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Keeping the team together: Transformation of an inpatient neurology service at an urban, multi-ethnic, safety net hospital in New York City during COVID-19

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ABSTRACT

The COVID-19 pandemic dramatically affected the operations of New York City hospitals during March and April of 2020. This article describes the transformation of a neurology division at a 450-bed tertiary care hospital in a multi-ethnic community in Brooklyn during this initial wave of COVID-19. In lieu of a mass redeployment of staff to internal medicine teams, we report a novel method for a neurology division to participate in a hospital's expansion of care for patients with COVID-19 while maintaining existing team structures and their inherent supervisory and interpersonal support mechanisms.

1. Introduction

The COVID-19 pandemic dramatically affected the operations of New York City hospitals during March and April of 2020. The hospitals in the outer boroughs of New York City (Brooklyn, Queens, Bronx, and Staten Island) were disproportionately impacted during this initial wave due to higher incidence of hospitalization for COVID-19 and presence of significantly less hospital beds per capita (214/100,000 in Brooklyn versus 534/100,000 in Manhattan). There have been more deaths in Kings County (Brooklyn) than any other county in the United States. This article describes the transformation of a neurology division at a 450-bed tertiary care hospital in a multi-ethnic community in Brooklyn during this initial wave of COVID-19. In lieu of a mass redeployment of staff to internal medicine teams, we report a novel method for a neurology division to participate in a hospital's expansion of care for patients with COVID-19 while maintaining existing team structures and their inherent supervisory and interpersonal support mechanisms.

2. Description of NYU Langone-Brooklyn

NYU Langone-Brooklyn is a 450-bed tertiary-referral, acute care hospital in Sunset Park, Brooklyn, a multi-ethnic neighborhood in South Brooklyn with high poverty and Medicaid enrollment rates. In 2019, there were 25,702 hospital discharges and 85,257 visits to the emergency department. The hospital has Joint Commission designated Comprehensive Stroke and Stroke Rehabilitation Centers and is a Level 1 Trauma center.

3. Description of neurological services pre−COVID

The Neurology Division at NYU Langone Hospital Brooklyn offers a comprehensive array of inpatient and outpatient neurological services including a Joint Commission-certified comprehensive stroke center, a closed neurocritical care unit, epilepsy monitoring unit (EMU) continuous EEG consult service, vascular neurology consult and ward services, and general neurology consult and ward services. The division had 1455

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discharges in 2019. There are 16 neurologists and 2 neuropsychologists on faculty, a neurology residency with 3 residents per class, and 13 advance practice providers (APP). The nursing staff has received advanced training to care for the neurology patient population. The faculty is complemented by voluntary neurologists from the community who assist with the inpatient teaching service. See Table 1A for weekday staffing of these services.

4. Description of services during COVID-19 wave of march-april 2020

We saw a surge in Emergency Department visits and hospitalizations of COVID-19 infected patients at NYU Langone Hospital-Brooklyn in spring of 2020. The hospital discharged over 1300 patients with COVID-19 from March 14, to May 14, 2020. Hospital wide, surge preparedness saw the opening of an outpatient respiratory screening center, development of a 40 bed respiratory unit in a previously closed adjacent rehabilitation center, the opening of 5 COVID-19 ICUs, and the conversion of almost all inpatient floor and stepdown units to COVID units. Intensive care unit capacity reached 5 times normal capacity (from 20 to 100 beds). Average daily census for fiscal year 2019 was 306. Peak hospital census was 406 on April 8, 2020. Rooms providing CT scans and MRIs were also converted to negative pressure rooms and detailed cleaning protocols were developed to prevent nosocomial spread.

4.1. Phase 1: streamlining of neurological services, (early March 2020–March 24)

In the initial stages of the NYC COVID-19 pandemic, our vascular and general neurology teams continued to care for patients with primary neurological disorders including those who tested positive with SARS-CoV-2 infection. In preparation for the oncoming wave, all staff were trained in proper donning and doffing of PPE via video and in-person instruction. Fit-testing was made available for all staff as needed due to new models of N95 masks entering the supply chain. Daily e-mail updates were provided by the Chairman and weekly update calls were held by the Division Chief.

Associated with a stay-at-home order issued by the Governor of New York on March 20, 2020, our division has previously reported a decrease in the number of stroke admissions and consultations [1]. Due to a Governor's order banning elective admissions, the epilepsy monitoring unit was closed and became a COVID-19 unit staffed by the medicine department. In order to more appropriately utilize resources, we moved to a streamlined schedule previously used for weekend coverage, which allowed for 2 LIPs to be redeployed each day. Our neuro-intensivists continued to care for non−COVID-19 ICU level neurological patients as they staffed the newly formed non−COVID-19 ICU for all non-−COVID-19 medical, surgical, and neurological patients. In addition, they staffed a COVID-19 ICU. The neurointensivists were not supervised directly by medical intensivists, but frequent meetings of all intensivists were held to discuss management strategies. On the outpatient side, all ambulatory sites rolled TeleHealth visits, and only urgent inpatient admission were allowed. Please see Table 2 for a description of changes to neurological services made during COVID-19.

Table 1
Pre−COVID-19 structure of the inpatient neurology wards and teams at NYU Langone Hospital Brooklyn.

Ward	Team	Clinical Responsibility
Neuro-Intensive Care Unit	**Neuro-critical care Team** • Neuro-intensivist • Neuro-critical care LIP[a]	Neuro-critical care and ICU level neurology consults
Epilepsy Monitoring Unit (EMU)	**Epilepsy Team** • Epileptologist • Epilepsy LIP • Neurology Consult LIP	EMU/c-EEG/Epilepsy consults
Neuroscience Unit[b]	**Vascular Neurology Team** • Vascular Neurologist • Ward Neuro LIP 1 • Stroke Consult LIP	Stroke Ward, Stroke Codes and Stroke Consults.
	General Neurology Team • General Neurologist • Ward Neuro LIP 2 • Neurology Consult LIP	General Neurology Ward and Neurology Consults

[a] LIP: Licensed Independent Practitioner: Trainee or APP.
[b] A senior neurology resident oversees both vascular and general neurology teams.

4.2. Phase 2: redeployment of residents and advanced practice practitioners (March 24th–April 6th)

As the number of COVID-19 admissions rose exponentially between March 24 and April 9, NYU Langone Brooklyn Hospital created multiple additional care teams to manage patients with COVID-19. Departments with excess staffing due to stopping of inpatient surgeries and other

Table 2
Restructure of the inpatient neurology wards and teams at NYU Langone Hospital Brooklyn during COVID-19 outbreak.

Ward		Team	Clinical Responsibility
Neuro-Intensive Care Unit	COVID ICU		
		Neuro-intensivist 1 + Neuro-critical care LIP[a]	Non COVID ICU care
		Neuro-intensivist 2	COVID ICU care
Epilepsy Monitoring Unit	COVID Unit		
		Epileptologist + Consult LIP 1&2	c-EEG/Epilepsy consults/ Neuroscience-COVID Unit
		Epilepsy LIP	Redeployed to staff pool
Neuroscience Unit[b]	Neuroscience - COVID Unit	**Vascular Neurology Team** Vascular Neurologist + Neuro LIP 1 + Neuro LIP 2 + Consult LIP 1&2	Neuroscience -COVID Unit care, Stroke Codes and Stroke Consults.
		General Neurology Team General Neurologist or Epileptologist + Neuro LIP 2 + Neuro LIP 3+ Consult LIP 1&2	Neuroscience-COVID unit care, General Neurology, ICU and Epilepsy Consults
		Back up Team Vascular Neurologist or General neurologist	Back up for Neuroscience-COVID unit and Consult service

[a] LIP: Licensed Independent Practitioner: Trainee or APP.
[b] A senior neurology resident oversees both vascular and general neurology teams.

elective admissions redeployed staff to a centralized pool which scheduled staff into new roles on COVID unit. Neurology participated in this redeployment by sending staff freed up by streamlining services as well as sending residents on elective, research, and subspecialty clinics to the pool. One ICU trained APP was redeployed to medical intensive care units to treat severely ill COVID-19 infected patients. Additional changes to the neurology residency training program across all NYU campuses have been previously reported [2]. Neurology nursing staff were floated to medicine and critical care services as RN extenders to assist in meeting the high nursing care requirements for COVID-19 patients.

4.3. Development of neurology COVID-19 inpatient service (April 6th–May 1st)

At the beginning of April, due to low stroke and general neurology censuses, we worked to develop the General Neurology and Stroke services into COVID-19 services. We admitted these patients to our 20-bed Neurosciences unit. With the closure of the EMU, the epilepsy attendings joined the general neurology attendings to staff the newly formed Neurology COVID-19 unit. Existing patients who were COVID negative were cohorted together. This allowed our existing inpatient teams to maintain existing working relationships as well as to maintain our relationships with nursing staff. Teams were formed with two faculty (one vascular neurologist and one general or epilepsy neurologist), a senior resident, a junior resident and one APP and became part of the admitting pool for COVID-19 patients. Rounds were carried out in the usual manner except that only the attending would enter the room to perform necessary elements of the physical exam to limit trainee and APP exposure and to reduce use of PPE. Due to the steep learning curve and the time intensive nature of caring for patients with COVID-19, an attending back up schedule was created to help with overflow COVID-19 patients and to assist with the consultative services and with stroke codes.

Prior to accepting respiratory COVID patients, neurology leadership worked closely with leadership in the department of medicine to share treatment templates, resource guides, and protocols to educate staff. While there was no direct supervision by a medicine attending, we identified a go-to medicine hospitalist to assist with any management questions. The treatment protocol developed by the medicine was distributed to all team members and COVID order sets were updated regularly. Faculty and staff engaged in Webinars to stay up to date with COVID-19 treatment. Members of the neurology spearheaded by one of the neurointensivists (T.Z.) developed a detailed review and protocol for the use of corticosteroids to treat COVID-19 respiratory symptoms that became the basis of a health system wide protocol.

We initially worked on a triage protocol to direct patients with less severe respiratory issues to the Neurology COVID teams, this was almost immediately abandoned due to the severe respiratory complications of virtually all patients admitted with COVID-19. The neurology COVID service then accepted any non-intubated patients to our service. Please see Fig. 1 for a comparison of weekly discharges from the neurology services and epilepsy monitoring unit during the pandemic surge period of 2020 compared to 2019.

Proactive rounding teams from anesthesia and internal medicine assisted teams with management of the patients most at-risk for needing intubation in the next 12−24 h. All decisions to intubate a patient where made by the pro-active rounding and code teams comprised of medical intensivists and anesthesiologists. In order to meet the demand for ICU level of care, critical care trained nurses collaborated with providers to manage rapidly deteriorating patients in place on acute care units.

In addition to neurology's efforts, a similar team was formed by our colleagues in the Departments of Rehabilitation Medicine and Neurosurgery with similar results.

4.4. Restructuring of the consultation service

The neurological consultative service across NYU Langone Hospital Brooklyn underwent several changes as the division geared to tackle this pandemic. In the early days of the outbreak, we maintained the normal structure of the consultative service: each team (neurocritical care, vascular, general neurology and epilepsy) continued to cover their usual patient base with one resident covering general neurology and epilepsy consults and a resident or APP covering stroke consults and codes ICU level consults were performed by the neurocritical care team. However given the initial decrease in consults across all divisions, a decision was made to consolidate all consultative services using one trainee or APP. In addition, in-person consultations were curtailed, and when possible replaced by curbside consults, in order to preserve PPE and minimize unnecessary exposure to COVID infected patients. Non urgent in-person consults were seen solely by the consult attending, whereas trainees and APP were responsible for evaluating all urgent in-person consults. Acute stroke care was provided in-person by the resident or APP in the usual

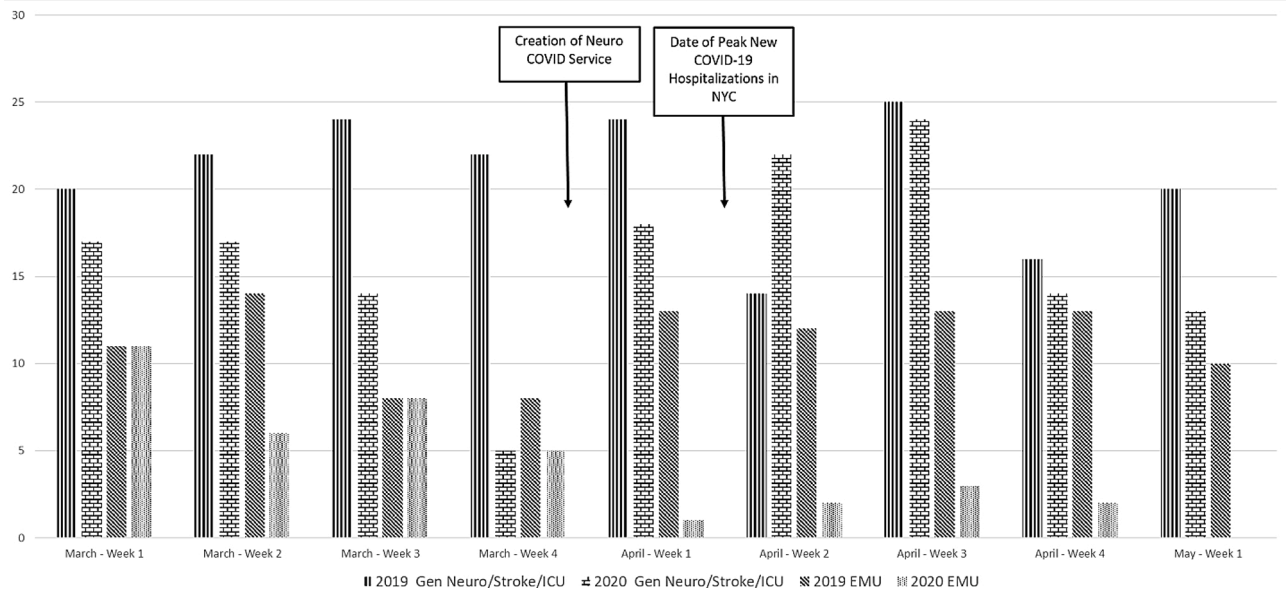

Fig. 1. Volumes on Neurology Service During COVID-19 Pandemic and 1 Year Prior.

manner without use of tele-neurology as the available tele-medicine applications would have required an already extremely busy ED nurse to facilitate the tele-consult (properly place the camera/tablet, assist with the exam, etc). Epilepsy consults followed a similar pattern, with only the attending going into the room to examine the patient. Bedside examinations were deferred completely if the consult question was solely related to medication management.

As the number of COVID patients increased, and as the neuro-intensivists were redeployed to COVID ICU units, all ICU level neurology consults were shifted to the general neurology service. While the number of consults was initially low, there was sharp spike in the number of consults as patients in the ICU started having sedation weaned and many were noted to have encephalopathies requiring work-up. At this point we added back one LIP to the consultation service. Back up attendings were deployed to help cover the consult service. Guidelines were developed pertaining to use of c-EEG, imaging and lumbar puncture in COVID patients.

4.5. EEG services

In the beginning of the COVID pandemic there was significant concern for the EEG technicians as many patients presented with seizure-like symptoms and encephalopathy resulting a spike of EEG requests. There was significant concern from the EEG techs given the amount of time they would be exposed during EEG hookup and retrieval. Additionally, there were concerns regarding conservation of PPE for the techs. In an effort to reduce unnecessary exposure of techs to patients with COVID-19, a committee met and created a protocol to protect both the patients and the technicians. In addition all EEG requests were vetted by the epilepsy on call attending. The following EEG triage guidelines were put in place:

1 No routine EEGs performed on COVID-19 inpatients.
2 No routine EEGs performed in the ED.
3 For urgent ED and ICU requests on COVID-19 patients needed for a few hours (e.g. to rule out status epilepticus), Ceribell rapid EEG monitoring was placed by the intensivist staffing the consult, thereby obviating technician exposure to the patient and minimizing PPE use given the attending was already entering the room to examine the patient.
4 If Video EEG for at least 24 h was indicated, then the EEG technician completed the patient hook-up with appropriate PPE, based on the patient's status.

4.6. Additional changes

A total of 5/21 trainees and APP (25 %), and 2 /15 full-time faculty (13 %) developed symptoms and were positive for SARS-CoV-2 infection. These infections required constant and daily changes in staff scheduling. Daily communication was essential, and staff was engaged by daily emails, secure chats and virtual meetings.

Two of our employees were asked to work from home due to medical exemption, and were enlisted to help communicate with patients' families through the family resource center which was created to communicate with and keep patients' families up to date. One of our residents who was on a medical exemption, provided virtual senior resident support with daily virtual pre-rounds and bedside rounds. In addition, this resident was proactive in providing educational resources to the residents who were on the frontline.

Residents' education was maintained via virtual platforms such as Webex and Zoom meeting, although many lectures were cancelled in the weeks with highest patient census. Neurology nursing staff has received critical care training in preparation for a possible second wave.

Our outpatient experience has been previously described and was converted to mostly virtual visits with a small in-person office presence maintained to help keep patients out of otherwise busy emergency rooms [3].

4.7. Staff wellbeing

Divisional leadership was on site every day, ensuring the wellbeing and safety of the staff, and ensuring adherence to CDC and hospital guidelines in use of PPE, hand hygiene and infection control. Monetary donations were collected from faculty to provide meals to the neurology staff and nursing personnel on the frontline. Virtual happy hours were scheduled biweekly and were very well attended. Fitness competitions among our residents provided them with a sense of normalcy in such daunting times. In addition, a comprehensive suite of psychological services was offered by our Department of Psychiatry and staff were regularly encouraged by divisional leadership to access these resources. Our own neuropsychologists provided lists of well-being and psychological support resources which were distributed to all staff. In-person, on-unit group listening sessions were also held by the psychiatry department to facilitate discussion of well-being amongst staff. No staff members required leaves of absence for wellness related issues.

4.8. Resuming services (May 2020–present)

The number of hospitalizations and the death toll across NYS flattened by late-April. At the beginning of May, surge medical teams had sufficient capacity and patients admitted for COVID-19 respiratory symptoms were no longer admitted to the neurology service. As COVID ICUs contracted, the Neuro ICU teams were released back to their regular duties by early May. The hospital was then divided between COVID-positive and COVID-negative units. The Neurology team now cares for COVID-negative patients in the neurosciences unit and for COVID-positive neurological patients in a designated COVID + unit. Stroke certified nurses were assigned to this separate unit to maintain our standard processes for neurological care. Our teams resumed pre−COVID-19 structure of 1 vascular attending and one general neurology attending overseeing a junior resident, an APP and one senior resident. The consultation team is back to its pre−COVID staffing setup with one APP or trainee covering stroke consultative services and a resident covering general neurology and epilepsy consults. ICU level neuro consults are now staffed by the neurocritical care team. The EMU remains closed, and the Epilepsy service remains a consultative service. As the ambulatory sites started reopening, residents' ambulatory rotations, continuity clinics and elective rotations are planned to resume.

4.9. Discussion

This manuscript describes a novel approach for an inpatient neurology division to participate directly as primary providers for patients suffering from primarily respiratory symptoms during a COVID-19 surge. By keeping existing teams intact, we were able to leverage the strengths of existing interpersonal relationships, support and supervisory structures, and team dynamics while also participating in the care of COVID-19 patients during a surge. During times of crisis, losing long-standing ties with familiar placed and people can lead to demoralization, loss of connection, and other psychological effects [4]. In addition, interpersonal relationships are critical for faculty learning [5].

Not only did creation of COVID-19 neurology teams benefit those in the neurology division, it created additional capacity for COVID-19 patient without putting additional administrative burden on the internal medicine department to create and staff new teams. We found that neurologists, especially those whose practices' consist of significant inpatient time, have many of the skills necessary to care for COVID-19 patients and are facile with the workflow of inpatient care such as familiarity with other inpatient physicians, nursing, ancillary support teams, pharmacy, the electronic medical record, and location of physical supplies and equipment throughout the hospital. This manuscript is limited by being a single-center experience and is a qualitative

description of a particular inpatient group practice that might not apply to all departments. In conclusion, neurology teams can maintain existing team structures, with all of their inherent benefits, while aiding in a hospitals creation of surge capacity during a viral pandemic.

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