Collaborating Across Private, Public, Community, and Federal Hospital Systems: Lessons Learned from the Covid-19 Pandemic Response in NYC

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In the spring of 2020, New York City became the epicenter of the Covid-19 pandemic in the United States. During the peak from March 10 to May 1, the hospitals of the Department of Medicine at New York University Grossman School of Medicine — including an academic, private hospital in a community setting, a private hospital, an affiliated public hospital, and an affiliated Veterans Affairs federal hospital — cared for more than 5,000 hospitalized patients with Covid-19. Each hospital encountered unique challenges based on its own resources, affiliations, size, and patient populations. However, with ongoing collaboration, leadership developed protocols applicable across sites. Despite these four hospitals being distinct, these collaborations resulted in many strategies that can be applied to a wide variety of medical centers that must rapidly respond to the unprecedented challenges created by the Covid-19 pandemic. In this article, the authors describe strategies for communication, surge planning, clinical care, and staff wellness.

When the novel coronavirus (severe acute respiratory syndrome coronavirus 2 [SARS-CoV-2]) began spreading in Wuhan, China, epidemiologists recognized the potential global impact. Models warned that highly infectious SARS-CoV-2 combined with the prolonged critical illness of Covid-19 would overwhelm health systems. The World Health Organization’s pandemic declaration and news of several overwhelmed European health systems in March 2020 made this prediction a reality. New York City (NYC) soon became an epicenter of the pandemic, with 168,845 of the
1,122,486 cases nationwide as of early May 2020. To help health care systems in the United States prepare for the pandemic, the Centers for Disease Control and Prevention published general guidelines, and several health systems have shared their own strategic models. However, local factors based on patient populations, affiliations, geography, and politics can influence the application of published guidelines. Therefore, a detailed description of an institutional response highlighting uniform approaches that are applicable in different systems and which unique strategies may be required can help prepare hospitals yet to experience peak disease activity and to plan for potential future surges.

This article focuses on our experiences — caring for more than 5,000 hospitalized patients with Covid-19 over 2 months — in the Department of Medicine at New York University (NYU) Grossman School of Medicine, through NYC locations across four hospital sites: NYC Health + Hospitals/Bellevue Hospital (BH), NYU Langone Health–Tisch/Kimmel Hospital (NYU-Tisch), NYU Langone Hospital–Brooklyn (NYU-Brooklyn), and the Veterans Affairs New York Harbor Healthcare System (VA). The relationship of these NYU-affiliated hospitals offers a unique perspective on the pandemic. These hospitals participate in the educational programs of the internal medicine residents, medical students, and subspecialty fellows, in addition to sharing many clinical protocols across sites. However, these four hospitals have different funding mechanisms, organizational hierarchies, and supply chains. In this article, we highlight the coordinated response and the nuanced challenges that each hospital faced during the Covid-19 pandemic. We focus on four core domains based on challenges faced: communication strategies, development of surge capacity (expansion of beds, staffing, and patient triage), clinical care, and staff wellness (Table 1).

Within the collaborative model of these four different hospitals, there are many practical tools that may be used as a template by medical centers of any affiliation or size, in addition to some areas in which varying approaches may be required depending on the hospital system.

**Hospital Systems and Department of Medicine Structure**

The Department of Medicine at NYU uses four main hospital sites: BH, NYU-Tisch, NYU-Brooklyn, and the VA. Each hospital has site-specific leadership with a chief of medicine, each of whom reports to their respective chief medical officers; each of the four chiefs of medicine also reports to a single chair of medicine through their academic affiliation with NYU. Directives from these lines of leadership typically align; however, the chiefs of medicine negotiate any conflicting directives or priorities when they arise (Figure 1).
Table 1. Challenges Faced and Strategies Used in Covid-19 Pandemic Planning

| Domain of Response | Challenge Faced                                                                 | Strategy Used                                                                 | Next Steps                                                                                                     |
|-------------------|--------------------------------------------------------------------------------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Communication     | Volume of information and pace of change; need for leadership to coordinate plans within each hospital and between hospitals and disseminate information | Frequent and multiple modes of communication to accommodate different communication styles | Develop multimodal communication strategies and tailor these strategies to the needs of staff; communicate within affiliated hospital systems and colleagues at other institutions |
| Surge capacity and expansion of beds | Sufficient ICU beds, negative pressure rooms, and continuous oxygen saturation monitoring | Transformed rooms to accommodate negative pressure and continuous oxygen monitoring needs; revitalized previously closed units; identified areas that could be converted to flex-ICU spaces | Ensure sufficient readily available flex-ICU spaces given that upwards of 25% of Covid-19 hospitalizations required this level of care |
| Staffing          | Sufficient staff to care for the rapid increase in patient volume with a particular strain on ICU nurse staffing; onboarding of staff new to the system or clinical area | Creation of staffing pools via multiple methods, including ambulatory care physicians and nurses and agency staffing; construction of teams to ensure sufficient expertise within a team; creation of robust onboarding programs | Not all of the same sources of staffing pools will be available for the next wave as the rest of the country is impacted; will need to be more dependent on internal staffing pools and less on volunteers and agency; early training of physician and nurses to prepare for ICU care |
| Triage            | Separation of respiratory and nonrespiratory patients on admission; need for processes to accommodate internal transfers and external referrals | Dedicated respiratory and nonrespiratory areas of the ED; systems in place for identification of transfers and handoffs | Continued planning for dedicated respiratory and nonrespiratory areas of the ED, as it is likely there will be more of a mixture between patients with and without Covid-19 in next wave |
| Clinical care     | Given limited evidence and a novel disease, there were many areas of clinical uncertainty | Working collaboratively to develop protocols in key areas such as respiratory failure, renal failure, code teams, and end-of-life care in addition to therapeutic management of Covid-19 | Continue to work collaboratively across sites (not just within affiliated institutions) and share evolving clinical guidelines and systems protocols |
| Staff wellness    | Covid-19 has created an unprecedented challenge to all health care workers | Access to mental health professionals and resources such as meditation, yoga, and schedules with sufficient time off to decompress | This is a marathon, not a sprint; there is a need for ongoing programs for staff wellness |

Source: The authors.
Organizational Structure of NYU Grossman School of Medicine’s Department of Medicine and Its Affiliated Hospitals

The chiefs of medicine at each hospital report to their respective chief medical officers (CMOs) (solid lines) as well as to a single chair of medicine though their academic affiliations with the NYUGSOM (dashed lines). H+H = NYC Health + Hospitals, VANYHHS = Veterans Affairs New York Harbor Healthcare.

Source: The authors.
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The hospitalists and primary care doctors do not rotate among the facilities, instead providing their clinical care at one of the four sites, as designated. Several of the critical care attendings staff the ICUs at more than one site, and many of the subspecialty faculty also rotate among hospitals. The NYU internal medicine residents, medicine subspecialty fellows, and medical students rotate among all of the clinical sites.

The four hospitals are distinct in their patient populations, size, infrastructure, affiliations, and business models (Table 2 and Figure 2).
Although case rates in Manhattan — where three of the four hospitals are located — were not as high as in the other harder-hit boroughs in NYC, the NYU affiliated hospitals received many transfers from areas of NYC with higher case rates.

Source: The authors.

FIGURE 2

Map of NYC and Location of the Four NYU Affiliated Hospitals

Although case rates in Manhattan — where three of the four hospitals are located — were not as high as in the other harder-hit boroughs in NYC, the NYU affiliated hospitals received many transfers from areas of NYC with higher case rates.

Source: The authors and NYC Health. COVID-19: data. The Official Website of the City of New York. Updated May 3, 2020. Accessed July 27, 2020. https://www1.nyc.gov/site/doh/covid/covid-19-data.page. NEJM Catalyst (catalyst.nejm.org) © Massachusetts Medical Society
BH is the tertiary referral center for the 11 acute-care facilities of NYC Health + Hospitals — an $8 billion public health care system. NYU-Tisch is composed of a quaternary-care referral center as well as a separate orthopedic hospital. NYU-Brooklyn, also a specialty referral center, is an academic hospital in a community setting in Brooklyn. The VA is a two-hospital system in Manhattan and Brooklyn, within the VISN2. It serves as the regional specialty referral center for veterans with cardiovascular and neurosurgical disease.

**Communication Strategy**

In times of crisis, effective communication from leadership is essential to disseminating information and can ameliorate anxiety and fear. The sheer volume of information and rapid pace of change made disseminating this information to a large number of staff very challenging. In accordance with crisis communication strategies, all four sites used multiple modes of communication including intradepartmental operations calls, town halls, daily videoconferences, and emails to engage staff, answer questions, and alleviate concerns (Table 3).

Independently, all four hospitals used twice-daily site-specific operations meetings with multidisciplinary leadership from key departments (e.g., general medicine, critical care, ED, psychiatry, nursing, facilities, and infection control). These meetings focused on data updates, departmental reports, and ongoing feedback to identify areas for systems improvements. Additionally, the chiefs of medicine from all four sites communicated on a daily Department of Medicine call. During these discussions, leadership across sites shared experiences, discussed facilities and staffing challenges, assisted each other in obtaining supplies, and shared clinical protocols. Information shared during these meetings resulted in collaborative solutions for major challenges such as renal replacement therapy and development of peritoneal dialysis programs and coordination of staffing as detailed in the sections below.

“Efficient communication within and among the four hospitals was vital and strengthened our ability to respond in each unique system of care; hospitals should ensure they have multimodal communication strategies for leadership and frontline staff.”

To disseminate information generated from these leadership meetings to frontline staff, we used multiple modes of communication strategies, including emails, videoconferences, town halls, and Slack. Some of these communications were group specific (e.g., residents or faculty) to address issues unique to them, and some were inclusive of all. For the residents, who rotated frequently among sites, communication via Slack proved to be an effective means of conveying site-specific information. In addition, residents received nightly updates from the internal medicine residency program director that consolidated information on patient volume, major systems changes, and ongoing challenges generated from the four chiefs of service.
Efficient communication within and among the four hospitals was vital and strengthened our ability to respond in each unique system of care; hospitals should ensure they have multimodal communication strategies for leadership and frontline staff.

**Development of Surge Capacity**

During the 2 months of the peak in NYC from March 10 to May 1, 2020, the hospitals of NYU cared for more than 5,000 patients with Covid-19 (NYU-Tisch, 2,180; BH, 1,186; NYU-Brooklyn, 1,356; and VA, 467; at peak census in early April, the hospitals had, respectively, 550, 396, 303, and 85 patients with Covid-19). Each site had plans for additional surge capacity beyond the peak census reached. NYU-Tisch was prepared for 434 ICU and 590 medicine bed capacity; BH, 200 ICU and 371 medicine bed capacity; NYU-Brooklyn, 78 ICU and 295 medicine bed capacity; and VA, 44 ICU and 70 medicine bed capacity. Staffing and equipment plans for these maximum planned bed capacities were ongoing at the time the peak census was reached and never ultimately required. With the exception of the VA, the medicine and ICU services at the three other hospitals comprised patients with Covid-19 almost entirely, with few or no non-Covid-19–related admissions during this time. Similar to what was occurring at other institutions, many of these patients had a high level of care needs, including continuous monitoring and ICU admission. To accommodate this demand, all four affiliated NYU hospitals developed systems to expand medicine and ICU bed capacities, to transform rooms to accommodate specific needs such as

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**Table 3. NYU Department of Medicine and Hospital Site Communication Strategies**

| Communication Strategy | Multisite Communication | Hospital Site-Specific Communication |
|------------------------|-------------------------|--------------------------------------|
| Meeting type           | NYU Department of Medicine leadership planning | NYU all-staff town hall | Site-specific updates*<sup>a</sup> | Hospital site operations planning |
| Leader/organizer       | Chiefs of medicine and residency program leadership | Internal medicine residency program director | Chair of medicine | Chief medical officer, chief of medicine, section chiefs, chief nursing officer, and site-specific residency leadership |
| Target audience        | NYU Department of Medicine leadership | All internal medicine residents (across sites) | All clinical and nonclinical staff | All staff, faculty and advanced practice providers, nursing, residents |
| Frequency              | Daily | Daily | Twice a month | Daily | Twice a day |
| Method of communication| Webex | Email | Webex | Webex, emails, Slack, in person but socially distanced in small groups |
| Goals                  | Share experiences and challenges | Site-specific clinical guidelines updates | Site updates on patient volumes, outcomes, operations planning | Site updates on patient volumes, protocol changes, PPE guidance, Patient volume and supplies updates |
|                        | Assist in obtaining supplies | Patient census and supply updates | Answer questions and concerns | Answer questions and concerns, Department reports |
|                        | Discuss current clinical guidelines and necessary modifications | Scheduling changes | Staff engagement | Staff engagement, Identification of gaps and planning needs |
|                        | Strategize on resident and fellow site allocation | Wellness initiatives |  |

PPE = personal protective equipment. *For site-specific updates, some communications were provider group–specific (e.g., only for residents or for nurses), and some were more global; the leader of the meetings was dependent on the target audience. Source: The authors.
negative pressure and continuous oxygen saturation monitoring, to expand and onboard staff, and to develop systems to handle the triage of a large volume of Covid-19 admissions (Table 4).

**Expansion of Medicine and ICUs**

In each hospital, previously closed units were revitalized and designated as Covid-19–specific floors. Neurosurgical, cardiac, and surgical ICUs and post-anesthesia care units, in addition to transplant centers and operating rooms, were converted to ICUs for patients with Covid-19. Many Covid-19–designated areas were converted to negative pressure, a crucial change in airflow used to control infectious spread of Covid-19. This process was completed on the basis of each hospital’s heating, ventilation, and air conditioning system. Newly constructed buildings within the NYU-Tisch network were equipped with built-in ventilation systems that could be easily adjusted to negative pressure. Some of these areas also had hardwired bedside-monitoring capabilities that facilitated rapid expansion of ICUs. However, in older NYU-Tisch and NYU-Brooklyn facilities as well as in BH and the VA, rooms needed to be converted to negative pressure using high-efficacy particulate air filtration units and other specialized ventilation systems. At BH, several medicine units were also outfitted with continuous pulse oximetry monitoring, an essential need for the care of patients with Covid-19, while the VA increased its telemetry capacity to meet the same demand.

In anticipation of a second wave, all four sites are planning continuously for additional flex-ICU spaces to ensure sufficient capacity; during the first wave, at least 25% of hospitalized patients with Covid-19 required ICU level of care. Hospitals considering further preparation for pandemics should consider a model with hospital rooms that may be converted immediately to negative pressure with ICU or advanced monitoring capabilities; approaches to achieve this may differ on the basis of the hospital system, as it did across our four sites.

**Approach to Staffing and Onboarding**

As Covid-19–specific units were built, the need for additional clinical staff grew, including the establishment of backup pools for surge and illness. There were four major considerations shared across sites in this approach: (1) source of staff; (2) onboarding of staff; (3) construction of teams to ensure sufficient expertise within teams; and (4) schedules to ensure time off and backup pools.

**Source of Staff**

There was variation across sites in how staff was recruited to meet the needs of this growing segment of the patient population. However, across all sites, cancellation of elective procedures and conversion of the majority of outpatient visits to televisits expanded the pool of physicians and nurses to deploy to the inpatient units. For all sites, the majority of additional staffing was recruited from this outpatient pool of clinicians. As hospitals that are associated with a network of ambulatory sites, NYU-Tisch and NYU-Brooklyn redeployed attending physicians, advanced practice providers, and nurses from the outpatient NYU network to the newly implemented Covid-19 medicine units and ICUs. Though this level of redistribution may be more difficult for smaller hospitals, this strategy provided a more fluid onboarding and accreditation process that was essential in rapidly deploying the necessary staff. At BH, NYU-Brooklyn, and NYU-Tisch — in addition
to redeploying outpatient attendings, nurses, and advanced practice providers — the medicine subspecialty, neurology, and surgical faculty were deployed to staff the medicine and ICU services. Additionally, BH hired many advanced practice providers, nurses, and attendings via agency staffing. NYU-Tisch and NYU-Brooklyn similarly employed agency-supplied nurses. At BH, nurse staffing was also supplemented by military staffing. However, limited reserves still existed for critical care nurses across sites. A small number of volunteer attendings from outside the institution, including several prior residents and faculty at NYU, served on the front lines as well. At the VA, the service redeployed general internal medicine and medicine subspecialty faculty, in addition to hospitalists, to staff teams. After the availability of on-site medical staff was exhausted, the VA DEMPS was activated to reallocate physicians and nurses from VISN2 (the VA’s health care network that covers the states of New York and New Jersey) and other networks across the country. The redistribution of clinicians, however, did not allow for rapid movement, and the demand for physicians and nurses by several other VA medical centers around the country delayed the DEMPS deployment.

Hospitals considering further preparation for pandemics should consider a model with hospital rooms that may be converted immediately to negative pressure with ICU or advanced monitoring capabilities.”

Graduate medical education (GME) staffing was administered through a collaborative effort between the GME office and the internal medicine residency program. Internal medicine residents
were placed into three-resident clusters with a preset 6-day-a-week, 12-hour-a-day call schedule regardless of the rotation to which they were assigned (e.g., ICU, wards, sick-call). This allowed for modular deployment of clusters, limiting concern about day/night transitions as well as ensuring that at least one member of the team was present at all times for patient–physician continuity.

As our clinical needs escalated, non–internal medicine GME volunteers were queried about potential roles they could serve, with consideration of their knowledge and skill sets (e.g., acute-care medicine postgraduate year 1 [PGY1] level work, ICU PGY1, emergency medicine PGY1, proning team, procedure team, and fellow functioning as a hospitalist attending). These residents were added to our three-person clusters, and a GME resource database was created to track the potential roles for assignment, the dates the residents were able to be deployed, and the hospitals to which they were credentialed. Working with the chiefs of medicine, the three-person resident clusters were then deployed to clinical areas most in need among the four hospitals determined by current staffing levels and patient volumes based on daily assessments. Fellows served in the hospitalist attending role across sites and were granted emergency credentialing as attendings coordinated by division administrators. Focus on hospital need rather than funding source (how many resident and fellow lines each site funds) allowed for rapid redeployment of the residents and fellows.

**Onboarding of Staff**

Creating robust onboarding plans was required for all staff: both those familiar with the clinical areas but treating a new disease and those new to clinical areas. Each site held focused weekly 60- to 90-minute orientations to the clinical service with a focus on the treatment of Covid-19. This was supplemented by a Covid-19 handbook created at each site (Figure 3). Although each site had variations of the Covid-19 handbook particular to their unique system, collaborating across sites that shared best practices created a common framework for these guides.
To provide additional training to physicians and advanced practice providers for staffing the ICUs, our Division of Pulmonary and Critical Care designed a half-day training course in the VA Simulation Center (a shared resource for the NYU Grossman School of Medicine). Attending physicians, fellows, and residents from all four sites were provided with a refresher course on ventilator management, pressor use, line placement, and point-of-care ultrasound. Through this course, we trained 116 physicians and 59 advanced practice providers to expand coverage for our ICUs across the NYU system.

**Team Construction**

Across all sites, teams were constructed to ensure balance between level of expertise and knowledge of the system, given that many staff were working in clinical areas not in their regular scope of practice. This was essential to ensure the safest care possible. For example, a subspecialty attending was paired with internal medicine residents and non–general internal medicine residents, or agency advanced practice providers were paired with a full-time hospitalist familiar with the
hospital system. Each ICU team was either led by an ICU attending familiar with the hospital system or a hospitalist familiar with the hospital system paired with an agency or volunteer intensivist.

Schedules To Ensure Time Off and Backup Pools for Illness

Across sites, the increased volume of high-acuity patients placed a heavy emotional burden on frontline clinicians. To ensure time off to decompress, each site made adjustments to its standard schedules for the faculty. For example, NYU-Tisch moved from a 7-days-on/7-days-off model to working only 3 or 4 consecutive days at a time. At BH, attendings worked 6 days a week with 1 full week off out of every 4 weeks. Each site also created backup pools for clinician illness so that coverage was easily arranged when someone was out sick with Covid-19 or needed time off because of burnout or other illness. The residents’ schedules were in 5-week blocks, which initially comprised 2 clinical weeks (6 days a week), 1 sick-call week, 1 backup sick-call week, and 1 learning plan week during which they participated in didactics and self-directed learning from home. This schedule proved to have insufficient time off because of significant utilization of sick call both for surge staffing and illness; the residents’ schedules were ultimately adapted to 2 clinical weeks, 1 sick-call week, and 2 learning plan weeks to include more protected time off.

“Across all sites, teams were constructed to ensure balance between level of expertise and knowledge of the system, given that many staff were working in clinical areas not in their regular scope of practice.”

In all four hospitals, the major limitation to unit expansion was not space, equipment, or physicians, but rather the availability of critical care nursing staff. In developing a model for expansion, it is crucial to recognize this need and establish an ongoing source of affiliated or voluntary nurses who can be employed as the clinical need grows. Alternatively, hospitals can develop training programs so medicine floor nurses can move to and from the ICU.

Overall, early identification of staffing pools — including backup for surge and illness, construction of teams on the basis of pairing of expertise and familiarity with the hospital system, and onboarding plans — were essential for preparedness. However, strategies of implementation varied depending on the hospital system. Additionally, sources of staffing pools may be different with the second wave because the entire country is now affected, and we all need to adapt and plan for this possibility and depend more on internal staffing resources.

Staffing: Role of Medical Students

Students train in each of our four hospitals throughout their medical education. To help with the surge of patients with Covid-19, approximately 50 senior medical students who had completed their coursework graduated early voluntarily and were accredited to work as residents.
As with many medical schools, we suspended clinical clerkships during the peak of the Covid-19 pandemic. Clerkship students instead served in roles that could be done virtually. Activities in this capacity included providing clinical updates to patients’ families, researching clinical questions posed by the medical teams, and participating in Covid-19 clinical research. The model of virtual team members is another method for expanding staffing pools with clinicians who cannot be physically present in the hospital.

**Source of Admissions and Triage**

Given the unique role of each hospital within its own system, there was variability in source of admissions at each site. This presented different challenges and resulted in some uniform, innovative strategies. Of the four hospitals, NYU-Tisch was faced with the most patients with confirmed Covid-19, peaking at 30 new Covid-19-positive patients every hour. To assist in triaging this volume and allow for separate areas for patients without Covid-19, NYU-Tisch redesigned the ED, creating a designated respiratory evaluation area. This area was retrofitted to maintain negative pressure throughout. Subsequently, the entire ED was converted to negative pressure. Specific acute-care floors and Covid-19 ICUs were identified to receive these new Covid-19 admissions from the ED. If the patients with Covid-19 had stable oxygen requirements after 2 days, they were transferred to a different unit for the remainder of their hospitalization. However, if they continued to show signs of clinical deterioration, including high levels of supplemental oxygen, they remained in these initial units. This intricate triage model was efficient in preserving hospital beds for severely ill patients on units with the appropriate level of care. Additionally, those patients who were initially triaged to a medicine unit and became critically ill were transferred to one of the designated Covid-19 ICUs.

NYU-Brooklyn, situated in the densely populated Sunset Park neighborhood in Brooklyn, received its admission base via the ED. The hospital also remained open as a referral center for acute strokes, ST-elevation myocardial infarctions, and neurovascular interventions. To separate patients with respiratory symptoms from patients with other complaints and to separate the severely ill from those with milder symptoms, the hospital set up an early triage system upon entry to the ED. Patients with milder respiratory symptoms were triaged to a negative pressure respiratory screening center, which saw a peak of 170-plus patients per day presenting with a respiratory illness, the majority of whom tested positive for Covid-19. Sicker patients with respiratory complaints were triaged to a negative pressure area of the ED, and those without respiratory complaints were grouped in a different area of the ED.

“In all four hospitals, the major limitation to unit expansion was not space, equipment, or physicians, but rather the availability of critical care nursing staff.”

BH, in contrast, had fewer direct admissions than did NYU-Tisch and NYU-Brooklyn and therefore had the capacity to accept a high volume of patients from the other acute-care facilities in the NYC Health + Hospital system that had had higher volumes of Covid-19 hospitalizations. During the 6-
week peak of the pandemic in NYC, BH received 600 transfers from other NYC Health + Hospitals. The coordination of these transfers occurred through the NYC Health + Hospitals central office. Census data from the 11 acute-care hospitals in the system were reviewed daily, and with the involvement of the 11 chief medical officers of each of the hospitals, patients were identified for transfer and handoffs given electronically. Triage of all patients admitted to BH, including these outside hospital transfers, occurred centrally through the ED, which was separated into respiratory and nonrespiratory units.

Within the two-hospital system of the VA, its Brooklyn site was initially identified as the Covid-19 hospital. This allowed the VA’s Manhattan hospital to treat solely non-Covid-19 admissions. The Brooklyn ICU quickly reached maximum capacity, however, and so a hybrid model was established at the Manhattan VA, admitting patients with and without Covid-19. Additionally, given the number of overwhelmed hospital systems in NYC, national leadership at the U.S. Department of Veterans Affairs enacted its Fourth Mission, which allowed for humanitarian care of nonveterans, first from the NYC Health + Hospitals network and subsequently from all hospitals in the New York region. Local agencies, including NYC Health + Hospitals and the Greater New York Hospital Association, met daily with a dedicated VA transfer coordinator to make decisions on number of transfers based on the capacity of other hospitals and the VA’s bed availability. The VA transfer coordinator then communicated directly with the VA ED and admitting staff about these transfers. The assessment and triage of these patients on arrival occurred in the ED. The total number of nonveteran cases (more than 110) represented almost one third of all Covid-19 admissions to the VA during this pandemic.

In a pandemic, tertiary- and quaternary-care referral hospitals can expect to be a central resource for system expansion. Smaller hospitals are likely to become overwhelmed and, with less space and fewer resources, may turn to these centers for assistance with overflow. Therefore, these tertiary and quaternary sites need to develop transfer and expansion protocols to care for these patients. All hospitals also need to prepare for triage of patients within their EDs and should consider respiratory and nonrespiratory areas.

**Treatment Protocols and Clinical Practices**

Given the limited evidence on the clinical management of Covid-19, sharing local best practices across sites was essential to providing high-quality care and to planning for resource shortages. BH is a designated special pathogens facility for which the purpose is to enhance the level of preparedness across the United States for patients with highly pathogenic infections. Given this expertise, at the onset of the pandemic in NYC, leaders at BH shared their clinical experiences of special pathogens with colleagues across NYU. NYU-Tisch and NYU-Brooklyn led the way in the development of several clinical guidelines specific to the treatment of Covid-19, such as the management of hypoxia and the approach to anticoagulation. Other sites adapted these guidelines, adjusting for system-specific nuances such as formulary medications, in addition to generating their own site-specific protocols. The shared departmental structure across sites allowed for daily specialty-specific briefings (particularly in infectious diseases, pulmonary, cardiology, and nephrology) to ensure the rapid dissemination of protocols. Residents, who rotated among sites, also facilitated in sharing of best clinical practices. Finally, the four hospitals were enrolled in
clinical trials together as NYU-affiliated hospitals, which was important in obtaining complex therapies for critically ill patients across sites. There were several challenging aspects of clinical care on which the four sites were able to collaborate to develop innovative solutions, highlighted below.

Management of Respiratory Failure

Respiratory failure requiring mechanical ventilation is a common complication of Covid-19, and anticipatory planning for ventilator needs is vital.\textsuperscript{24} All four hospitals closely tracked ventilator use, with daily assessments of ventilator counts and distribution according to clinical need. A ventilator allocation process was developed at each of our sites and modeled on the ventilator allocation guidelines developed (pre-Covid-19) by the New York State Department of Health in collaboration with the New York State Task Force on Life and the Law.\textsuperscript{25} Fortunately, the steps taken to expand supplies and maximize the use of that supply prevented the need for ventilator allocation. More specifically, the allocation process included plans that: (1) set thresholds for use of noninvasive ventilation to preserve ICU ventilators; (2) promoted adaptation of noninvasive ventilators for invasive use; and (3) identified patients who were candidates for downgrade to alternative ventilators so that ICU ventilators could be put back into circulation for new acute presentations.

“None of the hospitals ran out of ventilators. However, more so than ventilators themselves, the disposable components, such as ventilator circuits and expiratory filters, represented a threatened resource at all four sites.”

Being part of larger public and federal health care systems, BH and VA had similar centralized ventilator deployment processes within the NYC Health + Hospitals and the VISN2, respectively. At BH, there was centralized management of ventilators through the NYC Health + Hospitals system with the Department of Strategic Sourcing working directly with vendors, donors, state officials, and federal officials to procure ventilators. Each of the 11 acute-care sites of NYC Health + Hospitals reported daily on ventilator supplies, including numbers in use and on standby and type of ventilator. This allowed for a transparent system for ventilator distribution. On the basis of prediction models, severe ventilator shortages were anticipated within the VA system. In response, the Deputy Under Secretary for Health for Operations and Management instructed the VISN2 directors to identify potential supply gaps for mechanical ventilation needs. VISN2 directors were advised to validate ventilator counts and to update their equipment-management databases. On the basis of these centralized data, ventilators were redistributed. The Manhattan VA demand exceeded its own supply but was able to obtain sufficient numbers of ventilators from other VA facilities within its VISN2.

With the above systems in place, none of the hospitals ran out of ventilators. However, more so than ventilators themselves, the disposable components, such as ventilator circuits and expiratory filters, represented a threatened resource at all four sites. Interhospital communication allowed for these supplies to be distributed among the four NYU hospitals to meet urgent needs while additional supplies were obtained.
Management of Renal Failure

Many patients with Covid-19 also experience acute renal failure requiring immediate treatment, which can overwhelm hospital resources. All four sites were similarly challenged by the demand for renal replacement therapy. Nephrologists across sites collaborated on a uniform approach to handle renal replacement therapy. This approach included initiating a peritoneal dialysis program at each site and developing treatment protocols for continuous venovenous hemofiltration, preserving this modality of renal replacement therapy for hemodynamically unstable critically ill patients.

Additional strategies for optimizing dialysis resources at BH included gathering known Covid-19-positive patients on chronic dialysis in two-bed rooms to optimize nursing staff for bedside dialysis. The nephrology team at the VA adjusted the schedules of patients on chronic dialysis, when clinically appropriate, from three times a week to twice a week or shortened dialysis session duration to accommodate a larger number of patients. Additionally, the VA used newer portable all-in-one hemodialysis machines with ease of use that allowed for renal replacement therapy outside of the ICU. In addition, the greater VA network was called upon to provide existing supplies from less affected areas of the country as well as to send nephrologists to augment staffing with the increased volume of renal replacement therapy.

At all four sites, peritoneal dialysis ultimately provided a solution to expand renal replacement therapy capacity, as the procedure required fewer supplies and could be performed by trained in-house clinicians.

End-of-Life Care and Use of Rapid Response and Code Teams

All four sites saw an increase in rapid responses and codes and required strategies to safely meet these demands. The palliative care services at all hospitals worked proactively to discuss prognosis and outcomes with patients and their families. Proactive daily discussions, particularly in the ICUs, helped prevent decisions being made during the moment of decompensation.

At all four sites, it was essential to establish clear roles for rapid response and code team providers with principles of minimizing unnecessary entrance in patient rooms and ensuring adequate PPE. NYU-Tisch, NYU-Brooklyn, and BH all created Covid-19-specific rapid response and code teams. These teams were composed of hospitalist, critical care, surgery, and anesthesia attendings, in addition to nurses and respiratory therapists. As demand grew, the team was expanded to include residents at some sites. NYU-Brooklyn added a layer of proactive rounding to these teams, by which patients with high oxygen requirements were rounded on by the rapid response teams in addition to their usual care teams. At NYU-Tisch, an analytic tool to predict decompensation within 96 hours was developed to help target proactive rounding. Alternatively, the presence of patients with and without Covid-19 at the VA limited the ability to create a disease-specific team, but similar protocols were in place regarding roles and responsibilities and PPE.

Because hospitals are now encountering the first wave or preparing for the second wave, it is important to collaborate not just within affiliated hospital systems but more globally on
development of treatment guidelines as we all learn more about how to treat this disease. Additionally, we all will be similarly challenged by renal replacement therapy, management of respiratory failure and ventilators, and end-of-life care and code teams; hospitals need to have protocols in place for these domains of clinical care.

**Staff Wellness**

The Covid-19 pandemic has presented an unprecedented challenge to all health care workers, and efforts to promote wellness have been essential to help endure this challenge. In addition to treating a vast number of critically ill patients, many workers chose to separate from their families and friends for prolonged periods of time to minimize the risk of infectious spread. Additionally, given visitor restrictions, providers were often the sole support system for patients. For these reasons and more, staff wellness was an ongoing concern and priority.

“The effects of this pandemic on the staff’s mental health will continue far beyond the discharge of the last patient with Covid-19; therefore, these strategies to promote wellness will remain as long as the need persists.”

Because many staff were expected to take on additional hospital shifts to care for the immense number of patients, we created schedules with built-in time off to allow staff to recharge, as has been detailed above. Telehealth wellness visits were readily available for all frontline staff, with availability of evening hours to ensure sufficient access. Each site organized small-group discussions and debriefing sessions with all staff to promote ongoing conversations among employees at all levels. There were also group-specific debriefing sessions (e.g., for residents, faculty, or nursing) so discussions could occur within peer groups. Coping cards were distributed to staff; the cards featured information about skills that could be used in real time including techniques for minimizing stress, statements of self-appreciation, and activities for 1-minute mini-breaks to recharge. Wellness programs were provided to all NYU employees through an interactive webpage specifically created in light of Covid-19 (Figure 4).
NYU Langone Mental Health Resources

In response to the Covid-19 pandemic, the NYU Department of Psychiatry developed mental health resources for frontline health care workers at all affiliated hospitals, adding to some existing resources, and easily accessed via an internal website.

Among the resources included were meditation training, virtual yoga, breathing exercises created for use while wearing PPE, and guides for positive sleeping patterns. Additionally, resources were available for staff with families, including strategies for supporting children through the Covid-19 pandemic and how best to communicate with them about Covid-19 and how to manage reactions on the basis of developmental stage. Lastly, the philanthropic arm of NYU developed a central fund for assistance available to all NYU staff and NYU-affiliated physicians, regardless of their primary institution. This fund provided financial assistance for transportation to avoid public transportation, housing for those who wished to isolate from their families, and financial assistance for workers whose partners had been furloughed or lost their jobs.

We have seen an overall decrease in need for most of these resources now that Covid-19 rates are low and hospital volumes have returned to normal in NYC. Unfortunately, however, the effects of this pandemic on the staff’s mental health will continue far beyond the discharge of the last patient with Covid-19; therefore, these strategies to promote wellness will remain as long as the need persists.
Looking Forward

As NYC became the epicenter for the Covid-19 pandemic, the hospitals of the Department of Medicine at NYU — BH, NYU-Tisch, NYU-Brooklyn, and the VA — developed multiple strategies for communication, surge capacity, clinical guidelines, and staff wellness. Despite these four hospitals being distinct, there were many uniform approaches that can be adapted by hospitals of any affiliation or size. Collaboration within academic affiliations and, more globally, across the country will be beneficial to leadership, staff, and patients. This overview can be used for diverse hospital systems that are currently facing, or are likely to experience, a surge of patients with Covid-19 or future disaster planning of any kind.

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