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Preparing a neurology department for SARS-CoV-2 (COVID-19): Early experiences at Columbia University Irving Medical Center and the New York Presbyterian Hospital in New York City

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Introduction

Beginning in December 2019, a novel coronavirus, SARS-CoV-2 (COVID-19), began spreading rapidly throughout China and now is a global pandemic with cases reported in over 192 countries and territories worldwide. Clinically, COVID-19 ranges from a mild, self-limiting respiratory illness to severe progressive pneumonia and multiorgan failure. The first COVID-19 case was reported at the beginning of March in New York City (NYC), and now just three weeks later, NYC and its suburbs have over 5% of global cases. Worldwide, there is a rapid increase in the number of cases daily, including the number of patients requiring hospitalization and intensive care support.

While our internal medicine, emergency room, pulmonary/critical care. and anesthesiology colleagues are at the frontlines, neurologists are playing a critical role in patient care. Here, we describe the initial steps our department has taken to prepare for the COVID-19 outbreak. We highlight some of the steps neurology departments should urgently consider to prepare for an increased volume of COVID-19 patients in their hospital system. This manuscript provides a comprehensive guide for other neurology departments in terms of preparation for an influx of COVID-19 positive patients into their hospital system.

General departmental initiatives

As a department, we began holding routine meetings to prepare for COVID-19 in mid-February. Multi-disciplinary meetings are held with key staff including nursing leadership, intensive care leadership, inpatient and outpatient neurology department leaders, and departmental administrative leadership (Table 1). At the beginning of March, we held webcasts to our department weekly given the restrictions for large in-person gatherings to provide updates

on inpatient and outpatient clinical care activities, departmental research ramp-down, human resources issues, and updates on hospital and public health guidelines including key epidemiological information around COVID-19. There was an opportunity for departmental members including support staff to ask questions around work-related concerns.

Providing mental health support for the challenges we all face during this time due to social distancing and separation, child and elder care, financial, and clinical pressures was identified as an early critical component of our efforts. In addition to departmental neuropsychologists volunteering to provide free private counseling services, hospital-wide free tele-mental health support have also been made accessible to our department.

Inpatient neurology service preparation

Inpatient Neurology Services

During the early phase of our preparations, nursing leaders on our neurology units provided training for donning and doffing of personal protective equipment (PPE), nasopharyngeal sampling technique, review of protocols for patients who are persons under investigation (PUIs) and screening of our patients for possible COVID-19 symptoms. Hospital-based guidelines are reviewed regularly. A checklist that the nurses completed is performed for all patients admitted to our units for possible COVID-19 symptoms. As community spread continued to rise, this checklist is now done daily on all our inpatients. A COVID-19 binder was created on each unit to compile COVID-19 related documents including clinical guidelines, hospital protocols, and policies as well as our daily operations. A daily nursing huddle occurs to share information on COVID-19 and discuss PUI and COVID-19 positive cases on the unit. All trainees and inpatient neurology team members were trained in the same manner regarding

proper PPE use, protocols for PUIs and education around caring for COVID-19 patients routinely.

Inpatient leadership and our chief resident developed a schedule to scale down our inpatient services to necessary staff including resident trainees (Figure 1). Back-up schedules and defined skills for re-deployment (inpatient clinical, outpatient clinical, administrative, language skills) were done for trainees, neurohospitalists, and the neurocritical care team. Medical students and observers were removed from clinical services as was mandated by our hospital in early-March. All teams practice social distancing when rounding and teaching is occurring in workrooms and not at the bedside. We minimized the number of team members entering patients' rooms to the attending for PUIs or those who were COVID-19 positive. We are bundling orders and adjusting routine care (i.e. laboratory draws, the frequency of neurological checks, timing of medication administration) to the minimum to provide adequate care while being conscientious of nursing exposure time in PUI and COVID+ rooms.

All elective admissions for non-urgent purposes were cancelled in early March, and our epilepsy monitoring units (EMUs) were closed in both pediatrics and adult services. All urgent admissions and possible transfers were screened via phone for possible COVID-19 symptoms (including family members living in the same household) and accepted only if we could provide urgent management not available elsewhere. Re-screening for possible COVID-19 symptoms occurred when a patient arrived from an outside hospital or was directly admitted to our inpatient unit. If a patient was unable to answer questions regarding symptomology which is the case in many of neurological patients, we assumed these patients may have COVID-19 infection during ongoing community spread and considered them a PUI in consultation with our infection, prevention and control (IP&C) experts. All COVID-19 positive patients were centralized to

designated hospital units as well as specialized COVID-19 teams as the pandemic in New York continues to rapidly evolve. Patients with primary neurological conditions who are COVID-19 positive or PUIs remain on our neurology services. Thus, training of PPE donning and doffing a well as PUI protocols were essential for our inpatient team members.

Neurology Consult services

On our neurology consult services, we transitioned to "curbside" consultations, reserving in-person consultations for urgent inpatient issues and ED consults (i.e. new brain hemorrhage, acute stroke consults, ongoing seizures). All electroencephalograms (EEGs) ordered by non-neurology teams for PUIs and COVID-19 positive patients were required to be approved by our neurology consult teams to avoid unnecessary studies in the context of limited PPE and to protect EEG technicians. We subsequently developed mechanisms to expand our inpatient tele-neurology services to our emergency departments (EDs) and inpatient services.

Acute stroke care protocol in the ED, includes temperature check, oxygen saturation measurement and COVID-19 symptom screening before performing the National Institute of Health (NIH) stroke scale. If the patient cannot answer the screening questions, we assume the patient is COVID-19 positive requiring the use of PPE. The availability of PPE is an ongoing challenge in NY as well as many other regions of the country.

We changed our tissue plasminogen activator (tPA), thrombectomy, intracranial hemorrhage, and subarachnoid protocols across the hospital system enterprise to concentrate care allowing nursing care to focus on the COVID-19 surge of patients in the ED. Stroke care coordination across NYC centers has been essential with frequent citywide meetings involving

neurointerventional radiologists, neurocritical care directors, stroke team leaders, and neurosurgery.

Neurocritical Care Unit (NICU)

Currently, approximately 20% of our inpatient COVID-19 positive patients require intensive care unit (ICU) support and thus a significant number of COVID-19 positive patients have been moved to the care in NICU. Our ICU director frequently coordinates with hospital ICU directors to optimize care the of critically ill COVID-19 patients. There has been rapid development of protocols around the safe management of critically ill COVID-19 patients (i.e. intubation and other aerosolizing procedures, cardiopulmonary resuscitation). In early March, our NICU director and NICU faculty provided routine education and preparation to staff and trainees around acute respiratory distress syndrome (ARDs) management, guidelines for non-invasive positive pressure ventilation and high flow nasal cannula oxygen for suspected or confirmed COVID-19 patients, as well as ongoing clinical trials on antimicrobial and immunomodulatory treatments. Neurocritical care fellows were now deployed to maximize the care for critically ill COVID patients throughout our hospital system. Our critical care rounding teams were split to include a COVID focused team led by our neuro-intensivists and a non-COVID-19 team focused on the COVID negative neurological critically ill-patients lead by our neurovascular team (Figure 1). Teams have been restructured to include essential personnel with some team members providing remote support (i.e. pharmacists).

All intubations are done by anesthesia for PUIs and COVID-19 positive patients. Early transfer of patients out of our NICU was prioritized with an emphasis on early tracheostomies and percutaneous endoscopic gastrostomy (PEG) tubes, as well as early shunts. Our role in the

prognosis and assessment of brain death is essential as neurologists, and protocols are in place with regards to COVID-19 patients. Making an accurate and reliable prognostic decision will reduce ventilator usage, and conserve PPE resources. Guidelines from the American Heart Association (AHA) on neurologically related prognoses in COVID-19 patients after cardiac arrest are being developed. Some of the early steps we are taking include establishing a neurological examination by one intensivist, focusing on brainstem reflexes 48-72 hours after being off sedation, relying on spot EEGs rather than continuous EEG in select cases, and obtaining neuroimaging and somatosensory evoked potentials if feasible.

As with neurology patients in the ED, there was an early recognition that our NICU patients will not be able to provide the history to screen in which we have stressed to our institution the necessity of considering testing for COVID-19 in those circumstances in consultation with IP&C.

Ambulatory Neurology

In early March, ambulatory staff including call-center personnel and in-person patient greeters were trained to screen all patients and those accompanying the patient for possible COVID-19 symptoms. Patients were contacted to schedule their visit on a telecommunication platform and all patients were screened for symptoms. An ambulatory care protocol established by our hospital system was followed. Transition to tele-neurology visits began for our outpatient practices in early March with the complete transition by mid-March for all new and established patients. Plans were immediately implemented to provide laptops and technical support to enable all outpatient practitioners to practice remotely. Webinars and guides for both patients and providers were distributed rapidly to enable as many visits as possible to continue uninterrupted.

The university-wide ramp down in non-essential research activities has enabled us to increase the availability of telehealth sessions by providers who had previously dedicated significant time effort to research. Each division in our department created guidelines on which clinical scenarios warrant an urgent in-person visit. Any in-person visit must be approved by the division head and departmental leadership. Home EEG testing has been expanded. Botulinum toxin treatment for migraine has been continued, after the appropriate screening, to prevent relapse and avoid emergency room visits. Neurology infusion center patients are delayed when appropriate, transitioned to home infusions or consolidated in the main hospital infusion center. Urgent post-discharge telemedicine appointment slots were established in all divisions to allow for expedited emergency room and inpatient discharge when appropriate.

All in-person visits in our resident clinic were also converted to telemedicine or, if patients do not have the technical capacity to participate in video visits, to a telephone visit. Residents performed telemedicine visits remotely and staff with an attending (also remote) by phone or by Zoom meeting. For the patients who needed to be seen urgently, or who came in person for an appointment (if we cannot contact them) we established a rotating call system whereby one resident and one attending were available to come in within 30 minutes if needed.

Research

To minimize the number of individuals in the Medical Center and to be able to re-deploy needed manpower, equipment and supplies, all non-critical clinical and basic researches were ramped down in under guidance from University. The implemented plan involved: (1) setting-up a 96-hour ramp down policy to complete all ongoing critical experiments, stopping all noncritical experiments and preventing all new experiments; (2) establishing a list of a small number of

essential research personnel on-site at any given day to assure the proper functioning of large equipment such as freezers or incubators, maintenance of animal husbandry, and control the integrity of research spaces; (3) re-deploying research staff and post-docs, voluntarily and depending on skills, to assist teams working on critical tasks including COVID-19 research and testing; (4) pausing all clinical trials and observational studies that included patient contact which was not related to COVID-19 or did not have direct patient benefit per our institutional review board (IRB) policy and then eventually pausing all enrollment regardless of the potential for benefit. In addition, in discussion with the IRB and senior leadership concerning research administration, for patients already enrolled in clinical trials, potential or perceived risks of some protocol-specific events may outweigh the benefit and may be omitted, consistent with the Code of Federal Regulations. Once the ramp down plans were implemented, all research groups were encouraged to pursue all team activities and communications such as laboratory meetings, journal clubs, thesis committee meetings remotely via internet-based video conferencing technology.

Education

With regards to educational activities, all medical student clerkships- including neurology - were suspended in mid-March by the medical center and a virtual curriculum was created for the remaining weeks of their rotation. It was arranged with the National Board of Medical Examiners that the shelf exam is to be done remotely. For the residency and fellowships, conferences were continued via internet-based video conferencing technology.

Conclusions: Team involvement and cohesion, well-being, challenges and pathways ahead

The importance of coordinated, multi-disciplinary efforts to prepare neurology departments for the COVID-19 outbreak is essential. We have worked cohesively within the department, the hospital, and university to implement strategies to minimize the risk of COVID-19 transmission and perform the best of care for our patients. This has required ongoing adjustments and flexibility in our department. The need for close communication has been essential to the functioning of the department during these incredibly challenging times. There are certainly challenges ahead (Table 2) during the unprecedented health crisis with further necessary adjustments and taking this pandemic seriously cannot be underemphasized for neurology departments across the country and world.

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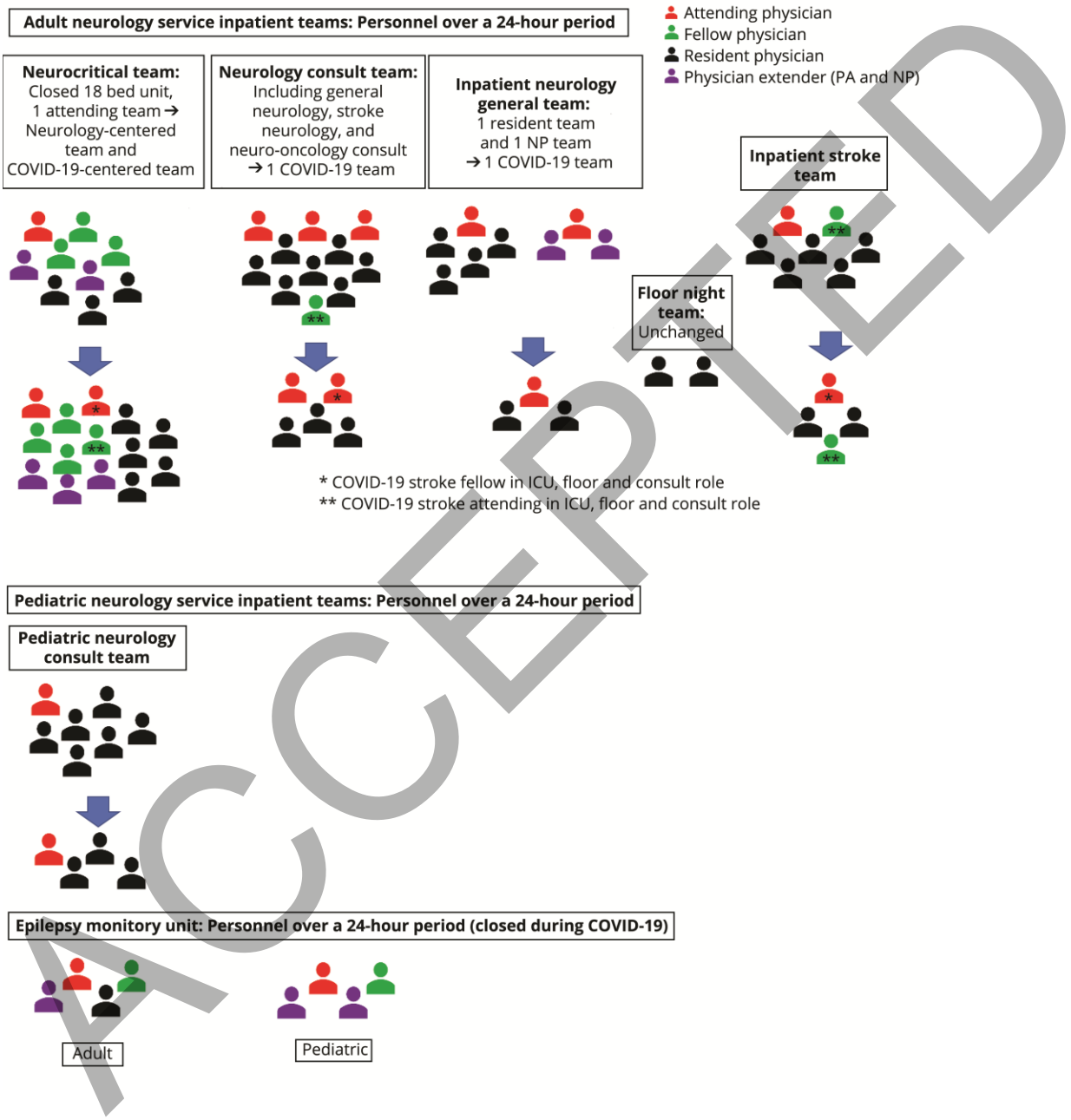
Figure Legend

Figure 1: Personnel changes on neurology inpatient services during the COVID-19 pandemic



Tables

Table 1: Interdisciplinary Meetings in the Neurology Department

Interdisciplinary Meetings and attendees	Select Topics of Discussion
Neurocritical Care -Critical Care Attendings across departments -Neurology Inpatient Attending director -Neuro-hospitalist Attendings -ICU Nurse managers -Step Down Unit Coordinators -Step Down Unit Nurse Managements -Neurology Chief Resident	-alignment of hospital initiative of cohort patients with COVID-19 -align with hospital initiative of increasing ICU beds -education on COVID-19 specific airway and ventilator management and research treatments -screening protocol for the altered and aphasic patient -training on PPE donning and doffing -protocol for increasing step down unit care for non-intubated ICU patients -increase deployment of residents from neurology and neurosurgery departments to align with care for increasing volume and medical complexity
Consult Service -Inpatient Attending Director -Neuro-hospitalists Attendings -Stroke Attendings -Neurology Chief Resident -Pediatric Neurology Consult Attendings	-addition of temperature and O2 saturation measurement to the stroke code vitals -screening protocol for the stroke responder and consult resident in the Emergency Department -training on PPE donning and doffing -conversion to telephone consults -implementation of tele neurology consultations -minimize resident and attending staffing to essential personnel
Inpatient Meetings -Inpatient Attending Director -Neuro-hospitalists Attendings -Stroke Attendings -Patient Care Directors -Nurse Management -Neurology Chief Resident	-screening protocol implementation for the outside hospital transfer and ED patient -nurse training on daily screening checklist -training on PPE donning and doffing -minimize resident and attending staffing to essential personnel -limit personnel bedside, resident teaching done in workrooms
Ambulatory Neurology -Outpatient Attending Directors -Faculty Practice Administrative Director -Inpatient Attending Director -Neurology Chief Resident	-full conversion to tele medicine visits -a policy requiring Chairman review and approval for in-person outpatient visits -screening protocol and education to staff and providers for patients approved to come for

	in-person evaluation -defer non-emergent diagnostics tests -resident redeployment from outpatient clinical shifts to in patient essential clinical shifts
Inpatient to Outpatient Transition (Discharges) -Outpatient Attending Directors -Faculty Practice Administrative Director -Inpatient Attending Director -Neuro-hospitalists Attendings -Stroke Attendings -Neurology Chief Resident	-inpatient checklist of patient information to provide to the outpatient scheduler -implementation of rapid telemedicine visits for hospital discharges
Bi-Weekly Department Announcement -Neurology Chairman -Chief Financial Officer -Inpatient Attending Director -Faculty Practice Administrative Director	-institution updates on hospital initiatives -education on symptoms and stay home policy if any symptoms present -work from home policy -telemedicine protocol updates -travel restrictions policy review -research updates

Table 2: Healthcare Worker (HCW) -related issues during COVID-19

HCW at risk: Preexisting conditions and age of providers	-Recognizing pre-existing conditions in our HCW -Deploy the HCW to low-risk clinical duties, such as telemedicine clinic, home consult call
Quarantine	-if any symptoms HCW is not to work -follow Institution guidelines and contact Work-Force Health and Safety for return to work guidance
Sick Call	-daily review of shift assignments, for the quarantined staff to identify those available for back up sick pull
Repurposed Staff	-follow institution policy for the redeployment of staff

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