Collaboration Between Tele-ICU Programs Has the Potential to Rapidly Increase the Availability of Critical Care Physicians—Our Experience Was During Coronavirus Disease 2019 Nomenclature

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OBJECTIVES: Implement a connected network between two Tele-ICU programs to support staffing and rounding during the first wave of the coronavirus disease 2019 pandemic in the United States.

DESIGN: Proof of Concept model.

SETTING: Northwell Health; a 23 Hospital, 40 ICU (500 ICU beds) healthcare organization serving the downstate NY area. During the initial coronavirus disease 2019 pandemic, Northwell Health rapidly expanded to greater than 1,000 ICU beds. The surge in patients required redeployment of noncritical care providers to the ICU bedside. The Tele-ICU program expanded from covering 176 beds pre pandemic to assisting with care for patients in approximately 450 beds via deployment of Wi-Fi-enabled mobile telehealth carts to the newly formed ICUs.

PATIENTS: Critically ill coronavirus disease 2019 patients hospitalized at Northwell Health, NY, at any point from March 2020 to June 2020.

INTERVENTIONS: To offset the shortage of critical care physicians, Northwell Health established a collaboration with the Tele-ICU program of Providence, St. Joseph Health in the state of Washington, which enabled the critical care physicians of Providence, St. Joseph Health to participate in virtual rounding on critically ill coronavirus disease 2019 patients at Northwell Health.

MAIN RESULTS: We developed an innovative hybrid model that allowed for virtual rounding on an additional 40–60 patients per day by a remote critical care physician at Providence, St. Joseph Health. This was accomplished in approximately 3 weeks and provided remote care to complex patients.

CONCLUSIONS: Our findings demonstrate the proof of concept of establishing a network of connected Tele-ICU programs as a rapidly scalable and sustainable paradigm for the provision of support from critical care physicians for noncritical care teams at the bedside.

KEY WORDS: coronavirus; coronavirus disease 2019; tele critical care; telehealth; tele-ICU

The current coronavirus disease 2019 (COVID-19) pandemic has highlighted the lack of an adequate number of fellowship trained critical care physicians to manage highly complex patients in the ICU and

beyond (1). Many solutions have been proposed and put into practice during the current pandemic by various health systems based on their locally available resources (2). Foremost among them is the tiered staffing model recommended by the Society of Critical Care Medicine (3, 4). In this model, critical care physicians in the top tier provide supervision to noncritical care physicians and advanced practice providers (APPs) forming the lower tiers. The model allows for the provision of remote critical care oversight to the bedside teams via Tele-ICU systems equipped with advanced audio video technologies, analytical tools, and remote patient monitoring capabilities. Many health systems have used Tele-ICU extensively to provide critical care support to the bedside teams during the current pandemic (5, 6). The capacity of the tiered staffing model to provide adequate coverage to the surge patients is limited by the number of locally available critical care and noncritical care physicians. During the current pandemic, adequate staffing of the lower tiers was facilitated by the cancellation of elective procedures and redeployment of noncritical care physicians to the ICUs. Although effective, this strategy was not without significant impact on non–COVID-19 care and finances. According to the American Hospital Association, U.S. nonfederal hospitals lost an estimated $161.4 billion in revenue from March to June 2020 as a result of cancellation of elective surgeries and other services (7). In addition, these cancellations can have significant adverse health consequences for patients. Thus, health systems will be reluctant to pursue this as a first-line strategy during emergencies. We hypothesized that a network of connected regional/national Tele-ICU programs is a feasible solution to increase the availability of critical care physicians at remote sites. In this article, we present a collaboration between two Tele-ICU programs, one experiencing a pandemic surge, and another not impacted at the time, to offset the shortage of critical care physicians at bedside.

RAPID SCALING OF NORTHWELL HEALTH'S TELE-ICU DURING COVID-19

Northwell Health is New York State (NYS)'s largest healthcare organization. Our strategy, designed to meet the increased need for providers that could care for the large cohort of critically ill COVID-19 patients (8), is outlined in **Figure 1**. The increase in ICU bed capacity was accomplished by converting new spaces into ICUs, such as step-down units, postanesthesia care units, emergency department (ED) holding areas, and former medical/surgical beds. As shown in **Figure 2**, at the peak of the first wave of the pandemic during the second week of April, our health system had approximately 3,400 hospitalized COVID-19 patients, greater than 1,000 beds ICU capacity including approximately 800 COVID-19 patients on mechanical ventilation in a single day. Elective surgeries and other services were cancelled, freeing up providers for redeployment to the newly formed ICUs.

Prior to the pandemic, our Tele-ICU program provided coverage to 176 beds in 10 ICUs at nine hospitals by a team of critical care board-certified intensivists, nurses, and APPs available 24/7. This involved continuous monitoring of vital sign alerts, proactive rounding on patients, assessment of all new admissions, and "on-demand" support to the bedside team. To support the rapidly expanding ICU beds, we deployed 43 mobile carts equipped with two-way audio-video, and high-definition Pan-Tilt Zoom cameras, thereby increasing the number of covered ICU beds from 176 to 450 at 17 hospital sites in a matter of weeks. A decision on prioritization and deployment of carts was made by representatives of regional hospital administration, Northwell Health's-Critical Care service and Tele-ICU leadership.

In order to maintain the Tele-ICU's established workflows as well as provide additional critical care support to noncritical care teams during the pandemic, we developed a hybrid approach for the provision of critical care services from the Tele-ICU. We retained the centralized 24/7 monitoring and oversight model for the existing hard-wired ICUs and added a virtual consultative model for the newly formed units equipped with mobile carts. A rounding script was developed that focused on ventilator optimization, hemodynamic monitoring, and evolving management of COVID-19, including potential complications. The mobile carts were activated at predetermined times by different bedside teams. Tele-ICU providers rounded with the bedside teams on individual patients, provided recommendations, and documented in the native electronic medical record (EMR). Together, this combined model ensured that the Tele-ICU provided a standardized management of covered patients based on the latest evidence and recommended best practices.
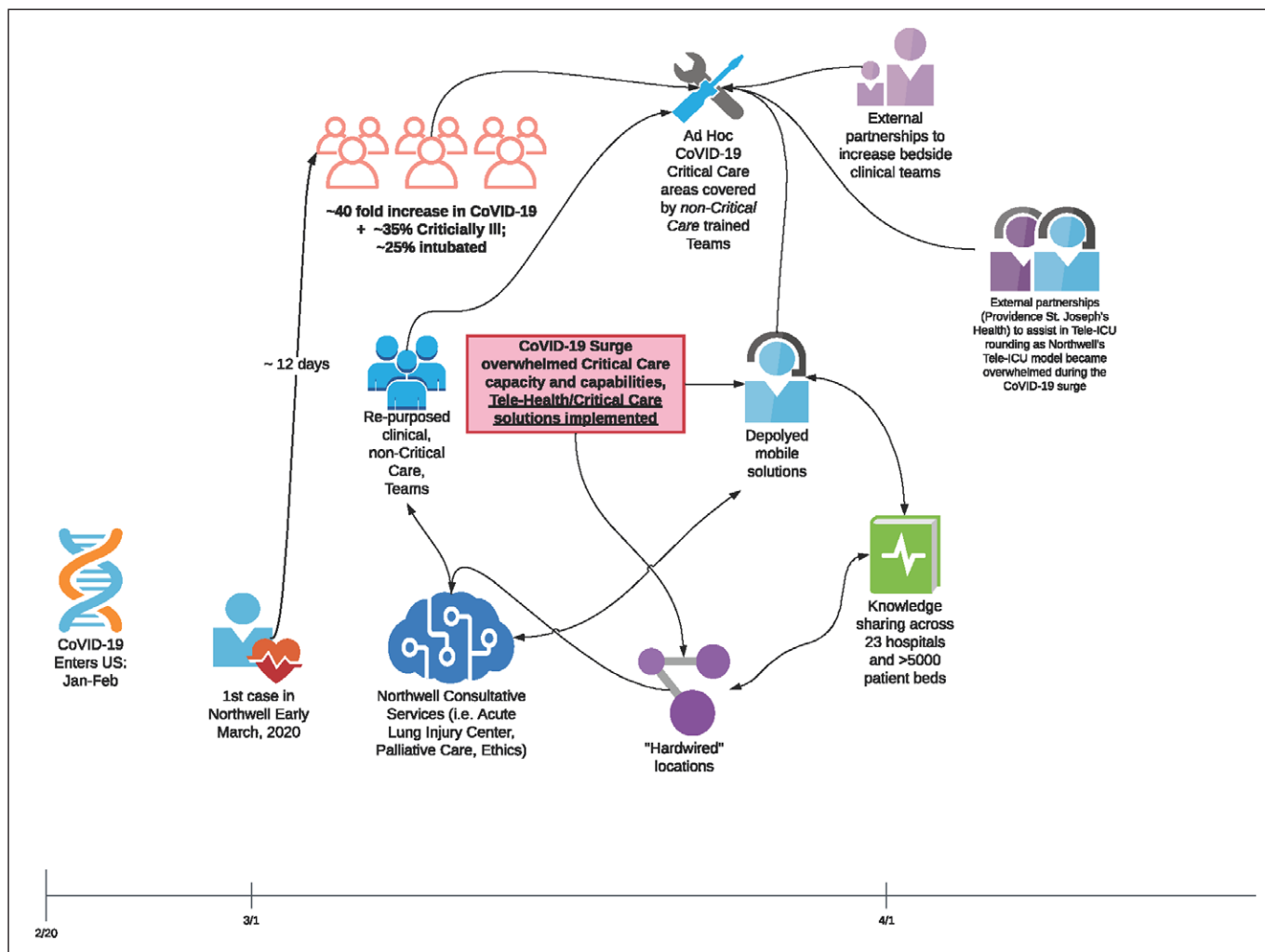
Figure 1. Northwell Health's strategy to meet the increased need of providers during the coronavirus disease 2019 (COVID-19) pandemic. Tele-CC = Tele-Critical Care, episodic, as needed critical care consultations, without continuous data streams/monitoring of the patient.

ESTABLISHING A TELE-ICU COLLABORATION BETWEEN NORTHWELL HEALTH AND PROVIDENCE/ST. JOSEPH'S HEALTH

The increased need for Tele-ICU coverage from the newly formed ICU units and the concurrent demand of our "per-diem" pool of critical care providers to work at the bedside significantly impacted our ability to provide around the clock adequate staffing of the Tele-ICU.

Discussions developed between our executive leadership with Providence, St. Joseph Health (P/SJH) headquartered in the State of Washington. P/SJH is a not-for-profit healthcare system with 51 acute care hospitals, a broad network of clinics, and services spanning the western part of the United States. Providence's Tele-ICU program leverages multiple teams across their footprint, working together to provide critical

care expertise to their partners. This widespread physician network enabled them to have the immediate bandwidth to provide support to an external health system in a matter of days. Considering the geographic variation in the impact of COVID-19 among the two states at the time, P/SJH provided help. Since both health systems had robust Telehealth programs, it offered the unique opportunity for setting up a virtual collaboration between the two Tele-ICU programs.

It took 3 weeks for multidisciplinary teams from both health systems to implement the collaboration between the Tele-ICU programs. The steps required for the implementation as outlined in **Table 1** can be used as a framework for setting up similar Tele-ICU collaborations. The process started by seeking "buy-in" from all key stakeholders in the covered hospitals (administration, nursing, critical care, and bedside team members). The availability of Northwell Health's
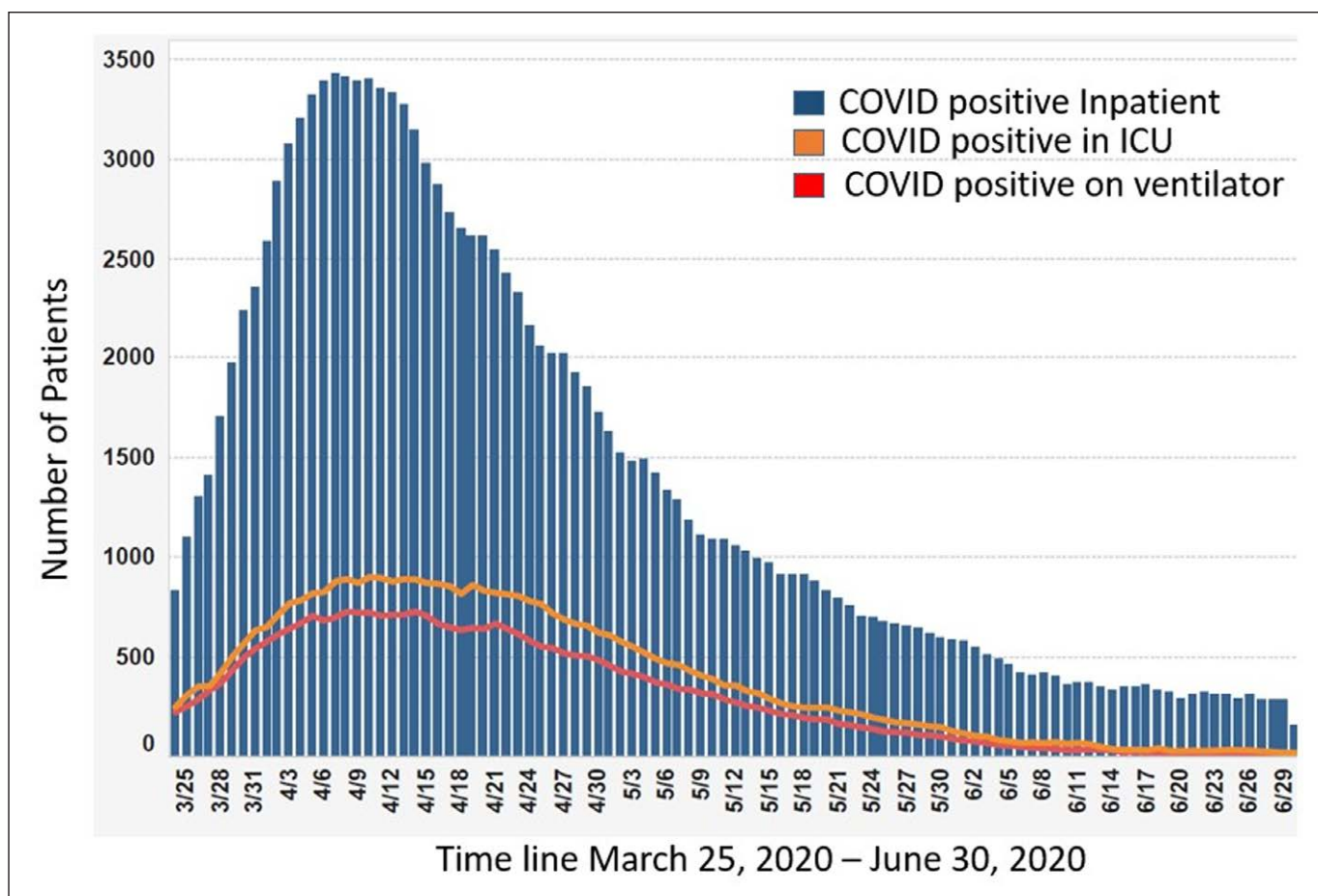
Figure 2. Trend in the total number of coronavirus disease (COVID)–positive admitted patients, number of COVID-positive patients in the ICU and on the ventilator at Northwell Health between the end of March 2020 and end of June 2020.

Tele-ICU physicians to provide 24/7 on-demand support allayed the biggest concern regarding access to critical care physicians and continuity of care. The approval of disaster privileges by Northwell Health and relaxation of NYS physician licensing requirement during the pandemic significantly reduced the time required for implementation. The most complex task was setting up the remote virtual private network (encrypted secure network connection), EMR access, and external vendor portal to connect to the mobile carts. Existing workflows were adapted for remote rounding on newly formed surge units for COVID-19 patients by the P/SJH team. Tele-ICU providers from P/SJH were provided virtual training on workflows, Northwell health's EMR, and mobile carts. As shown in **Figure 3**, rounding scripts and clinical protocols used by Northwell Health's Tele-ICU team were provided to the P/SJH team. The mobile carts were activated at predetermined times by different bedside teams, and the P/SJH critical care physician would then round on patients together with the

bedside teams via mobile carts. After the rounds, a verbal handoff was provided by the physicians at P/SJH to the Northwell Health's Tele-ICU team that included significant management changes, patient-specific concerns, and tasks to follow-up. Thus, the model allowed for noncritical care bedside teams to have dedicated scheduled rounding on each bed from critical care physicians of P/SJH and an around the clock "on-demand" response such as during rapid response/cardiac arrest situations from Northwell Health's Tele-ICU team. With the support of non-critical care physicians and residents at the bedside, a P/SJH critical care physician could round on 40–60 patients spread across two to three different hospital sites over a 6-hour shift. A total of 12 shifts were performed by the P/SJH team between the third week of April and the first week of May when declining number of COVID-19 patients no longer required additional support from the P/SJH team. During this time, approximately 350 patients were seamlessly rounded on by the P/SJH team.

TABLE 1.
Steps for Establishing a Connected Network Between Tele-ICU Programs of Northwell Health and St Joseph Providence Health

Telemedicine Services Agreement	Credentialing and Privileging	New York State Physician License	Technical Infrastructure	Project Management
Standard agreement with clinical responsibilities clearly outlined and reviewed and approved by legal and risk management team for both health systems.	Northwell Health approved disaster privileges for all physicians from P/SJH.	NYS Medical Board allowed out of state physicians with valid medical license and in good standing to practice in NYS.	Repurposing and purchase of mobile carts Access to Northwell Health's EMR. Access to external Vidyo portal to connect to mobile carts.	Medical Directors of both Telehealth programs helped design the workflow. EMR and workflow training of P/SJH providers. Training of Northwell Tele-ICU staff. Mock drills prior to formal launch. Post launch, regular communication between Medical Directors to address any issues in real time.

EMR = electronic medical record, NYS = New York State, P/SJH = Providence, St. Joseph Health.

DISCUSSION

As evident from the current pandemic, rapid scaling of ICU space, supplies, and staffing is required for providing adequate care to critically ill patients during a surge. There is a projected shortage of critical care physicians in the United States (9) that is further exacerbated during emergencies. Many strategies have been proposed to overcome the staffing shortage. Most of them are reactive in nature and have potential to disrupt other services for patients and add to the financial cost of the emergency. Some of the strategies that have been employed during the current pandemic include developing a tiered model requiring redeployment of critical care capable providers
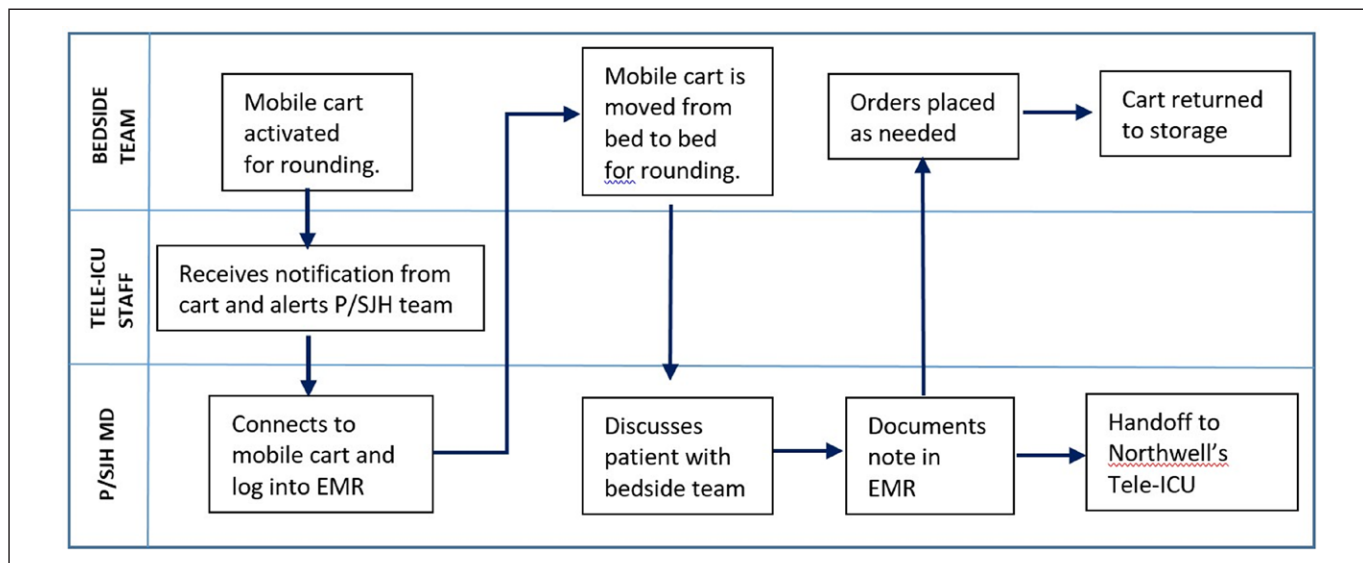
Figure 3. Rounding workflow using mobile carts. EMR = electronic medical record, P/SJH = Providence, St. Joseph Health.

after shutting down elective surgeries, rapid training of hospitalists and house staff in basic tenets of critical care, requesting retired critical care providers to return to work, and recruiting locum tenens physicians who may require travel and boarding arrangements.

Tele-ICU technology was developed to offset the shortage of critical care physicians and enable provision of care for critically ill patients under the supervision of trained critical care providers (10). Existing Tele-ICU programs function in silos providing care to ICUs within their individual network. We hypothesized that the establishment of a network of connected programs can be a proactive solution to rapidly increase the availability of critical care physicians at remote sites that are amid staffing shortages.

In our proof of concept study, we connected two Tele-ICU programs in geographically distinct locations to enable remote rounding by critical care physicians located at P/SJH on COVID-19 patients at Northwell Health. Our study has several strengths: 1) we facilitated rounding on a highly complex set of patients by experienced critical care physicians when such expertise was not readily available at the bedside. This was achieved by integrating remote critical care physicians with defined roles and responsibilities from the two Tele-ICU teams with the bedside teams. 2) The scheduled rounding/continuous monitoring hybrid model provided both directed and consultative support around the clock for the bedside team. The model received positive feedback from the bedside teams and hospital administrations of the covered sites. We provide an example of the feedback that was received: "As an orthopedic trauma surgeon with 25 years of experience, I found your dedication, judgment, and knowledge and that of your colleagues from the e-ICU network to be superior when I needed to handle the most difficult critical care cases. The power of the e-ICU system was that a person such as myself who was new to COVID-19 critical care could have access at any time and as long as I wanted to the best experts in the Country." 3) This implementation also facilitated Northwell Health's Tele-ICU program to decrease its own staffing by at least 1.35 full time employee (FTE; covers 1950 hr/yr) (6 hr/d is equivalent to 1.35 FTE) for the duration of the support from P/SJH and still allowed it to meet the increased demands for support. Thus during staffing shortages, when both the bedside and Tele-ICU programs have increased needs, connected Tele-ICU programs can offset the challenge

that may arise from vying for the same pool of locally available physicians. 4) Although the primary goal was to bridge the shortage of critical care physicians, we had simultaneously leveraged hospitalist physicians from P/SJH into our existing Tele-hospitalist program for admitting patients from the EDs using mobile carts. This further highlights the ability of connected Tele-ICU/Telehealth programs to integrate multidisciplinary remote team members (physicians, APPS, nursing staff, pharmacists) into tiered staffing models that can reduce the disruption of services for redeployment of staff.

The study has several limitations. The total number of shifts (12) completed by the P/SJH team were too few to attribute direct clinical outcomes to the model, and a larger multicenter study is needed to compare clinical outcomes between different staffing models. For quality assurance, we performed a random review of 30 notes documented by the P/SJH team that showed a focus on ventilator (87.5%) and hemodynamic management (18.5%) by the remote physicians that is consistent with the expectation from critical care oversight. Another limitation is that given the short duration of the support from P/SJH team, we could not perform a cost analysis of different staffing models. However, as previously described, a 6-hour shift provided by one critical care physician reduced the staffing need for Northwell Health's Tele-ICU by 1.35 FTE. This means that two critical care physicians each providing 6 hour shifts remotely can reduce the requirement for 2.7 FTE at the recipient site, which then adds an additional 12-hour shift by a critical care physician to work locally. Connected Tele-ICU programs are force multipliers that allow remote physicians to participate in patient care and also free up physicians at the recipient site. Last, based on the timing of the project relative to geographic surge of COVID-19, we established unidirectional support from P/SJH to Northwell Health. However, setting up bidirectional support was entirely possible within the timeframe as the state of Washington had also instituted relaxation in state licensing requirements during the emergency. The overall objective of the article is to stimulate discussion supporting the creation of a network of connected Tele-ICU programs with the agility to rapidly provide multidirectional support anywhere anytime.

We define connected Tele-ICU programs as having a technological infrastructure in place for "on-demand" access to EMRs/Tele-ICU platforms being used by different programs within the network, ready to use clinical

workflows, a cohort of critical care physicians with either multistate licenses, credentialing and privileges at different sites, and/or a repository of necessary paperwork ready to apply for the same. Last, there need to be multicenter financial and operating agreements in place or ready to deploy. To set up a robust infrastructure at a scale that can benefit any region of the country will require a concerted and coordinated effort between various federal, state, and professional organizations like the Critical Care Societies Collaborative and National Emergency Tele Critical Care Network. Although detailed discussion is outside the scope of this article, it is important to highlight a few key factors that will be critical to the success of such an endeavor. Some of the biggest challenges are the lack of interoperability between disparate EMR systems, a lack of robust health information exchange (HIE) infrastructure, and availability of low-cost Tele-ICU/Telehealth platforms that can integrate with multiple EMRs. Although overcoming these challenges is a long-term strategic goal, in the short term, providing remote access and training on multiple native EMRs is a feasible solution. Another key barrier is the lack of reimbursement for rounding of critically ill patients via Telehealth. Currently, current procedural terminology codes 99291-99292 for Critical Care Service delivered via Telehealth are considered billable by Medicare only through the calendar year in which the public health emergency (PHE) ends (11). We hope that studies such as this will be drivers for making these changes permanent beyond the PHE and for expansion of billable codes to include short focused remote rounding and real-time remote patient monitoring of physiologic data.

In spite of the challenges and limitations, we hope that the article provides the stimulus for various regional/national Tele-ICU systems to proactively form connected networks to overcome one of the biggest challenges in providing standardized highly complex care to critically ill patients during the current (or future) pandemic(s): the availability of critical care trained physicians.

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