of web-based video conferencing and the capability to record each lecture was particularly useful because both faculty and resident schedules were in constant flux. With the recording feature, residents were able to view educational content at a convenient time and rewatch specific lectures as needed.

Plans for Resuming Previous Surgical Operations

Many milestones need to be reached prior to safely resuming surgical operations. First, the volume of patients requiring critical care needs to decrease to the point that the operating rooms and post-anesthesia care units that were converted into critical care beds become available.¹⁴ Many surgeons, nurses, and staff were redeployed to other areas of the hospital and will need to return. Additionally, a surplus of personal protective equipment, supplies, and other resources will be necessary. Recovery planning efforts are under way with the creation of an internal task force with plans for outpatient and inpatient operating rooms to reopen in June. Committees were formed to create a scoring metric that will be used to prioritize the order of surgeries to be resumed first. In addition, guidelines are currently being developed to ensure that our institution is ready in the event that additional outbreaks occur.

Resident Physician Health Considerations

The health and well-being of the resident workforce was of utmost priority, and several resources were available. Services such as CopéNYP were established by the Department of Psychiatry and provided free telemedicine visits to mitigate acute distress and foster adaptive coping. Residents had scheduled video conferences with Department of Psychiatry faculty to discuss mental health concerns and strategies to alleviate stress, fatigue, and burnout. NYP OnDemand offered medical services via Virtual Urgent Care, a telemedicine platform. If house staff had any personal health concerns related to COVID-19, they were instructed to immediately contact their program director and Work Health and Safety. This allowed the department to centrally monitor exposure or health-related issues. Clearance from Work Health and Safety was required to return to clinical duty. At the peak, as many as 15 residents were quarantined in 1 day owing to becoming symptomatic or testing positive (Figure 2). Work-related travel was restricted by the institution, and personal travel, although not prohibited, was discouraged by the institution and department.

Lessons Learned

During the pandemic response, resident team structures and schedule changes were nearly made on an hourly basis. For a successful response, flexible and real-time communication was necessary between program leadership, ICU directors, and the residents. It was also vital to empower those in charge of scheduling to make decisions in the best interest of the residents without going through the normal approval process. Prompt and clear dissemination of information was essential, and it was important to arrange this in a format that reached off-site and redeployed residents. Daily teleconferences, using a cloud-based peer-to-peer software platform, with the program director and weekly teleconferences with the chair of surgery provided transparency on the current trend of admitted patients with COVID-19 who required mechanical ventilation, the number of house staff under quarantine, explanation of policies in real time, and a forum for questions and concerns to be raised.

Many changes to the structure of services were successful. The ICU patient-to-resident ratio was lower than prepandemic times and was capped at 4 to 5 patients per resident with oversight by 1 fellow and 1 attending physician per unit. There was no capping of patients on the floor; staffing was adjusted as needed and increased or decreased. Rather than separate teams consisting of surgical patients with or without COVID-19, we found that it was logistically simpler to allocate patients to specific services based on surgical problem or history. The procedure team proved to be a valuable resource that was heavily used. At the peak surge, the busiest time was during the day and this team may have been called on up to 15 times per shift justifying the dedication of human resources.

Some changes prompted issues that required attention. Owing to unpredictable fluctuation in both admission of patients with COVID-19 and surgical volume, some services and ICUs were either understaffed or overstaffed. To address this issue, frequent and open communication with senior residents of services was necessary to reassign residents based on need. Another unexpected problem was seen at the peak of the surge, when many residents reported fatigue and burnout. This was particularly prevalent in residents assigned to off-site rotations or nonsurgical redeployments owing to isolation. To address these issues, rotations were changed from the normal 4- to 6-week blocks to 2-week blocks to limit the time any resident was assigned to an especially emotionally demanding or off-site rotation. Having adequate medical and health resources available to ensure the well-being of the resident workforce during an unprecedented time proved invaluable.

Many unexpected challenges during this unprecedented time were encountered. In response to fears of transmission to family members at home, decontamination protocols were developed. Residents were instructed to come to work wearing clean clothes, change to hospital-provided scrubs, then change back into clean clothes prior to returning home. They were also recommended to shower immediately after returning home and leave soiled clothes or shoes outside of the living space. Additionally, NYP-WC provided room and board for essential workers in hotels and shuttle service to the hospital. Because many childcare facilities and services were suspended, childcare became an issue for many residents. NYP-WC opened emergency daycare and provided a childcare stipend to address this problem.

These lessons learned will lead to lasting change in the culture of the residency program. Resident physician health and wellness will continue to be prioritized, and transparency in decision-making is likely to persist as services return to preexisting surgical coverage. An increased emphasis on both early promotion and increased oversight in the ICUs is now established as more junior residents were deployed to cover advanced services, resulting in more direct senior oversight.

During the current convalescence period of what could be the first wave of the pandemic, these same principles will apply as program leadership seeks to restructure coverage to meet the ongoing needs of a more steady volume of patients with COVID-19 while also establishing coverage for the growing number of surgical cases. The challenge of returning residents to expected surgical training while staffing surgical ICUs that continue to care for large numbers of patients with COVID-19 will require innovative approaches and may include an expanded role for research residents functioning to fill gaps in coverage.

As we return to preexisting surgical volume prior to the pandemic and prepare to welcome a new class of interns, balance of surgical education and optimal patient care to those affected by the pandemic must be met. To succeed, this will require ongoing adherence to the principles of flexibility, transparency, and resident well-being.

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