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SPECIAL ARTICLE

Pandemic Preparedness: COVID-19 Lessons Learned in New York's Hospitals

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As the SARS-COV-2 pandemic ravaged the world, the United States saw more than 60 million cases and nearly 850,000 deaths directly due to the virus as of January 10, 2022.¹ In addition, there were an estimated 198,000 or more excess deaths not caused directly by COVID-19.² The first peak surge in spring 2020 occurred in Washington State, California, and New York.

In spring 2020, New York City was an epicenter of the global COVID-19 pandemic, with 203,000 confirmed cases between March and May³ (and a peak of >1,500 new hospitalizations per day.⁴ In March 2020 alone, both Columbia University Irving Medical Center hospitals in northern Manhattan admitted 1,150 adult COVID-19 patients, of whom 203 required mechanical ventilation and 101 died.⁵ By April 8, 2020, all 23 Northwell hospitals had over 3,500 COVID-19 patients, with more than 800 on ventilators.

The challenges presented by COVID-19 in downstate New York during the initial surge were much more daunting than in other areas of the state. For example, in a one-month timeframe between March 1 and April 4, 2020, one large 12-hospital system in the New York metropolitan area admitted more than 5,700 patients with COVID-19.⁶ Some hospitals had over 1,000 patients with COVID-19 admitted during that timeframe. Thousands of patients required intubation and mechanical ventilation, extracorporeal membrane oxygenation support, proning, high flow oxygen, and various modalities of dialysis support (continuous veno-venous hemodialysis, continuous veno-venous hemofiltration, sustained low-efficiency daily dialysis, intermittent hemodialysis, and rapid initiation peritoneal dialysis).

This first surge stretched the ability of New York's hospitals and other providers to deliver care to their communities, despite regulatory waivers issued by the state and federal government early on to provide increased flexibility to enhance capacity and staffing.

Longstanding inequities in healthcare were exposed during the pandemic, leading to greater spread within at-risk communities, increasing the likelihood of an overwhelmed healthcare delivery system.

In preparing for further pandemics, health care providers and administrators have been meeting to explore lessons learned. A critical part of emergency management is the after-action report. Additionally, multiple articles have been published retrospectively analyzing the approach to this pandemic, both in the United States and globally.

In view of the enormous number of cases in the New York metropolitan area in the spring of 2020, when less was known about the virus, analysis of the New York experience will help inform and prepare us for the next surge or future pandemics, and provide lessons for other disasters.

METHODOLOGY AND APPROACH

The Healthcare Association of New York State's standing Statewide Steering Committee on Quality Initiatives is comprised of hospital and health system quality, clinical, and patient safety experts. The committee prepared this report using multiple performance improvement methodologies to identify risks and opportunities in current structures, processes, and outcomes, and establish root causes and develop recommendations.

Performing a thorough, systematic analysis allowed for evaluating variation and potential relationships between certain factors that permitted the events identified in the Ishikawa (fishbone) diagram (Figure 1).

The committee used the growing number of research studies available, expert opinion, and brainstorming activities to develop this report further. By applying these techniques, the group was able to identify underlying system and process causes and contributing factors that resulted in an overwhelmed healthcare delivery system.

While hospitals are central to our state's pandemic response and the focus of this report, it is important to note that the lessons learned are from collaboration across the continuum of care. Whether a standalone facility or part of a larger health system, each hospital works closely to coordinate patient care with nursing homes, home health and

COVID-19 Lessons Learned

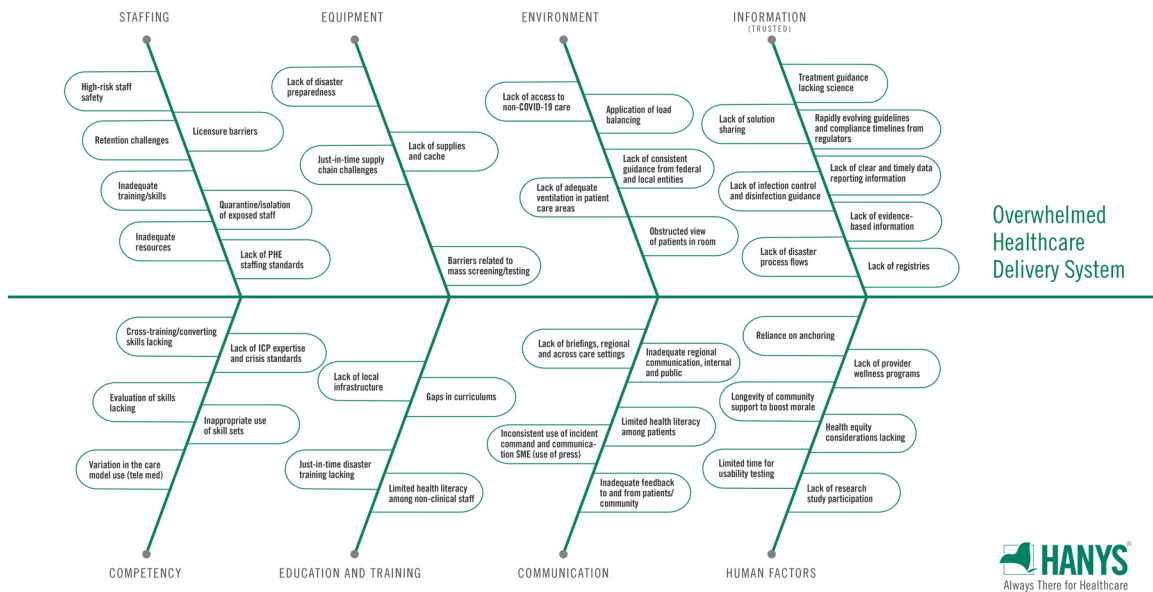


Figure 1: A thorough, systematic analysis was performed to evaluate variation and potential relationships between certain factors that permitted the events identified in the Ishikawa (fishbone) diagram.

other healthcare providers, and community organizations and government agencies.

This report highlights the eight categories identified in Figure 1: staffing, competency, education and training, communication, trusted information, human factors, environment, and equipment. Each category's section provides in-depth information about what worked well and where gaps were identified, along with recommendations for providers, hospitals, health systems, and county, state and federal policymakers to consider in order to better prepare and respond to future events.

The committee hopes this approach will produce fresh insights that will advance our capacity to deal with long-term, pervasive emergencies.

STAFFING

ROOT CAUSE: The lack of a coordinated, federal, state, and local staffing response system supported by a robust public health infrastructure to rapidly address healthcare staffing needs during a pandemic led to an uneven and inadequate supply of clinical expertise where and when needed. This increased the likelihood of staff stress, burnout, attrition, negative outcomes, and an overwhelmed healthcare workforce and system.

The spring 2020 COVID-19 surge presented many staffing challenges. The surging pandemic and resulting increase in patients needing inpatient care required hospitals and health systems to develop and open new inpatient

units and/or spaces to accommodate the increase. These new units/spaces had to be staffed and supported by both clinical and nonclinical staff. Staffing for these units would either need to come primarily from existing staff or new staff from outside the organization.

Training redeployed staff to care for critical care patients presented its own unique hurdles. The lack of sufficient critical care staff to treat patients on these new ICUs was a major issue, especially with the sudden need for these new care areas. Training redeployed staff stretched already sparse educational staff and resources, as educators were often involved in other projects.

While some hospitals had to immediately address an excess of patients, others were getting ready for the possibility of an overload. Due to the state's moratorium on elective surgery and in-person outpatient care, some hospitals had areas with excess staffing, leading to redeployment, layoffs, or furloughs.

Not all ambulatory or elective surgery staff had the appropriate skill sets. Even critical care-trained anesthesiologists had knowledge and training gaps in caring for long-term, intubated patients. Although these issues were resolved, it caused a lag in the availability of competent staff and showed that just-in-time training does not always meet urgent staffing needs.

Challenges were also experienced recruiting outside staff. County Medical Reserve Corps was activated in many parts of the state, but recruiting licensed medical professionals and administrative support staff from MRC was challeng-

ing as many MRC staff had commitments with their employers or were not able to work clinically with COVID-19 patients.

Additionally, the pandemic brought on new challenges and a shift in caring for, testing, and supporting staff. Staff were needed to perform required COVID-19 testing for patients, employees, and volunteers. New quarantine and isolation protocols, which required staff to be removed from work for 14 days, further exacerbated the strain on staff and hospitals' ability to provide care.

New York hospitals were also required to submit daily data to the Department of Health (DOH) and the federal government (first the Centers for Disease Control and Prevention [CDC], then the Department of Health and Human Services). Often, the data definitions and format of the questions varied, which put additional strains on hospital staff. In addition, the questions changed frequently (sometimes daily) and had challenging deadlines (within hours).

All of these challenges added to staff stress and burnout, leading to increased retirements and resignations. Serious healthcare staffing issues continue. We must treat the post-traumatic impact of COVID-19 on healthcare workers and identify staffing gaps and at-risk patients. Filling the pipeline of incoming workers must be a priority to ensure that our healthcare system is prepared to meet the growing needs of New York patients and communities.

What Worked Well?

The overwhelming majority of staff understood the need to care for the rapid influx of patients and were ready to assist and develop new staffing paradigms and scheduling models.

What worked well is illustrated by the following experience at one hospital:

- Physicians, residents, and nurses working in outpatient locations shifted their focus to inpatient care. Physicians worked outside of their specialty areas to cover extended ICU locations. For example, surgeons, anesthesiologists, and cardiologists with input from intensivists helped cover such extended ICU beds/spaces. Training physicians with the Society of Critical Care Medicine's Fundamental Critical Care Support course extended available staff and created more comfort in caring for the critically ill. In addition, hospital staff from other departments were reassigned to the emergency department to supplement the staff shortfall. Additional inpatient critical care units were opened to take patients from the emergency department (ED), decreasing their ED length of stay and ultimately making staffing more manageable.
- Changes in typical medical resident roles were needed. Resources had to be pulled from scheduled rotations. Many residents were relieved of outpatient responsibilities to help with the growing number of inpatients. Daily communication with residency leadership was essential to create safe and reliable processes and help residents

cope with stress and grief. Additionally, some resident staff were trained for typically non-physician tasks such as intravenous drips and use of smart pumps.

- Nurses and ancillary staff were also redeployed to provide cross-training and refresher training based on their prior experience, such as medical/surgical or critical care. Nurse educators prepared mandatory educational modules on basic isolation precautions for all hospital staff, and a review of donning and doffing for clinical staff. Additionally, nurse educators created rapid orientation and onboarding processes for the much-needed agency staff, comprised of a virtual orientation before their arrival and minimal hands-on orientation upon arrival. One organization partnered early with local 1199 SEIU (the union representing its nursing staff and support services) to message staff to prepare for increased patient loads and surge capacity.
- It was essential that staff heard both hospital leadership and union organizations give the same message and be supportive of each other. The same was true of cooperation between hospital leadership and other unions.

Typical work paradigms changed. For example, at one hospital, nursing supervisors—who are often the senior administrator in-house—were becoming overwhelmed during off-shifts. The nurse directors tried to be there 12+ hours a day, five to seven days a week. This was not sustainable. Changes were made in the nurse directors' schedule to work four shifts a week covering 6:00 AM to 3:00 PM, 8:00 AM to 5:00 PM, and 3:00 PM to midnight seven days a week. This gave the off-shifts additional help and staff saw management and felt supported, boosting morale. It helped the nursing supervisors manage the house and all the issues that were arising while protecting the directors from burnout.

As burnout grew and morale was tested, staff wellness was prioritized. Were basic needs of staff being met to foster a sense of physical and psychological safety so that they could feel secure and confident coming to work? A concerted effort was made to bolster morale and team spirit. Donated items from individuals, community groups, and organizations helped boost and support morale. Processes were developed for pickup and delivery of donated items.

Hospital staff were often greeted with thanks during shift changes. Each night in New York City, people opened windows or stepped out onto balconies and rooftops to give thanks and gratitude to all the frontline workers who risked their lives every day.⁷

In general, a sense of community and collaboration developed from all stakeholders. Medical staff, residents, and ancillary and office staff from departments not impacted by the pandemic surge were cross-trained and redeployed from a newly developed float pool managed by the command center. Engaged leadership fostered a sense of community and collaboration by helping meet the daily needs of the staff and patients.

What Didn't Work Well?

While staff were supportive and accepting of new roles, existing trained staff were limited, especially in critical care areas. Staff were trained to support new roles but on-demand training created challenges both in terms of the urgency and depth of training needed.

Additionally, due to high demand and limited supply, staffing agencies charged exorbitant fees beyond some institutions' financial capabilities, creating unequal recruiting potential among different health systems and hospitals.

Medical Reserve Corps (MRC) was available but limited enlistment due to lack of staff was an issue.

Recommendations for Hospitals/Health Systems/Providers

- Greater collaboration between all health systems is necessary to send staff to high-need areas. This must be regional and even national.
- Pooling staffing resources and planning pre-pandemic load bearing between at-risk hospitals and those with available resources may help with burnout and create a sense of support across institutions.
- Continue to advance collaborative efforts to develop and define innovative staffing models of care with consideration of education, experience, and competency along with acuity and ratios to better address future events.
- Increase staff access to post-pandemic mental health support.
- Hospitals/health systems should continue to collaborate and share best practices.

Recommendations for County/State/Federal Policymakers

- Federal, state, and local assessment of pre-pandemic planning should be done related to staffing and public health infrastructure to support at-risk organizations.
- Greater federal and state management of items on allotment is necessary to ensure hard-hit areas get the needed staff, along with equipment and supplies.
- Provide funding and structural aid/support to prepare for future healthcare staffing needs and mental health services of impacted staff.
- Collected data should be used to identify hot spots by ZIP codes and funnel assistance to those areas.
- Continue to support and help manage load sharing between hospitals.
- Help create staffing pools available at a capped fair market rate.
- Fair distribution of grant monies to underserved populations (e.g., Federal Communications Commission—telehealth) is needed to help support the work done by hospitals/health systems caring for this population.

COMPETENCY

ROOT CAUSE: The inability of healthcare organizations to rapidly pivot and move clinical staff to different roles requiring additional skills and competencies further stressed the system and workforce responsible for providing the training and oversight necessary. This increased the likelihood of staff stress, burnout, attrition, negative outcomes, and an overwhelmed healthcare workforce and system.

The COVID-19 pandemic stretched the competencies of New York state health systems in ways that were somewhat foreseeable. Most health systems were able to quickly build the infection control and disease treatment competencies required to meet basic patient needs, in part using protocols iteratively developed and quickly disseminated by large hospitals in New York City and federal agencies. However, pre-pandemic gaps in the competency of the healthcare workforce prevented many hospitals from optimally expanding their hard-pressed inpatient workforces. This had predictable, ongoing effects on staff resilience, burnout, and retention.

The dramatic surge of patients with novel infectious pneumonia taxed the competency of the healthcare workforce in at least four ways. First, and most obviously, hospital EDs and medical ICUs saw a substantial increase in their need for competent staff.

Delivering care for epidemic infectious diseases was once a main preoccupation of US hospitals, but these skills are not widespread among the highly specialized staff that comprise today's health workforce. At one time, every nurse was an expert at turning, positioning, and bathing immobile patients; suctioning the airway of patients with respiratory infections; and charting fever curves. Thousands of nurses now work in specialized areas such as cardiac catheterization laboratories or dermatology clinics or as utilization review specialists. Large hospitals employ teams of physician associates to hold retractors during robotic surgery or interrogate cardiac pacemakers. The range of skills possessed by physicians has become equally narrow.

As a result, an immediate challenge during the spring 2020 COVID-19 surge was how to expand the number of healthcare workers caring for patients suffering from acute respiratory failure when using staff whose normal roles did not include relevant competencies.

A second challenge arose in service areas that were not directly involved in delivering COVID-19 care but could not be reduced or suspended, such as birthing centers, radiology departments, and dialysis units. Staff in those areas needed to attain "on the fly" infection control competencies to work safely in the new pandemic environment.

A third competency challenge related to healthcare systems' ability to prevent the spread of viral illness, including among their own staff. This called on (and in some cases profoundly stressed) competencies in triage, diagnostic testing, contact tracing, quarantine, and vaccination that infec-

tion control departments already possessed, while requiring the rapid acquisition of new competencies (e.g., most hospitals needed to learn how to sterilize and reuse “disposable” personal protective equipment and other single-use items).⁸

An unanticipated fourth provider competency gap was an inability among some redeployed staff to use the local electronic health record (EHR). Providers unable to enter ICU admission orders or daily progress notes into the hospital EHR could not significantly contribute to the care of hospitalized COVID-19 patients, despite good intentions.

What Worked Well?

The principal need in hard-hit areas was to quickly expand ICU surge capacity. Successful strategies included:

- extending the reach of pulmonary-critical care physicians by switching them from the traditional attending physician role to consultants who supervised teams of volunteers (usually cardiologists, surgeons, or hospitalists accustomed to the hospital environment) who delivered minute-to-minute COVID-19 ICU care;
- shifting idled surgical critical care physicians and anesthesiologists to pulmonary ICU duty, often accompanied by their own trainees, pharmacists, advanced practice providers, and case managers;
- assigning young adult COVID-19 patients to pediatric hospital wards and ICUs, which in 2020 were often idled by the scarcity of COVID-19 cases among children;
- promoting students and trainees into the full-time workforce ahead of schedule (e.g., graduating the 2020 medical school class early to expand the number of resident physicians)⁹;
- asking medical and nursing students to take over non-clinical duties such as medical scribe, communicating with families, and locating supplies¹⁰; and
- attempting to expand the supply of critical care nurses by hiring locum tenens “travelers,” substituting certified registered nurse anesthetists for ICU nurses, enticing recently retired nurses to return to work and shifting registered nurses, licensed practical nurses, and aides from low-acuity positions into the ICU to work as “care partners” for regular critical care nurses.
- While New York state hospitals varied in how they adopted ICU surge capacity interventions, most followed a common script that the large New York City hospitals at the leading edge of the surge developed using iterative process design.¹¹ This was generally successful. Indeed, the manner in which competency in COVID-19 staffing, clinical operations, ethics, visitation policy, pharmacology, ventilation protocols, end-of-life decision-making, and dozens of other useful protocols spread across the state in advance of traditional scientific publication was a pandemic success story that deserves further study. Evidence suggests most New York state hospitals eventually acquired the competen-

cies needed to meet the second and third challenges successfully.

There was little patient-to-patient SARS-CoV-2 transmission and even less patient-to-staff transmission within New York state hospitals where staff were trained to use hand hygiene and N95 masks, and where enough masks and other personal protective equipment (PPE) were available (until the omicron variant).

This is probably explained by the fact that even simple surgical face masks reduce SARS-CoV-2 transmission by ~70% in hospital settings¹² and that all patient-facing healthcare workers in New York state are required to undergo annual N95 mask fit-testing, maintaining at least a basic level of competency in PPE use. Like the well-documented experience in Great Britain,¹³ healthcare worker infections in New York appeared to simply track the incidence of new infections in local communities.

What Didn't Work Well?

Notable competency gaps appeared early and remain a concern. Despite the innovative work-around measures described above, no organization was completely successful at expanding or substituting its cadre of full-time critical care nurses and respiratory therapists to comfortably meet the pandemic surge. Therefore, the competencies required to do those jobs are sufficiently unique that hospitals cannot readily deploy more workers when public health crises result in a larger number of people needing ICU care.

Should the current statutory scope of practice of critical care nurses, respiratory therapists, and physician associates expand to allow them to manage ventilators and other ICU therapies independent of physicians in a crisis? Given the connection between the physical and moral exhaustion experienced by full-time hospital nursing and technical staff over the last 18 months and the current crisis in hospital staffing, finding innovative approaches to sustaining the New York state hospital workforce is a top priority.¹⁴

Competency gaps also confounded some hospitals' attempts to “flex” physicians and advanced practice providers from outpatient and specialty roles into hospitals to help deliver inpatient COVID-19 medical care. Many health systems discovered that a substantial portion of their medical staff lacked basic life support and advanced cardiovascular life support certification, familiarity with mechanical ventilators, ability to use PPE, or experience managing simple inpatient medical problems.

Finally, while patient-to-patient and patient-to-staff transmission in hospitals were uncommon, many hospitals in the state did experience staff-to-staff transmission. This usually occurred as a result of employees reporting to work while ill or congregating in the workplace (e.g., during lunch) counter to social distancing guidelines. This situation was exacerbated by a lack of space to properly socially distance staff during lunch or other breaks. In this regard,

too, New York's experience mirrors that of European hospitals, where staff-to-staff was a frequent mode of transmission.¹⁵

Transmission of respiratory viruses between healthcare workers—potentially devastating when it reduces staffing levels due to illness or the need to quarantine—remains a challenge. Preventing staff-to-staff transmission of viral respiratory illness in the workplace requires more education and would benefit from innovative environmental designs that reduce the danger of droplet, aerosol, and contact exposure in work areas where healthcare staff congregate.

Recommendations for Hospitals/Health Systems/Providers

- Ensure healthcare workers maintain the basic competencies necessary to deliver emergency medical care in a crisis.
- Use economic incentives to expand the workforce. Adopt policies (e.g., tuition support, higher hourly pay, self-scheduling, flexible hours, paid continuing education, recruitment/retention bonuses) that encourage New York state residents to enter those fields and non-New York medical professionals to relocate here from other states.
- Expand virtual learning options for healthcare workers seeking to maintain general medical competencies.
- Recruit and maintain crisis response “flex” teams that can be deployed rapidly to hospital EDs and inpatient units in response to pandemic pneumonia, weather disasters, mass casualty events, and other public health crises.
 - Flex staff might be mostly advanced practice providers who normally work in outpatient clinics or procedure areas, rather than mostly physicians.
 - Members of the crisis response team would maintain a basic inpatient medical/surgical skill set, including basic life support, advanced cardiovascular life support, and advanced trauma life support certification; competency with PPE use; fluency in the hospital's inpatient EHR; familiarity with mechanical ventilator theory and practice; and competency in basic medical tasks like blood transfusion and fluid and electrolyte replacement.
 - Pre-certify flex providers as free of health conditions that would prevent them from working with infectious disease patients and as willing to be redeployed to inpatient critical care units (these two factors were sometimes barriers during the initial COVID-19 surge).
- Produce more education on preventing staff-to-staff transmission of viral respiratory illness in the workplace.
- Innovate environmental designs that reduce the danger of droplet, aerosol, and contact exposure in work areas where healthcare staff congregate.

- Create basic EHR education materials for newly deployed staff (or alternative approaches) to ensure that staff are able to enter ICU admission orders and daily progress notes into the local hospital EHR, including staff reassigned from an affiliated skilled nursing facility.

Recommendations for County/State/Federal Policymakers

- Provide enhanced funding as an economic incentive to expand the state's workforce (including recent retirees) in strategic categories to ensure a sufficient supply of competent staff.
- Expand the scope of practice for critical care nurses, respiratory therapists, and physician associates to allow them to manage ventilators and other ICU therapies independent of physicians in a crisis. This would improve efficiency and effectiveness.
- Expand maintenance of certification requirements for physicians and advanced practice providers.
- Create and sustain flexible public health crisis response teams that can be deployed to support hospitals and health systems in need of competent staff.

EDUCATION AND TRAINING

ROOT CAUSE: Insufficient disaster planning, education, and training for healthcare organizations, workers, and leaders led to delayed solutions, redundant efforts, and multiple barriers to providing safe care. This increased the likelihood of staff stress, burnout, attrition, harm, and an overwhelmed healthcare workforce and system.

Advances in health care science have driven specialization of the health care environment and workforce. Consequently, treatment options and improved outcomes have expanded immensely. Healthcare educational institutions have aligned their programs to support increased expertise in diverse specialties and training programs to support overall national goals and needs. This specialized workforce, however, is less flexible and adaptable at practicing outside of a trained and certified clinical scope. In the setting of a global pandemic caused by a previously unknown pathogen, immense changes were occurring at an unprecedented pace in healthcare.

Many highly specialized healthcare workers needed a significant amount of rapidly deployed education, training, competency, and oversight. This was evidenced by the scarcity of specialty nurses and respiratory therapists with the experience necessary to care for the growing number of acutely ill patients in a critical environment and an unknown treatment protocol. Many redeployed nurses from the ambulatory and surgical environments were without sufficient/recent inpatient clinical experience and the rapid development of an internal program for many healthcare facilities was difficult. Exposure to and the expertise to manage complex infectious diseases occurs most frequently in

larger institutions in highly populated areas. As COVID-19 progressed to rural areas with smaller hospitals without the resources to develop and maintain internal educational and training programs, it placed additional stress on the hospitals and workforce. Along with the ability to rapidly advance basic clinical skills, organizations needed to help staff develop new skills. Ensuring the proper use of PPE amid limited supplies and a lack of clarity regarding use, for example, added to organizational challenges.

Hospitals and health systems were not the only entities that suffered from a highly skilled workforce unprepared for the pandemic. The supply of public health experts and resources fell far below what was necessary to meet demand. Funding and infrastructure for public health institutions has stagnated in recent years.¹⁶ As such, when faced with a sudden and rapidly developing pandemic, public health expertise was not able to support providers.

Organizations received almost daily executive orders, reports, and requirements to review, communicate, and rapidly enact across hospitals, systems, and networks. To respond efficiently, organizations needed the legal and regulatory expertise to understand the intent of these complex and frequently changing requirements from the state, CDC, and others, along with the structure to support rapid change management principles.

Clinical leaders were fully integrated into disaster preparedness programs, many without prior exposure or experience in pandemic readiness. Knowledge surrounding social determinants of health, population health, equity, and diversity remain limited in some healthcare environments.

What Worked Well?

Despite the challenges, uneven resources, and gaps in knowledge and expertise, the majority of hospital leaders connected with internal and/or external organizations, creating regional networks to share information and coordinate responses. Statewide advocacy groups such as HANYS gave providers much-needed resources, forums, and advocacy to help them understand, communicate, and respond to the frequently changing state and federal requirements.

Most impressive was the development of clinical teams who created treatment guidelines and training modules that were shared broadly across the country through professional societies, medical and nursing journals, and informal networks.

Rapid changes and flexibility in state regulations covering telehealth, cross-credentialing through disaster privileging, documentation, and visitation rules also helped.

Many organizations built impressive and redundant communication pathways, including daily incident command meetings and briefings, physician and nursing leader briefings, executive communications, and even regional updates.

In addition, many organizations developed unique models of care delivery and training toolkits that should be considered and shared for future disaster planning.

What Didn't Work Well?

Over time, healthcare institutions prevailed and many positive changes have been and will continue to be made. However, the degree of stress on the organizations and their workforce was extreme, in part due to the lack of established national, state, and local structures to support collaboration.

There was a lack of public health expertise and resources to assist in the development and application of testing and contact tracing, along with an inability to provide and support the knowledge, skills, competencies, and data needed during the pandemic surges.

In addition, healthcare provider education programs may not include sufficient knowledge to prepare workers to adjust, cope, participate and lead in future pandemics and disasters.

Other key challenges included the following:

- Ambulatory care staff were timid about working in the inpatient setting and inpatient nurses found it onerous to educate and supervise the ambulatory nurses.
- Many redeployed providers had difficulty navigating and documenting in the EHR.
- There was no pre-planned disaster resource structure in place, such as a comprehensive nationwide medical reserve program. Recent retirees, for example, wanted to participate but could not be deployed because just-in-time training was not immediately available.
- The responsibility for deploying consistent education and training throughout the nation, state, and region and within health systems was unclear, leading many to “reinvent the wheel.”
- There was limited and/or uneven access to advances in online education and training models such as simulation and online clinical learning.
- Multistate/national licensure agreements and legislation were needed.
- Care delivery models were augmented to support staffing shortages. However, novice and redeployed staff did not always have immediate access to onsite leadership, expertise, and learning from clinical experts.
- Sorting out divergent professional society recommendations was challenging and often contrary to CDC or DOH.
- Data analytics, development, and expertise were insufficient in many healthcare environments.
- The focus on COVID-19 education, training, and other activities including deploying staff from quality and safety programs degraded the application of knowledge to other important priorities, such as prevention of hospital-acquired infections.

- The loss of staff, a move to traveler roles, childcare needs, and retirements led to a decline in the average level of education and training among staff, despite additional efforts.

Recommendations for Hospitals/Health Systems/Providers

- Expand incident command training for leaders and tailor it to pandemic readiness.
- Develop, expand, and align education within professional education and training programs for physicians and nurses regarding social determinants of health (SDOH), population health, equity, diversity, and disaster preparedness.
- Expand access to online simulation and clinical training.
- Rebalance staffing to create an educated and well-trained staffing buffer as a reserve to draw on in times of crisis. This may take the form of cross-trained clinicians who regularly rotate between specialty areas. In this way, well-trained staff could be shifted immediately to fill critical staffing needs in specialty areas.
- Create stronger ties with retirees who could be mobilized to assist (coordinate with state and federal programs).
- Educate and train managers for potential future pandemics in areas like supply chain.
- Increase staff support (physical and mental) for inexperienced staff called in to provide necessary care.
- Develop models of disaster care delivery that ensure experienced clinical experts provide leadership, expertise, and oversight to novice and redeployed staff.
- Maintain manager oversight to support less experienced staff, despite staffing shortages that can pull managers into direct care roles.
- Educate and train health systems in crisis and pandemic coordination.
- Develop online educational programs similar to Advanced Cardiovascular Life Support training modules for on-demand training for key clinical skills to reduce the burden of redeployment on local hospitals.

Recommendations for County/State/Federal Policymakers

- Establish greater coordination between the World Health Organization (WHO), CDC, DOH, and professional societies.
- Establish greater coordination among federal agencies; for example, the Occupational Safety and Health Administration (OSHA) was very late to the pandemic response when it was already being managed by CDC and by DOH in New York.
- Advance National Guard training and deploy them more liberally.
- Create a field hospital template and toolbox applications.

- Create a ventilator allocation process, policy, and regulations.
- Encourage professional education reform through grants to expand and align physicians' and nurses' knowledge on SDOH, population health, equity, diversity, and disaster preparedness.
- Create a national vetting process for all society guidelines to reduce the amount of credible information with mixed messages.
- Support advances in simulation and online clinical training.
- Support multistate/national licensure agreements.
- Assess and maximize practice to top of licensure for nursing and advanced practice nurses, especially surrounding telehealth and primary care.
- Create and deploy national education and training via the Department of Homeland Security about incident command in a broad crisis like a pandemic.
- Educate and train regional crisis/pandemic coordination.
- Design, educate, and train county health departments on their role in a crisis/pandemic, including their role in data collection, analysis, and visual display.
- Develop and maintain a national, state, and local health-care reserve program.

COMMUNICATION

ROOT CAUSE: The lack of a coordinated healthcare communication infrastructure covering local, regional, state, and countrywide healthcare institutions, governing bodies, professional organizations, and the media led to inconsistent communication, limited understanding of regional issues and needs, and inadequate recommendations/solutions for healthcare institutions, consumers, and communities. This increased the likelihood of confusion, mistrust, ineffective solutions, and negative impacts on health and the economies of multiple communities.

Consistent and effective communication is a challenge for most organizations even in the best of times. During times of increased stress and uncertainty, organizations without well-developed communication structures and practices in place will struggle to provide effective communication, resulting in unintended outcomes.

In healthcare, insufficient communication contributes to between 50% and 80% of sentinel events nationwide—a patient safety event that results in death, permanent harm, or severe temporary harm.¹⁷ In the face of a rapidly spreading and deadly pandemic, crisis communication is critical to both internal (providers and workforce) and external (patients and community) affairs. The growth of mergers and acquisitions within healthcare has highlighted the need for greater alignment and standardization of both evidence-based care/treatment and effective communication.

Proactive efforts to develop communication and collaboration structures and processes are critical to achieving this alignment prior to a crisis. These proactive efforts should include diverse communities and organizations in addition to hospitals.

Current capabilities to develop and implement effective communication structures remain uneven throughout healthcare. While the resources of larger institutions and networks may have been tested and improved by previous crises, smaller independent organizations with fewer resources still struggle to put these structures into place.

In addition, healthcare has been challenged with a workforce shortage for almost a decade prior to the pandemic. This, along with a degrading public health infrastructure and an aging population, increased pressure to ensure safe and effective care during this pandemic.

What Worked Well?

Clinical specialties and professional societies disseminated and communicated clinical studies, treatment protocols, and medical and nursing models of care fairly rapidly. Communication at the individual healthcare system level was also generally good, including between different medical specialties and across inpatient and outpatient care venues. Infectious disease specialists, chief medical officers, and other medical and nursing leaders maintained effective communication within most organizations.

Although frequent and rapidly changing information was a challenge, advocacy groups such as HANYS provided valuable context and follow-up.

In addition, statewide quality organizations were critical in providing advocacy for healthcare providers and valuable information and feedback to state and federal agencies.

Communication from state and federal agencies on alternative access models, licensure, and telemedicine was generally effective.

When organizations were required to restrict visitation, most were able to successfully use technology to support patient and family communication.

What Didn't Work Well?

While many hospitals and healthcare agencies developed communication within and between affiliates and regions, this was not consistent throughout the state. Regions were not established in advance with forethought of supply chain needs, transport, or expertise. Some provider organizations worked within their networks and others worked with regions based on geography or prior exposure and relationships, while others struggled independently.

Incident command structures, resources, and competencies varied, with minimal clinical leadership built into programs. This impacted individual hospitals and others in terms of how and what was communicated back to state and federal programs, thereby potentially impacting the availability of accurate and timely information.

Many large organizations had previously developed playbooks using communication methods such as video, electronic, web-based, face-to-face, and web postings to support effective communication with staff and the community. Others needed to develop these from scratch with limited expertise and resources.

Crisis management within healthcare institutions is individualized, and expertise is based primarily on resources. There are limited available resources from state and federal organizations to assist in coping with large-scale disasters. These factors particularly impact organizations that are rural and/or are not part of a larger system. Due to visitation restrictions, limited resources and a lack of protocols, the communication between healthcare providers, patients, and their families was difficult and often sporadic, increasing stress and anguish.

Statewide recommendations and directives were made without enough information or influence from regional healthcare leaders, leading to premature, unbalanced restrictions, as well as reduced access to care and staffing issues related to travel. This had significant clinical and financial impact on rural healthcare organizations, providers, and staff.

Timely, consistent communication from state and federal political leaders is critical in public health crises. When communication regarding COVID-19 became politicized, it adversely impacted public sentiment while decreasing consensus and collaboration.

Existing public health literacy and communication infrastructure proved insufficient to support broad consensus. This infrastructure was unable to stem the erosion of public trust and support and the proliferation of misinformation and/or misunderstanding.

Public health infrastructure was poorly resourced and was quickly overwhelmed and unable to provide timely services and communication to the public and healthcare institutions.

The media were not used to their best or fullest potential at the local, regional, and state levels. Political leaders, politics, and sensational stories often were the headlines and focus. Healthcare institutions required more support communicating with the public as they navigated restricted visitation policies, staffing shortages, COVID-19 surges, and data and resources for testing and treatment.

Communication and influence from various healthcare providers such as hospitals, clinics, nursing homes, and hospice care programs to state and federal agencies were unbalanced, impacting regulator decision-making and ultimately healthcare outcomes.

Opportunities for retired and non-working health care workers were not clearly communicated. Eligible workers were not easily located, and there was wide variation in incentives and training available.

Ultimately, the inability to rapidly flow, standardize, and scale communications between healthcare organizations;

local, state, and federal authorities; and the community influenced who, how, and what was communicated throughout the pandemic, sowing additional mistrust and fear.

Overall, communication about COVID-19 contributed to (rather than alleviating) misinformation, anxiety, confusion, and adverse outcomes.

Recommendations for Hospitals/Health Systems/Providers

- Reassess critical communication structures and relationships within and between affiliates and outside agencies including nursing homes, rehabilitation, and home care providers. Build on current disaster planning and advance collaborative improvement projects to develop teamwork skills and relationships.
- Develop crisis communication teams (including clinical expertise) along with associated policies and procedures. Leverage the capacity of larger health systems to support smaller hospitals.
- Identify and support internal public health clinical communicators for potential high-risk events in advance.
- Develop and advance relationships with local media to support public health literacy.
- Reassess/restructure incident command structures to include clinical and quality expertise and enhance management knowledge.
- Collaborate and advocate for state and federal public health workforce (voluntary and/or paid) and prepare for the next public health crisis by building communication and volunteerism for hospitals and health systems.
- Develop protocols and resources to support and ensure effective communication with patients and their families (support persons).

Recommendations for County/State/Federal Policymakers

- Provide support and recommendations regarding the development of federal, state, and regional operational and communication structures and models prior to the next pandemic or public health crisis. These models must have a regional component to prevent unnecessary and harmful directives.
- Provide support for crisis management and incident command tools and resources that enable effective teamwork and communication within and between health-care organizations as well as clinical experts (physicians, nurses, and frontline staff).
- Develop and provide data and dissemination models and tools that are accurate, defined, consistently communicated, and easily understood by the consumer.
- Follow [CDC recommendations](#) to use subject matter experts such as a chief public health communicator as the primary resource for communication and guidance for the public and providers. This is preferable to using political leaders as principal communicators of pub-

lic health information, which can politicize the message and dilute its acceptance and impact. Identify these experts in advance of high-risk events.

HUMAN FACTORS

ROOT CAUSE: Insufficient crisis and change management expertise and infrastructure within healthcare systems to address the impact of the pandemic on the workforce, including its systems and processes, led to the inability to adequately maintain/sustain support and overall risk reduction. This increased the likelihood of harm and an overwhelmed healthcare delivery system.

ROOT CAUSE: Longstanding inequities in health care were exposed during the pandemic, leading to enhanced spread within at-risk communities, increasing the likelihood of an overwhelmed healthcare delivery system.

Because of the rapidity of the pandemic surge and the acuity of patients' illnesses, many hospital staff had to be trained rapidly to achieve competency. New treatment areas were opened; hallways, auditoriums, conference spaces, and swiftly constructed triage tents were all used for patient care. Hundreds of new and complex policies, processes, and procedures needed to be developed quickly and taught to redeployed staff now caring for these critically ill patients. Moreover, new infection control processes were vital and were being developed in rapid-fire sequence as PPE supplies and availability fluctuated day to day.

For both staff and patient safety to be maintained, it was imperative that redeployed staff be rapidly and effectively trained in complex technologies, many of which they had not previously used. In addition, training and practice in appropriate infection control processes, including mastering complex donning and doffing techniques, equipment disposal, and the correct use of N95s, cover masks, goggles, gowns, and powered air-purifying respirators, was essential.

All of these competencies were learned under increased stress, fatigue (sometimes to the point of exhaustion), and realistic fears regarding personal safety and safety of friends, family, colleagues, and patients.

Work during the early stages of the pandemic was being rapidly reimagined, and all of these changes were occurring while staff were called upon to simultaneously treat critically ill patients afflicted with a new, little known illness.

Human Factors and Ergonomics

The principles of human factors and ergonomics (HFE) focus on how humans interact with their work environment and evaluate human capabilities and limitations. HFE assesses how work is actually performed in the workspace versus work as it is imagined or envisioned to be done in the "sterile world" conceived in policies and procedures.¹⁸ HFE principles include frontline usability testing, process simplification and standardization, situational awareness/planning, teamwork and training, and frequent com-

munications to disseminate new information and thereby reduce stress and errors caused by lack of knowledge, planning, and teamwork.

What Worked Well?

Application of HFE principles helped mitigate some of the safety risks posed by the first pandemic wave. For example, some organizations created work teams comprised of an attending physician (or appropriately trained fellow credentialed as an attending) who donned PPE and entered the patient's room to conduct a bedside evaluation. Other, often junior team members served as scribes. "COVID consult" teams were designated so that the frontline COVID-19 team could rapidly contact subspecialists for advice and assistance.

Orthopedic, critical care, and anesthesiology staff at some hospitals created "proning teams" to reduce the work of frontline staff, and anesthesia staff created "hypoxia teams" to monitor patients' oxygen status and appropriately adjust therapies. Surgical teams developed new intraoperative guidelines for needed surgical procedures and shared these throughout the hospital network.

Initially, around-the-clock product cleaning and donning and doffing training and observation sessions were conducted by the infection control and quality and safety teams to ensure that frontline staff developed confidence in their ability to correctly handle PPE. Many newly designated COVID-19 rooms had solid doors. Some hospitals cut and placed windows in the door so staff didn't have to constantly walk into the rooms.

At one organization, experts from pulmonary medicine, critical care, and anesthesiology created uniform policies, procedures, and goals to target appropriate oxygenation levels, employ high-flow therapy (which included the appropriate use of HEPA filters and negative pressure rooms) and created guidelines for intubation and respiratory therapy.

Once standardized, electronic ICU and telemetry health teams tracked the implementation of these processes throughout the organization. These telemetry teams were able to remotely monitor multiple patient care areas at once to help ensure that whenever possible, the care across the COVID-19 ICUs and floors was standardized and harmonized with newly created policies and procedures. The same e-ICU teams were able to track the progress of patients in the ICU and floor areas and determine which patients required their care to either be stepped up or down.¹⁹ This improved throughput and bed management at some hospitals.

In keeping with HFE principles, leadership huddles were conducted in a standardized fashion a minimum of three times daily to assess the movement of patients throughout the hospital and ensure standardized care and clear and concise communication. However, the sheer volume of cases limited this as a viable approach for some hospitals.

Other infectious diseases and medical and PhD pharmacists tracked product availability and created care pathways for the appropriate use of pharmaceutical agents. These experts served as an informed resource regarding newly evolving best practices, such as those defining the use of convalescent plasma, IL-6 antagonist, high-dose steroids, anticoagulants, ACE inhibitors, and the utility and safety of other widely considered therapies such as zinc, high-dose intravenous vitamin supplementation, and hydroxychloroquine.

Newly released medical information and updated guidance generated by academic, state, and federal resources were widely disseminated by email, online message boards, and frontline signage and through a network-wide COVID-19 website. The application of HFE helped establish a structure for newly created teams, improved patient safety, standardized care, and sought to mitigate stress by providing access to critical information, real-time training, and frontline staff support

What Didn't Work Well?

In the field of HFE, the "anchoring effect" is a cognitive bias that describes the common human tendency to rely too heavily on the first piece of information offered (the anchor) when making decisions. During decision making, anchoring occurs when individuals use an initial piece of information to make subsequent judgments. Anchoring is problematic for patient care because it can result in missed diagnoses and other errors. With COVID-19 evolving so rapidly, it was important for clinicians to be open to new information and to constantly integrate recent learnings into their thought process.

Similarly, the rapid pace and surge of patients meant that there was limited time for usability testing of newly designed processes and systems. Usability testing is critical, as it can help reveal "work arounds" and other flaws that introduce the opportunity for human error.

Finally, while there was an initial COVID-19 surge in spring 2020, the pandemic has now continued for nearly two years. In the beginning, there were many displays of community support for healthcare workers, including clapping, food donations, and first responder parades. Eventually, these expressions of appreciation tapered off, yet the stress on staff has continued. Health care workers are tired, burned out, and struggling to maintain morale. Hospitals are doing all that they can to address burnout and attract new workers, but this prolonged fatigue has the opportunity to introduce errors and harm to patients.

Recommendations for Hospitals/Health Systems/Providers

- Apply human factors engineering to ensure patient and staff safety during future pandemics.
- Conduct usability testing as much as possible.

- Recognize the importance of sustaining staff morale, mitigating the impact of fatigue, and preventing burnout over the long term.

Recommendation for County/State/Federal Policymakers

- Provide enhanced funding to support changes to the physical environment to support implementation of HFE.

TRUSTED INFORMATION

ROOT CAUSE: Insufficient public access/exposure to national and regional independent healthcare leadership expertise helped enable the politicization of the pandemic, increasing the likelihood of confusion, loss of public confidence, harm, and delays in effective care and treatments.

ROOT CAUSE: The lack of an existing, reliable database/registry for the collection, validation, and harmonization of meaningful, usable data led to the inability to rapidly and consistently collect, display, disseminate, and communicate accurate COVID-19 information across the healthcare system and to the public. This in turn led to delayed and inaccurate information being shared and increased the likelihood of confusion and mistrust.

Among public and frontline healthcare providers, there was a pervasive dread, a fear of what could happen and about personal safety. This fear led to some responses that seem extreme, especially in retrospect. At one New York hospital, a locum tenens provider presented for her shift in the ED decked out in a full gas mask outfit, far exceeding any PPE guidance in place. Some surgeons were reluctant to take COVID-19 positive patients with emergent conditions to the operating room.

What Worked Well?

Flow of information, as it became available, was essential. In one hospital, management presented frequent updates to the staff regarding disease prevalence, PPE supply status, and policy changes. There were few complaints when the facility locked down and allowed entrance at only two manned stations. Management was intentional about maintaining visibility on the clinical units, answering questions along the way. Hospitals that were part of larger systems received regular updates from corporate leadership.

Among those hospitals that were part of large academic medical centers with a universal EHR, some were able to enroll COVID-19 patients early on in research protocols. Others who had access to national registries were able to access trusted clinical information about specific patient populations.

Local newspapers often featured information from hospital press conferences to help disseminate information to the public. Other hospitals hosted weekly and/or daily

video press conferences to provide public updates on hospital capacity, infection rates, and other key information.

DOH hosted biweekly COVID-19 briefings for providers to share the most recent data and intelligence from across the state. HANYS and other associations also held frequent calls to share information, provide a venue for issue spotting, and facilitate collective problem solving.

Experiences from other countries were also helpful. Many hospitals used data from the WHO and other sources to learn how others were dealing with the same unknowns we were facing. Infection rates, hospitalizations, and mortality statistics from other countries also helped New York hospitals predict how the virus might behave on US soil.

With evolving protocols and research results, the toolbox for treatment was improving.

At some hospitals, it was the example set by the medical staff obtaining their COVID-19 vaccination early on that influenced the rest of the hospital employees to agree to be vaccinated, with some facilities achieving a greater than 90% vaccination rate.

To address the fear of the unknown, leaders needed to be visible and accessible, and disseminate credible information as it became available.

What Didn't Work Well?

While the need for restricted visitation was understood, it still placed a considerable burden on patients and staff. Patients with acute and chronic illnesses and those with altered mental status presented to the ED without being able to give complete or reliable histories. Staff strove to lessen patient loneliness and patient and family anxiety by facilitating tablet internet communication.

Politics influenced public perception regarding almost every aspect of COVID-19-related illness, prevention, and treatment. Armchair social media messengers held forth and widely influenced public opinion, spreading politically motivated “alternative facts” and outright fictions regarding the risks of infection, hospitalization, and death rates, and the risks and benefits of vaccination.

This severely impacted the ability of the scientific and medical community to convey actual scientific facts. The lack of access to concurrent, verified, trustworthy frontline data, as would have been available through the existence of a readily available registry system, led to the dissemination of conflicting information from federal and state government leaders. This lack of coherent, trusted information, in turn, eroded public confidence and hampered acceptance of behavioral changes such as masking and social distancing, among others, which were needed to reduce viral spread.

Patients and non-clinicians had limited health literacy. Individuals had inconsistent capacity to obtain, process, and understand basic health information needed to make appropriate health decisions. The knowledge and science regarding this new infectious disease were rapidly evolving, and without a clear “source of truth” the lay community

turned to a variety of other, often less reliable, sources to try to evaluate and respond to their risks of infection.

Guidelines and recommendations evolved rapidly at the state and the federal level. In New York, the governor issued a series of executive orders that provided much-needed flexibilities to hospitals and other providers, but the volume and speed of documents made it difficult to process the changes and apply adjustments internally. The EOs often also had aggressive implementation timelines.

Recommendations for Hospitals/Health Systems/Providers

- Encourage trusted leaders in the organization to be visible and accessible, disseminate credible information as it becomes available, and address fears of the unknown.
- Communicate with staff and the public frequently to establish a consistent, steady presence.
- Participate in national clinical registries, as feasible, to access sound data about the virus, treatment outcomes, etc.

Recommendations for County/State/Federal Policymakers

- Align local, state, and national guidance, recommendations, and reporting requirements as much as possible.
- Provide adequate implementation time for hospitals/health systems/providers when making changes to guidance and/or recommendations.
- Monitor other countries' experiences with viruses and other public health threats to help predict the experience in the state and in the United States.
- Develop a national database with clear definitions to enable healthcare providers and government bodies to more effectively monitor the pandemic and determine where resources and alternative responses are needed. By establishing a trusted source of validated data, public healthcare experts would be better able to apply and appropriately respond to rapidly changing information.

ENVIRONMENT

ROOT CAUSE: Lack of a proactive and predictive national healthcare environmental risk assessment and mitigation plan for pandemics led to an insufficient working environment. This increased the likelihood of stress, burnout, harm, and an overwhelmed healthcare delivery system.

COVID-19 profoundly changed the environment of care experienced by New Yorkers. The need for quarantine and infection control reduced access to most non-COVID-19 medical services and made hospitals off limits to families and visitors. The new physical environment delivered care in tents and from behind plexiglass barriers, while “load sharing” shifted patients among facilities and geographic regions. When the pandemic interrupted in-person care de-

livery, telehealth initiatives grew to satisfy patient needs for care in the new healthcare environment.

The environmental modifications required to care for the infected proved stressful to consumers and even more so to healthcare workers, contributing to burnout and attrition. There is a pressing need for healthcare systems to identify which modifications to the care environment improved COVID-19 treatment while avoiding healthcare worker burnout.

For consumers, the onset of the COVID-19 pandemic in March 2020 changed the familiar healthcare environment in ways that were immediate, unsettling, and profound. In hard-hit regions of the state, an early consequence was the loss of convenient access to 24/7 emergency care, as COVID-19-filled hospital EDs became places to avoid. Following soon after came delays in medical testing, suspension of elective surgery, and loss of access to longitudinal care, as clinics and physician offices reduced their hours or closed. The long-term adverse consequences of reduced access to care for chronic conditions such as cardiovascular disease and cancer have been well documented.^{17,20}

When patients were able to access the new healthcare environment, they encountered unfamiliar features for which few were prepared. In spring 2020, most community COVID-19 testing took place outside in tents. Normally smiling healthcare workers were masked, gowned, and shielded, removing human interactions that were considered part of the therapeutic environment. Hospitals quarantined known or suspected COVID-19 infections in negative pressure rooms on closed wards—an early 20th century practice that had disappeared from most hospitals with the introduction of antibiotics and vaccines. Hospitals that breached capacity were forced to care for mechanical ventilator patients in operating rooms, cafeterias, and hallways—or to “load-shift” them to another facility.²¹

What Worked Well?

Somewhat mitigating COVID-19's negative impact on access to the therapeutic environment was the rapid expansion (arguably long overdue) of telehealth initiatives by most New York state healthcare delivery systems, made possible by new flexibilities granted by the government. This trend mirrored the practice of centers of excellence in other parts of the United States (e.g., Mayo Clinic expanded video health visits from 200 to 35,000 per week in 2020²² and benefitted from the regulatory relief granted by the Federal Communication Commission's COVID-19 Telehealth Program²³ and CMS' decision to reimburse telehealth visits at in-person rates.²⁴

Nearly all delivery systems were able to mitigate the risk of infection by inaugurating at least a basic level of telehealth service; these experiences should also be subjected to after-action review to identify and archive best practices. Given the proliferation of threats to in-person healthcare delivery in the state—which include not only viral

pandemics but weather emergencies, natural disasters, and terrorism—there should be little argument that telehealth capacity and capability should be expanded to the greatest extent possible.

Nearly all New York state healthcare systems participated in some type of informal regional network that shared intelligence on COVID-19 hospital census and availability of PPE, durable equipment, vaccines, and pharmaceuticals. Daily data on these points were also submitted to DOH through the Health Electronic Response Data System.

Overall, New York's healthcare providers' response to pandemic-related challenges to environments of care must be considered a qualified success. With minor exceptions, nearly all hospitals, treatment centers, and residential facilities were able to use contact tracing, quarantine, industrial hygiene, PPE, and eventually vaccination to prevent the spread of coronavirus disease.

What Didn't Work Well?

Despite many successes, some pandemic-related changes in care environments caused harm and need to improve. Among the most obvious are those related to the well-being of frontline healthcare workers. All hospitals must develop innovative methods to create safe spaces where frontline staff can congregate to doff their PPE, eat, drink, and rest, without fear of spreading viral illness.

No healthcare system fully solved the problem of how to maintain human contact and communication with patients and families in an environment where in-person visitors were prohibited for many months. This caused considerable stress for patients—some of whom died alone—as well as for families and healthcare workers.

If pandemic-related modifications to the hospital physical environment were difficult for patients, the impact on healthcare workers was possibly even greater. Hospitals became busier, noisier (due to proliferation of ventilators, dialysis machines, and negative pressure air pumps), less predictable (owing to the many unknowns associated with COVID-19), less comfortable (due to the need to wear PPE constantly), emotionally stressful (due to the relatively high mortality of hospitalized COVID-19 patients and the frequent need to triage critical supplies) and more personally dangerous.

In surveys conducted during the pandemic, more than 50% of healthcare workers reported emotional distress, post-traumatic stress disorder, or burnout, with the highest rates reported by ICU staff and nurses.²⁵ Pandemic-related burnout may be a driver of the state's current shortage of healthcare workers, particularly patient-facing nurses.

Recommendations for Hospitals/Health Systems

- Study and disseminate best practices pertaining to facility renovations (including how to quickly stand up and stand down negative pressure isolation units as viral infections wax and wane).

- Participate in an informal regional network environment to share intelligence on COVID-19 hospital census and availability of PPE, durable equipment, vaccines, and pharmaceuticals.

Recommendations for Policymakers

- At the regulatory level, New York state and federal agencies (e.g., OSHA), as well as hospital accreditation vendors, should identify what construction and facility renovation practices proved most effective for infection control, quarantine, and worker safety and encode these into a common set of guidelines.²⁶
- Successful approaches to load balancing should be studied and collaborative relationships codified and strengthened where feasible.
- Hospitals and other healthcare facilities should be encouraged to adopt best practices via tax incentives, loans, or grants.
- Benchmark New York state telehealth capacity against other US states and developed nations so that we can remain at the forefront of this important trend.
- Support the expansion of telehealth through political action to maintain federal and private sector reimbursement for telehealth services at a level necessary for healthcare systems to sustain them.
- Study how New York state hospitals addressed virtual approaches for maintaining human connections to identify which strategies worked and which did not.

EQUIPMENT

ROOT CAUSE: Ineffective supply chain management systems, including just-in-time inventory and single source suppliers, led to demand far exceeding supply for many critical tools and treatments. Along with price gouging, this increased the likelihood of inequitable dissemination of supplies for many institutions, harm, and an overwhelmed healthcare delivery system.

The COVID-19 pandemic surge in New York during spring 2020 resulted in many challenges in equipment availability as the acceleration of the pandemic far exceeded the readiness of the supply chain. Suppliers were unable to ramp up product availability to meet demand. This was driven by the just-in-time inventory management model, a process of receiving supplies as close to the time of use as possible. Suppliers were accustomed to providing a usual amount of goods to a healthcare system at a given time. The surge demanded a greater amount of supplies to care for a larger number of patients in an atypical timeframe.

Additionally, many suppliers had single source manufacturing for best pricing that was overseas and limited. As the pandemic accelerated, the supply chain was disrupted due to overseas manufacturing issues and the increased demands on supplies/goods. Air cargo was delayed, and delivery dates were constantly in flux.

Transportation was impacted at every level, particularly in China as customs clearance was severely delayed. As a major exporter of many necessary products, this contributed greatly to supply issues. China being the first to be impacted by the pandemic also resulted in production drops that were difficult to overcome.

Many healthcare providers followed the same model of single source suppliers for best pricing. Hence, when this model failed, there were few avenues to turn to for immediate needs as major suppliers prioritized their customer base first. This practice in most cases shut down/delayed the conversation about obtaining immediate product for non-customers.

There was a great deal of visibility, discussion, and planning around PPE as a product line under pressure; however, many critical medical supplies and equipment were at dangerously low levels. The shortages resulted in higher product prices.

The surging pandemic severely impacted the availability of critical hospital supplies and equipment, including the following:

- PPE: masks, gowns, gloves and eye protection
- Ventilators
- COVID-19 testing supplies
- Oxygen needs in “new” units
- Oxygen adapters
- Pulse oximeters
- Negative pressure rooms (environmental)
- Dialysis equipment
- Drug supply for certain classes of drugs

What Worked Well?

While the pandemic challenged the supply chain by increasing the amount of and accelerating the timeframe in which equipment was needed, it also created collaboration and innovation. Most of the issues confronted required redesigning how supply was secured.

Physicians and clinicians accepted alternatives in the interest of continuing to care for patients with no product preference. Organizations worked with one another to share and collaborate on alternative supply sources that had proven to be reliable. Alternative suppliers were secured that were able to source from other countries besides China. However, this still came at a premium price. Additionally, accessing state/city resources for loaner ventilators and using ventilator alternatives (e.g., high-flow nasal cannula) helped support patient care.

Other successful strategies included the following:

- *Cross-collaboration from all stakeholders:* Very early on, at some organizations, all N-95 masks were issued based on a patient’s diagnosis and order for airborne isolation. This resulted in organizations being well-supplied later on. In addition, staff were educated about the need to be

conservative with supplies, since hospitals did not know when the next delivery would arrive.

- *Leadership engagement/senior leadership daily huddles/internal communication:* Some hospitals established COVID-19 testing supplies and procedures committees with all stakeholders (lab, ED, medicine, nursing, surgery, infection control, occupational health services, administration) to ensure adequacy of testing with the limited number of supplies. Others held daily meetings with supply chain staff to communicate needs with changing policies and recommendations during the initial stages of the pandemic.
- *Daily status reports:* Some organizations created daily medication status reports, using visual management tools (e.g., traffic-light color coding system) so that it was clear when supplies were reaching low levels.
- *Capacity management and expansion of IT services:* Some hospitals established reliable and somewhat robust IT infrastructure systems to enable virtual communication.
- *Innovation:* Some well-resourced organizations were able to produce their own supplies using 3-D printing, etc.

What Didn’t Work Well?

Most, if not all, routine supply chain activities were ineffective as the pandemic impact hampered distribution, staffing, and product and equipment availability. The global supply chain was not set up for a crisis demand that saw two- and three-fold increases over a period of one to two months. Committed suppliers, unable to increase production, were not able to fulfill their basic contracts with hospitals, resulting in shortages.

Hospitals and other providers experienced limited supplies across many different areas, with varying causes, including the following:

- Limited allotments from companies supplying COVID-19 testing swabs
- Limited vendors providing PPE, requiring each facility or hospital system to fend for itself
- Small community hospitals did not have the leverage of larger hospital systems for both PPE and COVID-19 swabs and supplies
- Limited dialysis equipment for surge in need
- Oxygen for both hospital inpatient and home health patients

Recommendations for Hospitals/Health Systems/Providers

- Multiple partners should source needed items for a crisis event.
- Key product categories need coverage beyond local and regional contracting to provide flexibility and more leverage during a crisis. However, this may result in higher day-to-day pricing by reducing sole commitments for those critical supply categories and stockpiling

on an individual basis, resulting in higher inventory and warehousing costs.

- Sources from countries other than China need to be options.
- Health systems should collaborate to ensure equipment is sent to areas where it is most needed.
- Create a business continuity plan for various disaster scenarios.
- Continue to collaborate and share best practices.

Recommendations for County/State/Federal Policymakers

- Government stockpiles were not large enough and the amount of reporting work required did not equal the benefit of supply or equipment relief.
- Product classifications should be assessed to identify the key risk areas.
- Product and equipment transparency needs to be pursued and prioritized.
- Too often, one company's equipment will only work with their consumables (sole source). Equipment needs to be standardized to increase flexibility and sharing options during a crisis.
- Transportation must be reviewed and fixed, as every mode of transportation was a challenge. Ships were stranded in ports, airports were closed, and trucking companies had staffing difficulties.
- Warehousing has to be affordable, as inventory levels need to be addressed.
- Enhanced reimbursement/funding is needed to ensure hospitals have resources to secure and store supplies at appropriate levels.
- Federal and state management of items on allotment should ensure hard-hit areas get needed supplies.
- Collect data to identify hot spots by ZIP codes and funnel assistance to those areas.
- Assure PPE and equipment supply chains and adequate stockpiles to avoid shortages.
- Fairly distribute grant monies to underserved populations (telehealth, etc.).

CONCLUSION

Early 2020 was a sobering time for healthcare in New York state. The COVID-19 crisis highlighted a fragmented healthcare system that never fully prepared for a long-term pandemic event that grew so quickly.

Healthcare inequities were shown in a new light. Differences in capacity to respond between small and large organizations were seen, as well as the inability to continue routine care in this type of situation.

Despite these stresses, New York's healthcare providers, government officials, healthcare associations (such as HANYS and regional healthcare associations) and communities all rose to the occasion.

There was continuous learning and performance improvement. These lessons learned need to be reviewed by local providers and by our public health departments.

Despite the tremendous loss of life and stress on healthcare staff and the communities they serve, we should with humility reflect on our successes and now, despite the pandemic, continue to plan for the future. Every threat provides an opportunity to improve. This is the basis for performance improvement.

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