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Blueprint for Restructuring a Department of Surgery in Concert With the Health Care System During a Pandemic

The University of Wisconsin Experience

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The current health care environment is complex. Systems often cross US state boundaries to provide care to patients with a wide variety of medical needs. The coronavirus disease 2019 pandemic is challenging health care systems across the globe. Systems face varying levels of complexity as they adapt to the new reality. This pandemic continues to escalate in hot spots nationally and internationally, and the worst strain on health care systems may be yet to come. The purpose of this article is to provide a road map developed from lessons learned from the experience in the Department of Surgery at the University of Wisconsin School of Medicine and Public Health and University of Wisconsin Health, based on past experience with incident command structures in military combat operations and Federal Emergency Management Agency responses. We will discuss administrative restructuring leveraging a team-of-teams approach, provide a framework for deploying the workforce needed to deliver all necessary urgent health care and critical care to patients in the system, and consider implications for the future.

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The current health care environment is extremely complex. Systems span regional and state boundaries to provide state-of-the-art care to patients with a wide variety of medical needs. Coronavirus disease 2019 (COVID-19) is a rapidly spreading pandemic that is challenging health care systems across the globe. Systems have faced varying complexities adapting to the new reality, and patients may pay a grievous price when the demand for medical and critical care exceeds the supply. This pandemic continues to escalate rapidly in hot spots nationally and internationally, and the worst strain on our health care systems may be yet to come.

The importance of preparation is highlighted when we consider the needs of our own family members, whether for COVID-19-associated care or another urgent medical condition. The inability to access potentially life-saving care because of lost opportunities to prepare is heartbreaking. The purpose of this article is to provide a road map developed from lessons learned from our experience in the Department of Surgery at the University of Wisconsin (UW) School of Medicine and Public Health and UW Health, based on our past experience with incident command structures in military combat operations and Federal Emergency Management Agency response. We will discuss administrative restructuring leveraging a team-of-teams approach, provide a framework for deploying the workforce needed to deliver all necessary urgent health care and critical care to patients in our system, and consider implications for the future.

System Overview

At the UW, the health system is integrated with the School of Medicine and Public Health to manage all aspects of patient care. As the COVID-19 pandemic began to spread globally, UW quickly recognized the need to adapt and evolve practice. The health system activated the hospital's incident command team weeks before the epidemic hit the state to initiate a system-wide response to this pandemic. The Department of Surgery contributes surgical assets throughout all aspects of the health system, which spans the entire state of Wisconsin and parts of northern Illinois. However, this review will focus on the response developed and deployed in the Madison, Wisconsin, hospitals. At the time of this writing, we have started to see a rapid increase in patients with COVID-19 in Wisconsin, but the peak surge is estimated to still be nearly a week away. These plans were conceived and implemented prior to the beginning of the surge. We felt strongly that early implementation would allow for processes to be iteratively adapted to the needs of the oncoming COVID-19 surge.

Hospital System Incident Command and Department of Surgery Response

The health system's Incident Command Team recognized that the specific challenges of COVID-19 were different from the prior

incidents it has managed. The planning and operations around a mass casualty incident or an acute shortage of a resource, such as an information technology shutdown, are different than what is required for a sustained response over a prolonged period of weeks, months, or longer. In addition, this pandemic can affect and diminish the workforce itself, requiring a layered approach to staffing models to adjust for anticipated absenteeism. The main difference from our prior experiences was the need to provide a workforce capable of caring for large numbers of patients with critical illness over a protracted period, with appropriate backup built in.

Initial steps included cessation of all elective inpatient surgical care with prioritization of urgent and emergency cases only. Additionally, ambulatory care was converted to telehealth visits only. This allowed us to focus on reorganizing our department's clinician structure to meet an increase in workforce demands for the health system. The Department of Surgery includes 11 subspecialty divisions, with 5 divisions previously falling under the umbrella of general surgery: surgical oncology, minimally invasive surgery, endocrine surgery, colorectal surgery, and acute care and regional general surgery. The department sponsors 4 primary surgical residencies with cohorts of 6 to 52 resident physicians each: general surgery, plastic surgery, otolaryngology, and vascular surgery. In addition, we have a large advanced practice professional (APP) workforce (made up of nurse practitioners and physician assistants), supporting both ambulatory and inpatient clinical operations. Typically, faculty members, residents, and APPs are assigned to 1 of the 11 subspecialty services and have individual schedules with no backup other than shifting work internally within their small teams.

Meeting the challenge of COVID-19 required a reorientation of our administrative structure within the Department of Surgery. In the book *Team of Teams: New Rules of Engagement for a Complex World*,¹ Stanley A. McChrystal describes how to move from a more hierarchical and traditional structure in which information flows up the chain and decisions come down in a linear fashion to a structure that is more fluid and agile. This team-of-teams concept is dependent on the free flow of information among and between various teams, as well as a clearly communicated mission. Teams must have a shared consciousness of how and why.

Communication

We operationalized this concept and defined our mission as providing urgent surgical and critical care to all who need it. Communication has been a major focus. We have instituted twice-daily 30-minute conference calls within and between the various teams in our department. These calls are designed to disseminate consistent information to all team members at the same time. They function to allow concerns to be elevated or share new information among and between teams. To reduce the volume of email, we leveraged secure texting applications to establish specific chat groups for critical information that needs to be shared between conference calls. These chat groups share information in real time, allowing for agile adaptation to rapidly changing situations. **Figure 1** shows how individual departments and interdisciplinary cross-departmental teams must engage in constant bidirectional communication with each other and with the central hospital Incident Command System to respond to a pandemic such as COVID-19.

Guiding Principles

We formulated a list of guiding principles to act as a cornerstone for our decisions and attempted to adhere to these principles as much as was practical.

- We are committed to structuring COVID-19 services in a multidisciplinary fashion that are agile and flexible, to respond effectively and provide remarkable health care.
- We will maintain workforce to provide other urgent health care needs of all patients, whether they have COVID-19 or not.
- Attending physicians, fellows, residents, and APPs must be agile and flexible regarding shift schedules, locations, etc.
- We need to synchronize clinical operation periods throughout departments.
- We will be responsible stewards of personal protective equipment.
- We will accomplish these things with the physical and psychological safety of clinicians at the front of mind.
- We will strive to limit any one group's exposure to COVID-19-intense settings as much as possible.
- We will advocate for procedures and resources needed to protect clinicians.

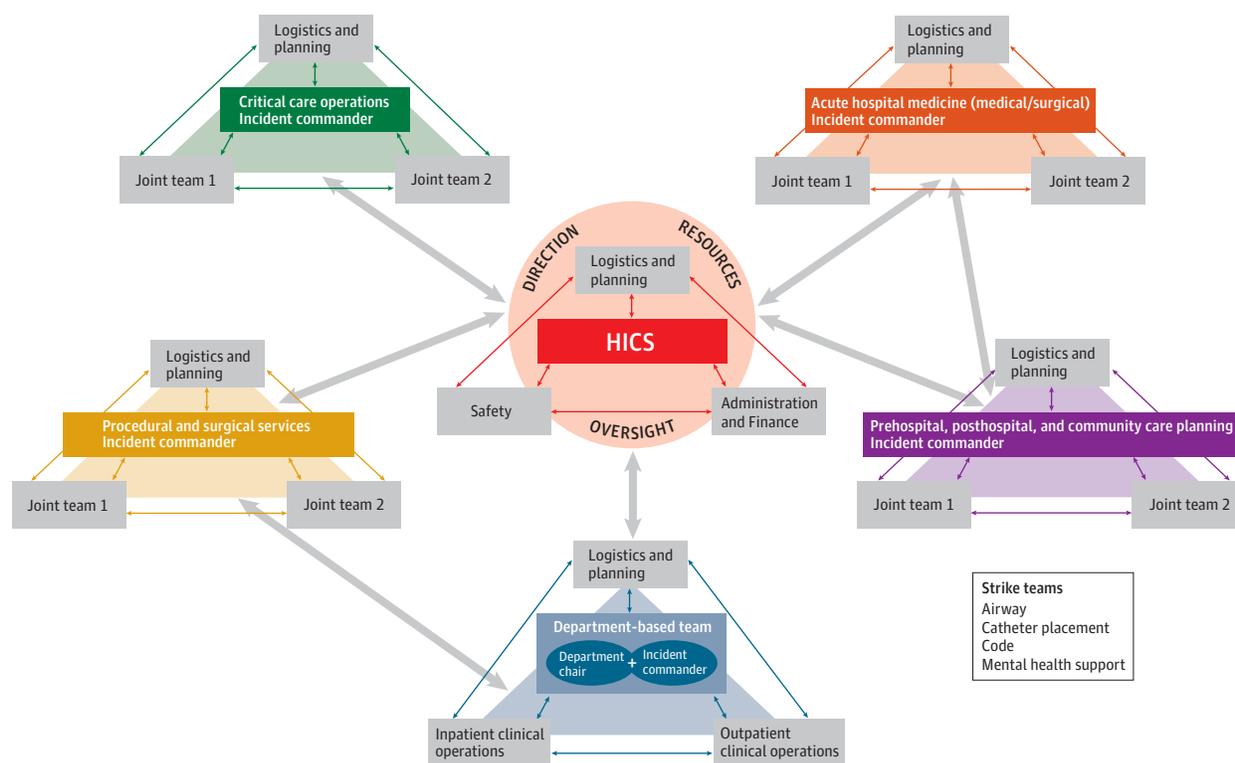
Focus on Workforce

As planning for the critical care and acute inpatient needs of patients with COVID-19 continued, we realized that we could not make our plans in a vacuum—every department and clinical unit is interdependent in some way. Formation of an interdisciplinary team with members drawn from multiple departments was required to meet the needs of large numbers of patients with COVID-19 who were in the intensive care units and on inpatient floors. The primary threat was outstripping our internal human resources to meet the rapidly escalating patient care demands. To meet the increased tempo of intensive care unit and hospital medicine operations, we would need to pull clinicians from across all departments in the health system. Clinicians would become independent of their traditional specialties—such as surgery, ophthalmology, anesthesia, family practice, and medical subspecialties—to provide a united clinical response to the expected surge in patients with COVID-19. At the same time, departments would need to ensure that they retained sufficient workforce for urgent subspecialty care. To accomplish this, we used the following framework to reorganize our surgical services and design cross-departmental care teams for the intensive care unit and the hospital medicine services.

Organizational Framework

The paradigm used for staffing redesign within the Department of Surgery as well as for the cross-departmental teams in the intensive care unit, the COVID-19 floor, and the stepdown unit was based on the tiered care systems suggested by the Society of Critical Care Medicine.² In this system, a content expert oversees up to 4 teams that are staffed with clinicians at various levels of experience,

Figure 1. Coordinated Mobilization of a Health Care System in Response to the Coronavirus Disease 2019 Pandemic



A joint team is an interdisciplinary team of clinicians, nurses, and all other staff responsible for delivering domain-specific care. HICS indicates the hospital incident command system.

allowing the content expert to care for more patients than would otherwise be possible using normal staffing models. In the intensive care unit environment, the content expert is an attending physician who is board certified in critical care or surgical critical care and active in the care of patients who are critically ill during normal operations. These clinicians were identified by each department that provides critical care services. This system requires synchronization of schedules across hospital departments and divisions so that clinicians can move seamlessly across services without disrupting or leaving gaps in schedules in their home division or department. To build these teams, we needed to understand the competencies required for each tier and the competencies present within our potential workforce. Because clinicians with varying levels of experience will manage patients that will require intubation and venous and arterial catheter access, we also needed to organize strike teams to provide these specialized services when required. These strike teams broaden the pool of clinicians that can contribute to intensive care unit-specific and COVID-19-specific teams without requiring additional procedural training.

Synchronizing Work Cycles

To create a pool of clinicians that could be deployed in layered teams either on the surgical services or the hospital medicine and critical care teams, all schedules had to be synchronized across

the system. This required all residency programs, subspecialty surgical services, and APP schedules (both inpatient and ambulatory) to align with a modular schedule of 5-day blocks and 12-hour shifts. The 5-day block provides a good balance between prioritizing clinicians' physical and psychological safety when caring for patients with COVID-19 and minimizing excessive handoffs. Additionally, societal time standards have already been disrupted by shutdowns and social distancing measures; therefore, there was no compelling reason to adhere to a 7-day system. Every day is essentially a Saturday. Should a clinician experience an unprotected exposure to COVID-19, the US Centers for Disease Control and Prevention's recommended 14-day quarantine period fits into 3 of these interchangeable blocks.³ Another important factor of the interchangeable system is that the scheduling paradigm spreads the burden of care across the entire health care workforce. This creates an all-in spirit and avoids the erosive narrative in which some clinicians assume a much higher risk while their colleagues are more protected. All other clinical departments in UW Health synchronized their schedules in the same manner so that they could also contribute clinicians to these layered and cross-departmental critical care and hospital medicine teams while continuing to provide urgent and emergency care to their usual patient populations. The operating rooms were also staffed to a 7-day-a-week model with 12-hour shifts so that they could provide predictable staffing models as more anesthesia clinicians were pulled to support critical care and airway strike team opera-

tions with the COVID-19 surge. Of course, local resources and considerations may not allow for synchronizing of schedules, or some locations may find a different cadence is appropriate. We felt that this particular cadence struck a good balance for our situation.

Understanding Competencies

In creating consolidated surgical services as we prepared for COVID-19 surge, we surveyed our faculty across all divisions in the Department of Surgery to ascertain their comfort level in caring for patients in need of acute emergency general surgery or patients requiring surgical critical care. Likewise, we evaluated the competencies of our APP workforce to understand who had experience delivering care in the inpatient setting, in what disciplines, and who could provide first-assist support in the operating room if needed (Table 1). This allowed us to build a leveled grid of clinician competencies (Table 2), ranging from an attending physician who is a content expert to a clinician qualified to see patients with direct supervision. It is important to note that for levels 2, 3, and 4, clinicians could come from various pools, including attending physicians, fellows, APPs, and residents. As an example of how this leveled competency system can be used to create a tiered service, the levels and number of clinicians needed to staff our collapsed trauma, emergency general surgery, and burn services are shown in eFigure 1 in the Supplement.

Building the Teams

Once the staffing structure was specified and work cycles were determined, we asked the specialty general surgery services to create coverage schema that would allow for care of patients on their services while also supplying surgeons to staff the combined trauma, emergency general surgery, and burn (TEB) service. Each division was asked to provide an attending physician to staff the TEB service for every other work cycle. We also created a super-rounder position, responsible for rounding on the consolidated general surgery specialty service. For example, in work cycle 1, a breast surgeon participated as the super-rounder for the consolidated services and a colorectal surgeon worked as the daytime surgeon for the collapsed TEB service. We layered in backup from an acute care/trauma surgeon who is also the clinical operations attending physician of the day. The clinical operations attending physician is responsible for taking all requests of transfer into the system, triaging those requests, and distributing patients to the teams. This person is also responsible for solving scheduling issues that come up as clinicians move in and out of the workforce because of health-associated or other issues.

The Resident and APP Workforce

Our residents and APPs are most of the level 3 and 4 clinicians needed for the surgical teams, as well as the workforce for the teams caring for patients with COVID-19 in the intensive care unit and on the floor. To create a deep bench of clinicians who can be deployed across inpatient services based on comfort level and

appropriate supervision, we collapsed our experienced inpatient and operative-assist APPs with our surgical resident workforce into a single pool of clinicians. This larger pool also allowed for the creation of multiple layers of redundancy and the ability to keep part of the workforce at home waiting for deployment in the event of illness or quarantine absenteeism.

To align our surgical training programs with the broader institutional response, we took an inventory of all trainees within the general surgery residency as well as our integrated training programs in vascular surgery, plastic surgery, and otolaryngology. The APPs throughout the department were included, with a plan to deploy them in a similar fashion to assist with service coverage. We sought to cover all of the surgical services using a maximum of half of our trainees and APPs at any given time, such that the remaining half could be deployed to medical and critical care services for care of patients with COVID-19 or could be positioned at home awaiting deployment. Teams covering the surgical services covered both inpatient care and operating room cases for their respective services, as depicted in Figure 2. Residents were pulled from any outpatient clinic responsibilities. Night float was covered by an intern float service with rotating home-call senior backup from residents on their 5-day block, with exceptions for the night trauma, intensive care unit, and off-site services, which had dedicated in-house residents (Figure 2).

We elected to use a 20-day cycle, with trainees covering the surgical services for 10 days, followed by 5 days of potential COVID-19 care and 5 days off. For residents rotating in the combined medical/surgical intensive care unit, we elected to shorten the period of clinical work to 5 days on followed by 5 days off, to align with the other members of this team. Subspecialty training programs covered themselves with a similar 20-day block system. Any additional residents not used by their own service were redeployed to assist in the coverage of the remainder of the surgical services. In a departmental effort to consolidate workforce, we elected to stop all surgical coverage at 1 hospital that performed primarily elective procedures but did have an emergency department and a low volume of urgent or emergency general surgery consults. These urgent and emergency cases were transferred to one of our other institutions where surgical services persisted. The trainee coverage of all surgical services is shown in Figure 2.

Clinical and Educational Changes

To minimize the number of personnel required to cover the surgical services, residents were removed from certain responsibilities. As outpatient clinic visits had decreased and converted to telehealth, faculty were instructed that residents would no longer be used to cover the clinic. Residents with high-risk comorbidities were held out of clinical responsibilities but assigned to answer patient calls from home. This allowed home-based resident teams to take some workload off the residents in the hospital, while ensuring that they would not have a work-associated COVID-19 exposure. To maintain an educational curriculum for the trainees, a daily online video conference was organized to provide 2 hours of educational content each weekday. These were led by the residents who were currently off service and moderated by a faculty member with content expertise.

Table 1. Clinician Competency Survey

Item No.	Survey questions	Response options
Physician survey		
1	What is your current primary clinical practice setting?	Outpatient, inpatient, or procedural
2	Have you ever been certified in advanced trauma life support?	Yes or no
3	Are you comfortable writing inpatient orders independently?	Yes or no
4	Are you comfortable writing inpatient orders with assistance from an attending physician?	Yes or no
5	Do you have a board certification in critical care?	Yes or no
6	Are you comfortable with independent ventilator management?	Yes or no
7	Are you comfortable with independent nonventilator intensive care unit management?	Yes or no
8	Could you assist with intensive care or ventilator management with guidance from a critical care attending?	Yes or no
9	Do you feel comfortable placing a chest tube?	Yes or no
10	Do you feel comfortable placing a central line?	Yes or no
11	Are you comfortable with performing intubation?	Yes or no
12	Are you comfortable being an independent attending of record, including writing orders/notes and making independent medical decisions, for patients needing general or intermediate care in general medicine?	Yes or no
13	Are you comfortable being an independent attending of record, including writing orders/notes and making independent medical decisions, for patients needing general or intermediate surgical care?	Yes or no
14	Are you comfortable functioning independently in the general care or intermediate care setting, given necessary technical assistance with inputting orders/notes in the electronic medical record?	Yes or no
15	Are you comfortable evaluating and treating patients needing general or intermediate care with assistance from an attending?	Yes or no
Advanced practice professional survey		
1	Role	Nurse practitioner or physician assistant
2	What is your current primary clinical practice setting?	Outpatient or inpatient; procedural or operating room; emergency department
3	What patient population do you typically care for?	Adult or pediatrics
4	Select all facilities that you can deploy to.	UH, TAC, AFCH, UPH-Meriter, DHC, other
5	Are you certified in advanced cardiovascular life support?	Yes or no
6	Are you comfortable with independent ventilator management?	Yes or no
7	Are you comfortable with independent nonventilator intensive care management?	Yes or no
8	Could you assist with intensive care or ventilator management with guidance from a critical care clinician?	Yes or no
9	Do you feel comfortable placing a chest tube?	Yes or no
10	Do you feel comfortable placing a central line?	Yes or no
11	Are you comfortable performing intubation?	Yes or no
12	Do you have experience providing operative first-assist support? If yes, please describe	Yes or no
13	How competent are you with making medical decisions for patients needing general care-level and intermediate care-level general medicine (evaluating and treating)?	I can do this independently, I could do this with guidance, or I cannot do this
14	How competent are you with making medical decisions for patients needing general-level and intermediate-level surgical care (evaluating and treating)?	I can do this independently, I could do this with guidance, or I cannot do this
15	How well do you understand inpatient workflows (admission, discharge, rounding)?	I understand them, I could do this with guidance, or I do not understand them
16	How proficient are you with the inpatient electronic medical record?	I am proficient or I could function with guidance
17	Can you perform direct patient care (eg, turning, transferring)?	I could do this, I could do this with guidance, or I cannot do this
18	Please describe any other skills or experience, clinical or nonclinical, that may be valuable in a crisis situation (eg, interpreter services, information technology, previous nursing experience).	Free-form response

Abbreviations: AFCH, American Family Children's Hospital; DHC, Digestive Health Center; TAC, the American Center; UH, University Hospital; UPH-Meriter, Unity Point Health-Meriter.

Table 2. Clinician Autonomy Grid

Level	Acute care surgeon	Non-acute care surgeon attending physician	Fellow	APP	Resident physician
1. Independent attending physician of record and content expert	Board-certified in surgical critical care	NA	NA	NA	NA
2. Clinicians who are capable of functioning independently as a general surgeon	NA	(a) A general surgeon with understanding of ventilator, sepsis, and shock management and recent abdominal operative experience; (b) a general surgeon providing inpatient acute care who has gained or can gain comfort in the skills above; or (c) a general surgeon with specialized practice but with recent experience with broad-based general surgery practice	(a) An acute care surgery fellow who is capable of practicing independently but lacks attending privileges, or a general surgery board-eligible fellow currently in another training program; or (b) a non-general surgery fellow in a fellowship with recent general surgery exposure	NA	NA
3. Clinicians who need some guidance functionally or legally	NA	An attending physician not currently providing subspecialty general surgery without recent experience with broad-based general surgery practice but could function with additional guidance and direction	A fellow in another division without recent general surgery exposure or comfort	(a) An acute care APP with surgical assistant and procedural capabilities; or (b) an acute care APP with procedural capabilities	(a) A senior resident in general surgery (program year 3 or higher); (b) a senior resident in surgery, surgery subspecialties, emergency medicine, and anesthesia (program year 3 or higher); or (c) a resident in surgery, medicine, emergency medicine, or anesthesia (program year 2)
4. Clinicians who can see patients but need more direct supervision	NA	An attending physician not currently providing any surgical services and needing much supervision or guidance	Any fellow in a primarily nonsurgical setting	(a) Any APP in an inpatient setting; or (b) any APP in an outpatient setting	(a) A resident in any department that currently provides acute inpatient care (program year 2 or higher); or (b) a resident in program year 1 in any department, or any licensed physician

Abbreviation: APP, advanced practice professional; NA, not applicable.

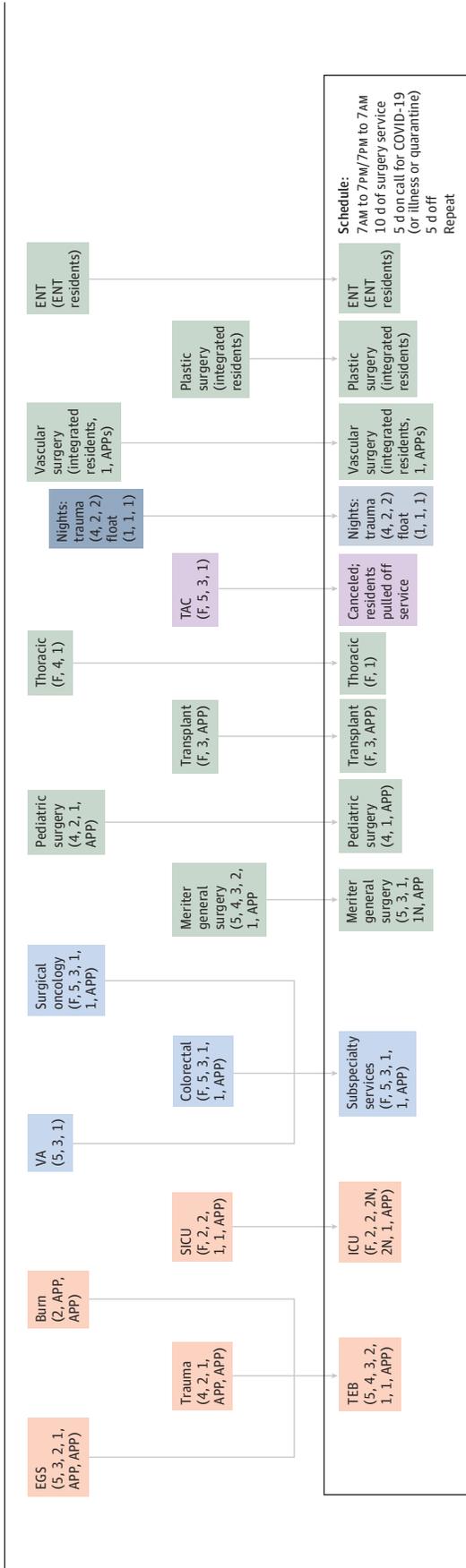
Application of Organizational Framework to Critical Care and Hospital Medicine

Most patients presenting with COVID-19 and requiring hospitalization will be on a general hospital or intermediate care medicine service, with 5% to 7% requiring intensive care.⁴ It is clear that other clinicians will need to provide support for both patients with and without COVID-19 on the hospitalist medicine and critical care services. We therefore worked in partnership with intensive care unit leaders from 4 other departments (internal medicine, emergency medicine, anesthesia, and neurosurgery), as well as leadership from hospital medicine, to survey faculty and APPs across all departments in the health system (Table 1) to assess how clinicians might be deployed in a layered cross-departmental team. We created competency grids similar to Table 2 and built critical care and hospital medicine teams using the same basic design outlined by the Society of Critical Care Medicine.² eFigure 2 in the Supplement displays the levels of clinicians required for day and night coverage for COVID-19 critical care units.

Development of Strike Teams

As the viral load of COVID-19 is highest in the upper airways and nasopharynx, intubation and airway management are the highest-risk procedures in a patient with COVID-19, because of potential aerosolization of the virus. Surgical airways are not recommended in this patient population for the same reason, so the rate of success with orotracheal intubation needs to be high. Therefore, these high-risk procedures should be performed by the most skilled workforce, to minimize overall risk. We created airway strike teams as shown in Figure 1 to deploy across the system. These teams are led by an anesthesia faculty with 2 level 3 type clinicians that will be drawn from anesthesia and otolaryngology. This allows for a deep bench of clinicians with expertise to perform these procedures as safely as possible. Defining this competency separately and attaching a workforce to it also allowed for easier deployment of residents, APPs, and faculty members to environments that they may be less familiar with, such as the intensive care unit, because they did not have to be prepared to perform intubation.

Figure 2. Restructuring the Surgical Residency Rotations



Night float (N) indicates that a resident is assigned to that unique service; other services are covered by the combined night-float system. The American Center (TAC) is an affiliated short-stay hospital offering primarily elective surgery. APP indicates advanced practice professional; COVID-19, coronavirus disease 2019; EGS, emergency general surgery; ENT, ear, nose, and throat; F, fellow; ICU, intensive care unit; SICU, surgical intensive care unit; TEB, trauma, EGS, and burn care.

Demobilization and Implications for Future Operations

It is tempting to focus only on the crisis directly in front of us, but the current pandemic is just the beginning. When hospitals finally begin demobilizing their COVID-19-specific infrastructures, demand for

delayed elective care will surge, causing a new stress on hospital systems. Instead of returning to the status quo by retracting back into traditional silos and providing medical care as we always have, the agile hospital system must continue to adapt to provide efficient care during this secondary surge. Ultimately, we will likely need to seek out and embrace a new normal in which best practices developed during the pandemic continue to shape the medical care processes of the future.

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