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Deploying the Physician Workforce During a Respiratory Pandemic: The Experience of an Academic Teaching Hospital During the COVID-19 Pandemic

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The early experience of Wuhan, northern Italy, and Washington State gave Boston hospitals time to prepare for a surge of patients in need of hospitalization for pneumonia and acute respiratory distress syndrome related to SARS-CoV-2 in the spring of 2020.¹⁻⁴ We present our experience of preparing and organizing physicians to manage this respiratory and critical care disease, employing the resources of an entire physician community, and considering how to deploy for another potential surge later in the year. Tufts Medical Center and Children's Hospital is a 415-bed tertiary and quaternary referral hospital, providing full services, including pediatric, medical, surgical, and neurologic intensive care, extracorporeal therapies including extracorporeal membrane oxygenation (ECMO), level I trauma service, and cardiac care with the largest regional heart transplant program. The primary teaching hospital of Tufts University School of Medicine, the medical center, sponsors a large graduate medical education program, with 453 residents and fellows in 46 programs. The overall faculty is relatively small, with 18 pulmonary and critical care (PCCM) faculty members covering one medical intensive care unit (MICU) at Tufts Medical Center as well as at 2 affiliate hospitals, 25 infectious disease (ID) physicians, and about 200 full-time clinical internal medicine (IM) faculty members.

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The authors declare no conflicts of interest.

Q Manage Health Care
Vol. 31, No. 2, pp. 99–104

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DOI: 10.1097/QMH.0000000000000321

Typically, 48 licensed beds are adult intensive care (10 medical, 10 surgical, 20 cardiac/cardiothoracic, and 8 neurology/neurosurgical), with an additional 10 pediatric (PICU) beds.

The medical inpatient service does not have a hospitalist program but is based on a subspecialty service program, with subspecialists in cardiology, general hematology/oncology, bone marrow transplant, nephrology, gastroenterology, ID, pulmonary, geriatrics, and general IM working as supervising attendings for the ward services. This model resulted in a large number of faculty members with expertise in inpatient service coverage. In the face of anecdotal experiences reported out of Italy in early 2020,⁴ we strategically planned to increase the capacity of our adult ICU from 48 to 91 beds and our inpatient services—excluding hematology/oncology and cardiology—from 84 to 176—in order to accommodate the impending pandemic surge.

PRINCIPLES OF DEPLOYMENT

As with other academic medical centers, our institution saw significant disruption to its normal educational and academic structures in mid-March 2020 when a state executive order mandating social distancing resulted in widespread introduction of remote learning, transition of ambulatory clinics to telemedicine, and suspension of elective surgery and other procedures.⁵ The Tufts MC Graduate Medical Education (GME) Committee, the Designated Institutional Officer (DIO), and the chief executive officer determined that significant redeployment of house officers necessitated a declaration of the Accreditation Council for Graduate Medical Education (ACGME) Pandemic Emergency Status (also referred to as stage 3).⁶ This declaration was necessary to accommodate the disruptions to GME work across the medical center. The physician work pool was composed of all active clinical faculty members and the house staff (fellows and residents) of all training programs. We employed the following principles to create multidisciplinary COVID-19 ward and ICU teams and to design a curriculum to orient team members to their new roles. The Chief Medical Officer designated the DIO and the President of the Medical Staff to oversee house staff and attending staffing, in coordination with

the Vice-Chair of Medicine for Quality Improvement and the Director of the MICU. Within the context of the Emergency Status,⁶ these individuals were given authority to make COVID-19 deployments to existing and novel care teams:

1. *Skill set matching.* Using a combination of surveys and leadership meetings, we clustered physicians according to who possessed the necessary skills in providing anticipated services during COVID-19 surge. The goal was to deploy individuals to clinical work areas that were most closely aligned with their skill sets and recent clinical activity, recognizing that everyone felt an initial level of discomfort with the care of a new disease. We identified attending physicians and house staff with prior experience in our critical care settings, recent experience with ventilator management, or with skills in inpatient care. We identified individuals with demonstrated emotional intelligence and leadership skills to support a number of training and information exchange functions.
2. *Orientation and support.* To support those entering new work environments and interacting with a new set of colleagues, we organized a specific 60- to 90-minute weekly virtual orientation to the service that included an overview of COVID-19 clinical care and strategies to streamline daily workflow. Leadership conducted walk-rounds to identify challenges and needs of the teams.
3. *Multispecialty teams.* To expand the capacity of inpatient services, we created new teams of non-IM faculty with IM house staff or non-IM house staff with IM faculty (Table). On the ward services, this included faculty from neurology and pediatric hospitalists and house staff from pediatrics, neurology, psychiatry, and obstetrics and gynecology. This provided each team with physicians experienced with the workflow on the medicine services and the management of common comorbid conditions.⁷
4. *Weekly deployments assigned to a department or division.* To simplify scheduling, and to allow departments and residency programs to organize their internal staffing needs, each new deployment was assigned as an ongoing weekly assignment for a specific department or division to cover. Individuals were assigned by the division or department, allowing these units to coordinate their ongoing schedules. For example, pediatrics was assigned a slot for attending coverage and 1 resident slot on 1 team, and the pediatrics department determined which specific attending and resident would be deployed on a weekly basis.
5. *Cross-coverage support to resident deployments.* To maintain compliance with ACGME resident work hour limitations, IM residents provided backup and sick coverage for the new non-IM residents. We developed replicable staffing units that could be flexed up to accommodate a surge for the ward and ICU services. Where possible, we as-

signed geographic locations for teams, which allowed for efficiency in care, close proximity of primary and consulting ID teams, and conservation of personal protective equipment (PPE).⁸

- 6 Wherever possible, we planned and employed new teams and services before the need was apparent, especially since the magnitude of the need was uncertain. This resulted in some potential overstaffing of the inpatient floor teams but ensured that individuals felt oriented to the new deployment with a smaller number of patients.

DEPLOYMENT PLANNING

The initial deployments removed ID and PCCM faculty physicians from the inpatient ward rotations on their respective services, changes necessitated by the expansion of clinical roles and responsibilities for these physicians. These were covered by the other services with inpatient expertise.

Given the reports of provider illness⁹ and the need for those with mild symptoms to leave work while awaiting test results, we ensured that all physician schedules had an adequate sick call provision. This initially required cancellation of vacation schedules and moonlighting commitments until past the height of the surge.

ID needs

The faculty in the Division of Geographic Medicine and ID worked closely with hospital administration to interpret the implications of the epidemiology of COVID-19 and provide continuous updates for infection prevention, allocation of limited PPE, and guidelines for COVID-19 testing. They organized and provided oversight for COVID-19–related research including participation in randomized clinical trials. Division faculty provided extensive outreach to the workforce overall on diagnostic testing, treatment, transmission, and changes in PPE policy.

Leadership in ID identified a number of roles that could be assumed by other physicians to expand their faculty's capacity for direct patient consultation. First, they created "ambassador" positions; these individuals proactively rounded daily on the inpatient and later outpatient services, providing in-person updates to frontline staff and offering an opportunity for the workforce to raise questions and concerns. These roles were assumed by trusted members of the active and emeritus faculty, including surgery, pediatrics, IM, and radiology. Second, we assigned non-ID ambulatory providers to provide accurate, real-time testing guidance to both the emergency department and ambulatory COVID-19 testing centers, given the uncertainty and rapid evolution of guidance regarding COVID-19 risk assessment, testing algorithms, and initial limited testing capacity. Third, a team of surgeons and nurses provided real-time support with PPE, both for respirator fitting and for ensuring proper technique in donning and doffing in order to prevent self-contamination.

Table. Medical Wards Coverage and ICU Coverage

Usual vs COVID Surge Medical Wards Physician Staffing			
Ward Coverage	Pre-COVID Staffing (Example of a 2-Intern Team)	COVID Surge Staffing (Example of Paired Teams)	
Daytime coverage			
Number of patients (maximum)	18	18	18
Attending	IM attending	IM attending	Non-IM attending
Resident	R2 or R3 IM resident	R2 IM resident	R3 IM resident
Intern	2 R1 IM resident	1 R1 IM resident 1 Non-IM resident	1 R1 IM resident 1 Non-IM resident
Nighttime coverage			
Attending	Home call only	IM attending in-house (cross-covering 4 COVID teams and staffing new COVID admissions)	
Resident	2 R2 IM residents (doing admissions) 1 R3 IM resident (doing admissions)	2 R2 IM residents (each doing cross-covering 2 COVID teams)	
Intern	2 R1 IM residents (each cross-covering 5 teams, up to 12 or 18 patients per team)	N/A	
Usual vs COVID Surge Critical Care Unit Physician Staffing			
ICU Coverage	Pre-COVID Staff (for Our Single MICU)	COVID Surge Staffing (Example of one of Our 3 COVID ICUs)	
Daytime coverage			
Number of patients	12-16	20-24	
Attending	PCCM attending	Critical care attending (PCCM or anesthesiology)	
Tier 2	PCCM fellow	Attending or fellow ^a	Attending or fellow ^a
Residents	1 R3 IM resident 2 R3 IM residents	1 R2 IM resident 2 Non-IM residents ^b	1 R3 IM resident 1 R2 IM resident 1 Non-IM resident ^b
Intern	1-2 R1 IM residents	0-1 R1 IM resident	0-1 R1 IM resident
Nighttime coverage			
Attending	Home call only	PCCM attending in house (covering 2 teams)	
Resident	1 R3 IM resident (cross-covering) 1 R2 IM resident (doing admissions)	1 IM R3 resident (cross-covering and doing admissions) 1 anesthesiology resident (cross-covering and doing admissions)	
Intern	N/A	N/A	

Abbreviations: COVID, coronavirus disease 2019; ICU, intensive care unit; IM, internal medicine; MICU, medical intensive care unit; PCCM, pulmonary and critical care; R1, resident year 1; R2, resident year 2; R3, resident year 3.

^aAttendings from cardiology or nephrology; fellows from nephrology, oncology, and cardiology.

^bNon-IM residents from anesthesiology, otolaryngology, and orthopedic surgery.

Addressing needs for critical care

The Division of PCCM immediately converted its schedule for ICU coverage expansion to provide in-house 24/7 coverage of 5 full MICU services at Tufts Medical Center and 2 affiliates. Building upon the Society of Critical Care Medicine’s Tiered Staffing Strategy for Pandemic,¹⁰ the ICU team developed a hierarchical 3-tiered coverage model for the ICUs in order to increase critical care capacity:

- Tier 1 comprised critical care faculty from pulmonary, anesthesia, and surgery. They were responsible for triage decision making, ventilator/respiratory failure management, attending documentation, and billing (shared with tier 2 attend-

ings). Tiers 1 and 2 also performed the vast majority of direct patient care and assessments, given the scarcity of PPE.

- Tier 2 comprised fellows from critical care, cardiology, and nephrology or cardiology or anesthesia attendings with critical care experience. As mentioned, Tier 2 participated in direct patient care and assessments.
- Tier 3 comprised house staff or advanced practice providers. Tier 3 was responsible for documentation, orders, communication with consultants, and daily family communication.

The original MICU team was maintained as a hybrid unit available for COVID-19, persons under investigation

(PUI) for COVID-19, and non–COVID-19 admissions. The first COVID-19 ICU team was located in the existing neurocritical care space, with a capacity of 15 patients. The SICU was the next ICU available to accept COVID-19–infected patients, with their usual staffing coverage of surgical intensivists, anesthesiology, and surgical house staff. The PICU was initially converted to care for those younger than 30 years with COVID-19, using its existing staffing structure, with support from the pulmonary consult team for adult care. With very few cases younger than 30 years in need of critical care, the PICU quickly transitioned to providing critical care to mostly adult patients with severe COVID-19. The cardiac care unit (CCU) service transitioned to a hybrid service of COVID-19 and non–COVID-19 cases, managing complex cardiac patients including those on ECMO, those with pre- and postorthotopic heart transplants, and those with mechanical cardiac assist devices. Once these resources were utilized, we created 2 additional teams, converting a prior ward space into an ICU. These teams utilized both PCCM and anesthesiology at tier 1, with tier 2 covered by fellows and tier 3 covered by house staff from IM, anesthesiology, and otolaryngology. In addition, there were overnight PCCM and SICU attendings in residence each night.

ICU leadership identified a number of key functions and tasks that other specialties could provide, thus relieving PCCM physicians to focus on critical care management:

1. *24/7 procedure service.* Staffed by interventional radiology and vascular surgery, the procedure service accommodated the increase in need for central venous and arterial access. Over 3 months and more than 130 patients with COVID-19, we experienced no central catheter infections using this standardized approach.
2. *Intubation team.* A dedicated staffed by anesthesia faculty performed all COVID-19 and PUI intubations.
3. *Tracheostomy team.* Otolaryngology and trauma surgery undertook insertion and management of all tracheostomies. These procedural teams allowed for standardization of the care across all ICUs and improved patient safety.

Inpatient COVID-19 services

With reduced numbers of admissions with non–COVID-19 disease, and an increasing expectation of COVID-19 illness, we made a number of adaptations to our ward services, consolidating non–COVID-19 services while creating additional COVID-19–specific clinical services. Nursing organized to cohort all COVID-19 and PUI patients on 2 specific floors, admitting or transferring those with negative tests to non–COVID-19 teams, to both conserve PPE and ensure geographic support to the providers assigned to provider safety and patient care.

Because of increased IM resident and attending assignment to ICU services, the COVID-19 medicine services required additional staffing from non-IM residents

and faculty. We addressed these needs by similarly developing plans for pairs of COVID-19 teams to care for patients on the same geographic unit to ensure the non-IM faculty had a “buddy” for quick questions or informal consults on patient care issues. One team in the pair was composed of a general IM attending, a junior IM resident, and 2 non-IM interns (otolaryngology and obstetrics/gynecology). The other team had a neurology or pediatric hospitalist attending, chosen because of their experience on inpatient wards and expertise in differential diagnosis and management of respiratory illnesses. They were supported by a senior IM resident, an IM intern and a resident from their own department. Because COVID-19 symptoms overlap with so many other conditions, most admissions were labeled as PUI for COVID-19, until more rapid testing allowed for this determination soon after admission. Because of the multiple transitions of care, and the frequent overnight deterioration of respiratory status of patients, we created an overnight COVID-19 team, dedicated strictly to covering the existing COVID-19 patients and admitting new COVID-19 patients or PUI. This night team included 1 IM attending and 2 senior IM residents; this team would evaluate new admissions and facilitate transfers both to the ICUs if patients decompensated overnight and to non–COVID-19 services if a patient under investigation was ruled out for COVID overnight. Palliative care physicians assumed a proactive role in patients with hospitalizations of greater than 5 days or critical illness, maintaining continuity of communication with family and patient and supporting care progression consistent with patient and family preferences. Their role was critical in the context of numerous provider transitions as patients transferred between services and as physicians’ rotations were shortened in order to provide respite and reduce burnout.

We designated a group of senior and emeritus faculty members to serve in multidisciplinary teams capable of implementing crisis standards of care. Utilizing the guidance developed by a statewide consortium¹¹ this group prepared to evaluate cases if the region as a whole reached crisis standards and required support for triage decisions. Fortunately, these teams were never deployed.

LESSONS LEARNED

Our deployment was based upon a strategy of identifying physicians with relevant skill sets and experiences, with the aim to distribute pandemic clinical work across the broadest possible clinician workforce. Deploying physicians from other services was made easier with the cancellation and delay of elective procedures, surgical procedures and many ambulatory visits, which provided physicians with reduced clinical needs in their usual care and increased the number available for redeployment. We identified a number of key lessons from our deployment experience.

1. Critical to the success of deployment was the need for training and orientation—to a new disease, to new roles, to new work environments,

and to new people. Those deployed demonstrated initial concern about having the appropriate skill set to provide care for this patient population. This training and support was critical to ensuring everyone had the confidence that they could succeed in the job asked of them. This lesson applied to both house staff and faculty, especially those from non-IM services asked to staff a medicine team. Key features of the orientation included training on COVID-19 care, knowing how to access consultants, especially in critical care, nursing, and IDs, and knowing the escalation pathways if patients had a clinical deterioration.

2. *The success of deployments:* Adaptability, problem solving, and an ability to rapidly assimilate into an unfamiliar work environment seemed more important than specific skills in the success of deployments. Identifying and deploying thought leaders and physicians with flexibility for supporting roles such as ambassadors were significant factors in the success of deployment for an entire service.
3. With several weeks to prepare for the peak in cases, we stood up services, allowing teams time to develop the processes for proper and safe use of PPE, to assign which team members would examine which patients, and to develop an order to daily tasks.
4. We identified the value of developing a scalable, modular model of the care team and then replicating as many times as needed. As care needs became more critical, deployments could then be completed quickly.
5. We identified early-on the need for work spaces for existing and new teams that allow for physical distancing while maintaining proximity to the patient care areas. Visitor restrictions created space in family waiting rooms.
6. The deployment process benefited from the close support by, and regularly scheduled huddles between, IM chief residents and the chief residents of deployed non-IM house staff to identify and quickly address concerns and ensure that all house staff deployments adhered to work duty hours.
7. *Central deployment:* We centralized deployment decisions to eliminate deploying the same persons or making multiple concurrent demands of a small cohort of physicians.
8. While we initially requested completion of individual skill set assessment and daily schedules, in the end, these were not helpful. We needed to deploy as teams in rotation for each position, not pick out specific individuals.
9. The blurring of the traditional academic departmental silos resulted in greater interdisciplinary teamwork, new collaborations across departments, and efficiencies in care. Two examples of this increased efficiency in teamwork included having an obstetrical resident on a COVID-19 ward team with 2 COVID-19–positive women in early stages of labor, and the COVID-19 ward team staffed by a neurology attending and a resident caring for patients with active neurological issues with COVID-19.
10. We focus here on the deployment of the physician workforce, which occurred in tandem with additional deployment of nursing, technicians, pharmacy, and respiratory therapy, to name some of the examples. Discussion was needed with leadership across the organization to ensure we conducted redeployments in tandem and built systems that supported the entire workforce. For example, the leadership rounds served to train and support the entire workforce, and nursing and respiratory therapy reported on the benefits to their staff of the additional daytime and nighttime faculty coverage.
11. While we disbanded many standing conferences and didactic activities, we identified ample opportunity to teach. Weekly Department of Medicine Grand Rounds on care of COVID-19 via videoconferencing reached up to 10-fold normal attendance including trainees and faculty from other departments, with extended question-and-answer periods through the video chat feature. Many of us reflected on the lessons we had learned in prior epidemics on how to think through the management of a new disease and how to deal with one's own uncertainty and fear in the face of a potentially fatal contagious disease. Many faculty members drew analogies to learning to trust the mask and plastic shields against this pathogen the way we had to learn to trust wearing gloves and universal precautions for blood drawing during the initial phases of the AIDS epidemic.
12. One of the key lessons learned was the need to manage stress at all levels. Any new contagion without known treatment requires medical personnel to take a certain level of personal risk, and with that, inevitable anxiety and uncertainty for themselves and their families. Many of these anxieties were reflected in the concern over PPE policy, as we had limited supplies, and evolving data on which procedures and care required what protection. Discussion sessions, which allowed individuals to voice their own discomforts and share examples of their own concerns, were some of the strategies to help one another deal with the uncertainty.
13. The fact that most patients in the hospital had the same disease allowed for standardized teaching and accelerated learning, facilitating safe care by noninternists. Creating integrated teams with critical care and ID oversight accelerated effective collaboration and standardization of care, and integration, enculturation, and alignment of disparate groups around COVID-19 care.

CONCLUSION

As we have approached the second surge, we anticipated a few key differences. Unlike the first surge when the hospital was completely closed for elective visits and procedures and there were “all hands on deck,” there has been less reduction in necessary care for other conditions. We anticipated that the bulk of responsibility of handling patients with COVID-19 in the second surge would rest within the Department of Medicine and spent the intervening months training additional faculty members to serve on inpatient services and hiring additional critical care faculty. We have found the prior lessons on physician deployment provided insight into ensuring a specific focus on physician well-being and sustainability.

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