

# Comparison of emergency consultations of patients with neurologic complaints before and during COVID-19 pandemic in a single tertiary hospital in Makati City, Philippines

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## Abstract

**Background & Objective:** COVID-19 forced us to develop adaptive ways to the new normal of healthcare delivery. Neurology has one of the most diverse types of patients who require urgent, prolonged and multidisciplinary care. This study aimed to understand the impact of the unprecedented community lockdown among patients with chronic and new onset neurologic conditions on emergency room (ER) utilization in a single tertiary hospital in Makati City, Philippine. **Methods:** We retrospectively examined all consecutive neurology referrals made at the ER from March to August 2020 and compared them with a control group consisting of all ER neurology referrals during the same months in 2019. **Results:** There was a 45% decline in the volume of referral to neurology service at the ER during the first 6 months of the lockdown period. There were fewer females who sought emergency neurologic care ( $p=0.019$ ). The average age of patients increased from 55.5 years ( $\sigma=19.9$ ) in 2019 to 59.5 years ( $\sigma=18.4$ ) in 2020 ( $p<0.001$ ). The top three chief neurologic complaints in 2019 were dizziness (17.7%), motor weakness (14.1%), and headache (13.2%). In 2020, the top three neurologic complaints where motor weakness (19.0%), decreased level of consciousness or loss of consciousness (13.2%), and dizziness (11.2%), ( $p<0.001$ ). The average time from symptom onset to ER admission in 2019 was 5.1 days ( $\sigma=23.9$ ) which increased to 8.4 days in 2020 ( $\sigma=28.1$ ), ( $p<0.001$ ). The proportion of patients with no co-morbidities at the ER decreased from 27.6% in 2019 to 17.0% in 2020 ( $p<0.001$ ). Patients with pre-existing cardiovascular diseases, endocrine diseases, pulmonary diseases, renal diseases, cancers, and others have significantly increased ( $p<0.05$ ). However, the increase in the proportion of patients with pre-existing neurological disorders ( $p=0.143$ ) was not statistically significant ( $p>0.05$ ). The only pre-existing neurologic conditions with significantly increased in proportion was stroke ( $p=0.010$ ). Among new onset neurologic diagnoses, headache and facial pain ( $p<0.001$ ) and peripheral and other neuropathies ( $p=0.005$ ) significantly decreased in proportions while proportions of cases with new stroke or vascular pathology ( $p<0.001$ ) and encephalopathy ( $p=0.003$ ) have significantly increased. ER dispositions showed a significant ( $p<0.001$ ) decrease in proportions of patients who were admitted, discharged, and transferred to hospital of choice; while patients who were discharged against medical advice and who died at the ER have significantly increased.

**Conclusion:** The initial six months of community lockdown during COVID-19 pandemic caused a significant change in the characteristics of patients referred to neurology for emergency care. These changes provide us a new perspective on how to better deliver optimal neurologic care to these diverse patients especially during times of pandemic.

**Keywords:** COVID-19, pandemic, community, lockdown, quarantine, neurologic, complaints, emergency, healthcare

## INTRODUCTION

In December 31, 2019, a clustering of pneumonia cases was observed in Wuhan, China. It was later reported that the cause of the outbreak was a

new type of corona virus or COVID-19. The first confirmed case in the Philippines was reported in January 30, 2020 in a 38-year-old female Chinese from Wuhan. Due to its alarming spread and severity, the COVID-19 infection was considered

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as a pandemic by the World Health Organization (WHO). In March 15, 2020, Metro Manila was placed under Enhanced Community Quarantine (ECQ). All land, domestic, and air travel were suspended and residents were advised to stay home. Hospitals stopped elective or direct-to-room admissions and postponed non-emergency surgeries. All hospital admissions and almost all consultations were made through the emergency room (ER).

While the world's focus was on COVID-19; social isolation, changes in food and alcohol consumption while at home, restrictions on physical activities, lack of gym, clinic and pharmacy access, financial depletion from losing jobs, and lack of sleep may have indirect but lasting effects on many neurologic diseases. These collateral effects of COVID-19 may have changed the emergency room utilization of patients with neurologic conditions.

The objective of this study is to gain perspectives on how COVID-19 community lockdown has affected emergency room consultations of patients with neurologic complaints during the first 6 months of the recent pandemic.

## METHODS

This is a retrospective single-center analytic cohort study conducted at a 717-bed capacity tertiary hospital in Makati City, Philippines.

### *Settings, participants, study size*

To determine the initial impact of COVID-19 pandemic and community lockdown to ER utilization of patients with chronic neurologic conditions and new neurologic concerns, we included all ER encounters of neurology service in our center during the first 6 months of COVID-19 lockdown from March to August 2020 and compared it with ER referrals of the same months in 2019. The latter was considered as "before COVID-19 pandemic" or "pre-pandemic". The first COVID confirmed case in our center was admitted in March 8, 2020. All patients with neurologic complaints but were not officially referred to neurology were excluded.

### *Variables and data sources*

This study gathered the following demographic and clinical data from all neurology emergency room encounters: age, gender, chief complaint, reason for referral to neurology, time from onset of presenting symptom to time of ER admission, pre-

existing co-morbidities and chronic neurologic conditions, new-onset neurologic diseases or neurologic diagnoses, and final dispositions at the ER (e.g. discharged, transferred, left against medical advice, admitted to either in-patient ward or intensive care unit (ICU), expired or died at the ER). Pediatric neurology patients were also included. All neurology patients who were referred to neurology service outside of the ER (e.g. from ICU, in-patient ward, delivery room) were excluded. All data were collected from a chart review through the hospital's electronic medical records (EMR).

We considered all chief complaints commonly referred to neurology service such as (1) trauma or fall, (2) headache, (3) dizziness, (4) imbalance, (5) motor weakness, (6) facial asymmetry, (7) slurring of speech, (8) visual changes, (9) pain (except non-neurologic pain), (10) numbness or paresthesia, (11) disorientation or confusion, (12) decreased level or loss of consciousness, (13) seizure, (14) involuntary movements other than seizures (e.g. tremors, myoclonus), (15) language disturbance, (16) memory lapses, (17) sleep disturbance, or (18) non-neurologic. Other reasons for neurology referrals are: (1) sedation, (2) follow-up care, (3) clearance for anticoagulation, (4) clearance for procedure/surgery, (5) post-arrest management and prognostication, or (6) with neurologic symptoms other than the chief complaint. Due to broad range of time of symptom onset to time of ER consult, time was measured and compared in days. Records which did not indicate the specific time (i.e. historian wrote few days, few hours, the night prior, morning prior) were classified as unspecified time and were labeled as missing data. Pre-existing co-morbidities were grouped under (1) neurologic, (2) cardiovascular, (3) endocrinologic, (4) pulmonary, (5) renal, (6) cancers, (7) gastrointestinal, (8) chronic infections and (9) others. Pre-existing and new-onset neurologic diseases were classified under the following categories: (1) headache and facial pain, (2) seizure, (3) stroke (i.e. including all vascular events), (4) encephalopathy, (5) infection, (6) tumors, (7) degenerative disorders, (8) peripheral neuropathies, (9) neuropsychiatric, (10) trauma, (11) others.

### *Statistical analysis*

All data were collected using the review of all electronic medical records of patients who satisfied both the inclusion and exclusion criteria of the study. Data was collated and cleaned using Microsoft Excel 360 and was analyzed using the

STATA 17 MP. Continuous variables such as age and time from symptom onset to final emergency room admission were presented in means and standard deviation while discrete variables were presented in frequencies and percentages. Test for difference of continuous variables utilized Z-Test for Mean Differences between the 2019 and 2020 since the study utilized a population census data. The Chi-Square Test for differences in distribution was used to analyze the differences of discrete variables between the 2019 and 2020 if distribution of variables has at least 5 frequencies per category. If variable distribution has categories with less than 5 counts, Fisher's Exact Test was used as a statistical test for variable distribution. Statistical tests with p-values less than 5% were regarded as significantly different.

## RESULTS

There were a total of 3,398 neurology referrals during the predetermined period of 2019 and 2020 received from all units (i.e. from ER, general inpatient wards and ICU); 2,163 (63.7%) in 2019 and 1,235 (36.3%) in 2020, respectively. This showed an over-all 43% drop in neurology referrals in our center during the first 6 months of the lockdown period. Similarly, there was a 45% decline in the volume of referral to neurology service at the ER. The proportion of neurology referrals that were received from the ER in 2019 and 2020 were not significantly different at 66% and 68% respectively. A total of N=2,283 (67.1%) patients with neurologic complaints who consulted at the ER were included in the study. Of these, N=1,472 consulted from March to August 2019 while N=811 consulted from March to August 2020.

From March to August 2019, the proportion of females (53.5%) was greater than male patients. Female patients decreased to 48.3% from March to August 2020 ( $p=0.019$ ). Average age upon ER admission of patients significantly increased from 55.5 years ( $\sigma=19.9$ ) in 2019 to 59.5 years ( $\sigma=18.4$ ) in 2020 ( $p<0.001$ ). Upon ER admission, top three chief neurologic complaints were dizziness (17.7%), motor weakness (14.1%), and headache (13.2%). This distribution changed significantly in 2020 where motor weakness (19.0%), decreased level of consciousness or loss of consciousness (13.2%), and dizziness (11.2%) became the top three chief neurologic complaints ( $p<0.001$ ). Other reasons for referral other than the chief complaint have no statistically significant changes. Data were summarized in Table 1.

The average time from symptom onset to ER

admission in 2019 was 5.1 days ( $\sigma=23.9$ ) which increased to an average of 8.4 days in ( $\sigma=28.1$ ) in 2020. This increase of time from symptom onset to admission was found to be statistically significant ( $p<0.001$ ). (Table 2)

In terms of pre-existing co-morbidities, there was a significant decrease in the proportion of patients with no co-morbidities from 27.6% in 2019 to 17.0% in 2020 ( $p<0.001$ ). In general, patients with pre-existing cardiovascular diseases, endocrine diseases, pulmonary diseases, renal diseases, cancers, and others (i.e. rheumatologic, hematologic, urologic and gynecologic) have significantly increased ( $p<0.05$ ). However, it was noted that the increase in the proportion of patients with pre-existing neurological disorders ( $p=0.143$ ), gastrointestinal diseases (0.126), and chronic infections ( $p=0.327$ ) were not statistically significant ( $p>0.05$ ). (Table 3)

The proportions of patients without pre-existing neurologic conditions decreased significantly from 72.3% in 2019 to 68.2% in 2020 ( $p=0.039$ ). Among measured conditions, the only pre-existing neurologic conditions found to significantly increase in proportion of cases from 2019 to 2020 was stroke ( $p=0.010$ ). Emergency room visits of patients with previous headache and facial pain ( $p=0.563$ ), seizure ( $p=0.589$ ), encephalopathy ( $p=0.534$ ), infection ( $p=0.225$ ), tumors ( $p=0.647$ ), degenerative disorders ( $p=0.064$ ), peripheral and other neuropathies ( $p=0.871$ ), neuropsychiatric ( $p=0.742$ ), trauma ( $p=0.210$ ), and others ( $p=0.614$ ) did not significantly change ( $p>0.05$ ). (Table 3)

Among new onset neurologic diagnoses, headache and facial pain ( $p<0.001$ ) and peripheral and other neuropathies ( $p=0.005$ ) significantly decreased in proportion from 2019 to 2020 while proportion of cases with all types of new stroke and/or vascular pathology ( $p<0.001$ ) and all types of encephalopathy ( $p=0.003$ ) have a statistically significant increase from 2019 to 2020. There was no significant change in proportion of cases with new-onset of seizure ( $p=0.509$ ), infection ( $p=0.694$ ), tumors ( $p=0.606$ ), degenerative disorders ( $p=0.132$ ), neuropsychiatric ( $p=0.051$ ), trauma ( $p=0.089$ ), and others ( $p=0.186$ ) among patients between 2019 and 2020. However, patients without new-onset neurologic conditions decreased significantly from 5.6% before pandemic to 2.7% during the pandemic ( $p=0.001$ ). The distribution of final ER disposition also changed significantly ( $p<0.001$ ). (Table 3)

This study found a statistically significant decline in the proportion of ER admission from 2019 to 2020 (from 76.5% to 74.5%), a significant

**Table 1: Gender, age, chief complaint, other reasons for referral**

Characteristics	Pre-COVID (2019) N = 1,472	During COVID (2020) N = 811	p-value
	n (%)	n (%)	
Gender:			
Male	685 (46.5%)	419 (51.7%)	0.019
Female	787 (53.5%)	392 (48.3%)	
	<b>Mean (SD)</b>	<b>Mean (SD)</b>	
Age (years)	55.5 (19.9)	59.5 (18.4)	<0.001
	<b>n (%)</b>	<b>n (%)</b>	
Chief Complaint:			
Head trauma/fall	84 (5.7%)	32 (3.9%)	<0.001
Headache	195 (13.2%)	67 (8.3%)	
Dizziness	260 (17.7%)	91 (11.2%)	
Imbalance	20 (1.4%)	12 (1.5%)	
Motor weakness	208 (14.1%)	154 (19.0%)	
Facial asymmetry	24 (1.6%)	19 (2.3%)	
Slurring/dysphonia	51 (3.5%)	40 (4.9%)	
Visual changes	19 (1.3%)	8 (1.0%)	
Pain	24 (1.6%)	8 (1.0%)	
Numbness	69 (4.7%)	29 (3.6%)	
Disorientation/confusion	43 (2.9%)	26 (3.2%)	
Decreased level of consciousness/LOC	151 (10.3%)	107 (13.2%)	
Seizure	124 (8.4%)	64 (7.9%)	
Involuntary movements other than seizure	8 (0.5%)	4 (0.5%)	
Language disturbance	20 (1.4%)	30 (3.7%)	
Memory lapses	4 (0.3%)	4 (0.5%)	
Sleep disturbance	8 (0.5%)	2 (0.2%)	
Non-neurologic	160 (10.9%)	114 (14.1%)	
Other Reasons for referral:			
Sedation	0 (0.0%)	0 (0.0%)	0.054
Follow up care	89 (6.0%)	52 (6.4%)	
Clearance for anticoagulation	1 (0.1%)	1 (0.1%)	
Clearance for surgery/procedure	4 (0.3%)	0 (0.0%)	
Post arrest prognostication	6 (0.4%)	8 (1.0%)	
With neurologic symptoms (other than the chief complaint)	70 (4.8%)	56 (6.9%)	
None	1302 (88.5%)	694 (85.6%)	

**Table 2: Symptom onset to ER admission**

Characteristics	Pre-COVID (2019) N = 1,472	During COVID (2020) N = 811	p-value
	Mean (SD)	Mean (SD)	
Time from symptom to final ER admission (days)	5.1 (23.9) (106 missing data)	8.4 (28.1) (29 missing data)	<0.001

**Table 3: Pre-existing co-morbidities, pre-existing neurologic conditions; new onset neurologic conditions**

Characteristics	Pre-COVID (2019)	During COVID (2020)	p-value
	N = 1,472	N = 811	
	n (%)	n (%)	
<b>Pre-existing comorbidities:</b>			
None	407 (27.6%)	138 (17.0%)	<0.001
Neurologic disorders	408 (27.7%)	248 (30.6%)	0.143
Cardiovascular diseases	787 (53.5%)	538 (66.3%)	<0.001
Endocrine diseases	376 (25.5%)	266 (32.8%)	<0.001
Pulmonary diseases	719 (4.8%)	65 (8.0%)	0.002
Renal diseases	109 (7.4%)	126 (15.5%)	<0.001
Cancers	66 (4.5%)	71 (8.8%)	<0.001
Gastrointestinal diseases	43 (2.9%)	33 (4.1%)	0.126
Chronic infections	17 (1.2%)	14 (1.7%)	0.327
Others	107 (7.3%)	96 (11.8%)	<0.001
<b>Pre-existing neurologic conditions:</b>			
None			
Headache and facial pain	1064 (72.3%)	553 (68.2%)	0.039
Seizure	10 (0.7%)	4 (0.5%)	0.563
Stroke/vascular	45 (3.1%)	22 (2.7%)	0.589
Encephalopathy	226 (15.4%)	159 (19.6%)	0.010
Infection	1 (0.1%)	2 (0.2%)	0.534
Tumors	0 (0.0%)	1 (0.1%)	0.225
Degenerative disorders	35 (2.4%)	17 (2.1%)	0.647
Peripheral & other neuropathies	51 (3.5%)	41 (5.1%)	0.064
Neuropsychiatric	30 (2.0%)	17 (2.1%)	0.872
Trauma	28 (1.9%)	17 (2.1%)	0.742
Others	14 (1.0%)	13 (1.6%)	0.210
	13 (0.9%)	6 (0.7%)	0.614
<b>New-Onset Neurologic Conditions:</b>			
None	82 (5.6%)	22 (2.7%)	0.001
Headache and facial pain	199 (13.5%)	63 (7.8%)	<0.001
Seizure	156 (10.6%)	93 (11.5%)	0.509
Stroke/vascular	474 (32.2%)	348 (42.9%)	<0.001
Encephalopathy	226 (15.4%)	165 (20.3%)	0.003
Infection	19 (1.3%)	12 (1.5%)	0.694
Tumors	46 (3.1%)	28 (3.5%)	0.606
Degenerative disorders	30 (2.0%)	24 (3.0%)	0.132
Peripheral & other neuropathies	173 (11.8%)	65 (8.0%)	0.005
Neuropsychiatric	56 (3.8%)	18 (2.2%)	0.051
Trauma	114 (7.7%)	47 (5.8%)	0.089
Others	19 (1.3%)	6 (0.7%)	0.186

decline in proportion of ER discharges (i.e. sent home) (from 16.0% to 13.1%) and a decline in proportion of ER transfers to another hospital (from 1.2% to 0.9%). On the other hand, during the community lockdown in 2020, there was a significant increase in proportions of neurology patients who left against medical advice (5% to 7.6%) and who died or expired at the ER (1.1% to 3.9%), as shown in Table 4.

## DISCUSSION

To our knowledge this is the only study which described the initial impact of the first six months of COVID-19 lockdown in Metro Manila among patients with general neurological complaints at the emergency room. The 45% decline in ER referral to neurology service in our study is comparable to other reports of about 44-47%

**Table 4: Emergency Room disposition**

Characteristics	Pre-COVID (2019)	During COVID (2020)	p-value
	N = 1,472	N = 811	
	n (%)	n (%)	
ER disposition:			
Admitted to wards or ICU	1129 (76.7%)	604 (74.5%)	<0.001
Sent home	236 (16.0%)	106 (13.1%)	
Transferred to another hospital	18 (1.2%)	7 (0.9%)	
Left against medical advice	73 (5.0%)	62 (7.6%)	
Expired at the ER	16 (1.1%)	32 (3.9%)	

decline in overall emergency room neurology admissions during the COVID-19 lockdown.<sup>1,2.</sup>

<sup>3</sup> Since there was no significant change in the proportions of ER referrals to neurology service, 66% in 2019 and 68% in 2020, we can surmise that the role of neurologists at the ER remained relevant and that the decrease in volume of referral was only due to the overall decrease in number of patients who went to the hospital to seek care.

In 2019, majority of neurology patients at the ER were female (53.5%). During the pandemic, there was a decline of female patients to 48.3%. The statistically significant reversed proportion of female and male patients during the community lockdown suggests that female neurology patient were more likely to avoid going to the hospital during the initial months of the pandemic.

As for the age, the youngest patients referred to neurology in 2019 were one-year-old. This is similar during the same period of 2020. However, in 2020, these youngest patients were only seen during the first half of March prior to the announcement of the community lockdown and all were brought due to convulsive seizures. The youngest patients were 10-year-old or older from April to August 2020. The significant increase on the average age of patients who consulted at the ER was likely due to the closure of the pediatric unit at the emergency room during the community lockdown. Most pediatricians shifted to telemedicine during this period. This explanation may be unique to our cohorts since the center's department of neurology accepts both adult and pediatric referrals at the ER.

A Korean study, found that dizziness, followed by motor weakness and altered mental status were the top 3 complaints in 2020.<sup>4</sup> Our study also found a significant change on neurologic chief complaints at the ER. Patients complaining of motor weakness increased from 14.1% to 19% in 2020. Similar to the same period before the pandemic, there were still more male patients

complaining of motor weakness than female. However, male with motor weakness were much less in number in 2020 than the decline observed in female (124 to 84 male vs. 85 to 70 female). Despite that there are still more male than female patients brought due to motor weakness, the chances that male patients with motor weakness were not brought to the ER during the pandemic are plausible. Patients with chief complaints of headache and dizziness, on the other hand, both declined in number. Similar for both complaints, there were more than three times decline in number of female patients compared with two times decrease in number of male patients. These top two complaints with significantly lower number of female could be the main neurologic complaints which represent the decline in overall number of female ER consults during the pandemic. Female patients with dizziness and headache could have opted to stay at home than consult the ER. During the pandemic, the second most common neurologic chief complaint was decreased level of consciousness or transient loss of consciousness (13.2%). This complaint was observed more common among male during both periods in 2019 and 2020. The proportion of patients with non-neurologic chief complaints but were referred to neurology increased in 2020 (10.9% to 14.1%). This represents patients who came at the ER due to other reasons such as dyspnea, chest pain, generalized body weakness or fever, but were eventually referred to neurology due to pre-existing neurologic diagnosis, presence of accompanying neurologic symptoms or due to emergence of neurologic symptoms while at the ER. The top two reasons for referral other than the chief complaints are still follow-up care and if there was a neurologic symptom noted aside from the chief complaint. In 2020, the top three neurologic symptoms other than the chief complaints which prompted referral were decreased sensorium (26.8%), seizure (17.9%)

and disorientation or confusion (16%). This could mean an underestimate of these symptoms as chief complaints at the ER in 2020 since these symptoms were regarded only as sequelae of the primary symptoms.

The time from initial symptom onset to ER admission also significantly increased in terms of days, from 5.1 days in 2019 to 8.4 days in 2020 which resulted to delay in management. Most of the previous studies on emergency consultations during the pandemic did not include this factor but only described the change in number of ER visits and the mode of transportation to the ER. There was also a significant decrease in the proportion of patients without co-morbidities who went to the ER in 2020 than in 2019 (from 27.6% to 17.0%). Significant increase in ER consultations was found among patients with pre-existing cardiovascular diseases, endocrine diseases, pulmonary diseases, renal diseases, and cancers. This implies a negative impact of the community lockdown among patients with co-morbidities as compared with patients without co-morbidities.

One study found that lockdown restriction measures were found to be associated with worsening of neurologic symptoms. Reported worsening was more than 20% among patients with pre-existing headache, Parkinson's disease, neuropathies, dystonia, cognitive impairments and amyotrophic lateral sclerosis (ALS). Although the need for urgent consultations was found among only 7% of 2,000 subjects, it exceeded 10% among patients with ALS, cognitive impairments, myasthenia and Parkinson's Disease.<sup>5</sup> Notably, our study found no significant increase in patients with pre-existing neurologic conditions at the ER during the initial months of lockdown. It suggests that having pre-existing neurologic conditions did not increase the likelihood of ER visits during the initial months of the lockdown. This underlies the importance of strengthening our out-patient care and clinic access among patients with chronic neurologic conditions during community lockdown. The only significant increase in proportions among patients with pre-existing neurologic conditions from 2019 to 2020 was stroke and/or any neurologic conditions of vascular pathology (i.e. transient ischemic attack, subarachnoid hemorrhage). Among neurology patients, the community quarantine situation was noted to have greater impact on those with conditions requiring multidisciplinary team management, polypharmacotherapy and supportive therapies such as neuromotor, speech and occupational therapies, which practically

describe stroke-care.<sup>5,6</sup> Importance of these areas of neurologic care should be given more attention during pandemic.

Regarding new onset neurologic diseases or diagnoses at the ER, our study found a significantly fewer proportions of headache and facial pain as well as peripheral and other neuropathies in 2020. This finding supports other reports that there may be some improvement in headaches and less exacerbation of different neuropathies during the lockdown or this could also signify a higher tolerance to pain and/or paresthesia because of the fear of going to the hospital. It is also possible that these patients could have overused emergency room visits in the past and that they could have been managed as out-patient during clinic hours. In one Italian study, observed subjects with known migraine had fewer migraine attacks and reported lesser pain during COVID-19 quarantine.<sup>7</sup> However, in another study, 21% of patients with known chronic headaches reported worsening of symptoms.<sup>5</sup> Similar to 2019, there were still more female with new onset headache and new onset peripheral neuropathies despite the overall decline of female neurology patients at the ER during the pandemic. Our study also found that new stroke of all types and/or vascular pathology as well as all types of encephalopathy has significantly increased during the initial period of community lockdown. This is contrary to previous studies which showed a mean fall of 38% in new stroke diagnoses, 59% decline in number of daily stroke transfers from referral centers, 50% reduction on minor stroke and transient ischemic attack (TIA) admissions.<sup>1,2,8,9</sup> However, one study described that in contrast with a decline in minor stroke and TIAs, there was higher prevalence of severe stroke (NIHSS >10) on admission during the lockdown period.<sup>2,10</sup> This may mean that the increase in new stroke diagnoses in our study was due to worse stroke presentation or progression of stroke due to delay on seeking emergency care from stroke onset. Stroke severity was not measured in our study to confirm this. Acute ischemic stroke (AIS) was the most common new neurological diagnosis found in another study, followed by BPPV, vestibular neuritis, and seizures. They were also able to conclude that stroke was particularly more common among patients who are 40 year-old and above and metabolic encephalopathy was found among 60 year-old and older patients.<sup>4</sup> In this study, new-onset stroke remained more common among male than female before and during the pandemic with almost similar proportions. Interestingly, new

onset encephalopathy was more common among female patients before the pandemic but was found more common among male during the pandemic.

Our study also found that seizures and degenerative neurologic conditions (e.g. Parkinson's disease) including its exacerbations increased in 2020 but have no statistically significant change in proportions when compared with 2019. In a study done in Japan, they found that patients with Parkinson's disease and seizure disorder increased in the outpatient clinic during the first and second wave of COVID 19 pandemic.<sup>11</sup> We speculate that this could explain the non-statistically significant increase in the emergency room setting. Among persons with epilepsy, there were reports of difficulties in follow-up and increase in seizure number particularly among those chronically taking more anti-seizure medications and with poor sleep quality.<sup>6</sup> Interestingly, despite the popularity of mental health issues during the lockdown, there was also a decline in number of new-onset neuropsychiatric diagnoses (e.g. anxiety, depression, hyperventilation syndrome) but the proportions were found to have no statistically significant change from 2019. Our study may however underestimate the prevalence of neuropsychiatric diseases during the lockdown period since many of the patients usually do not seek emergency care and would prefer outpatient clinic consults. In 2020 there was also fewer proportion of patient referred to neurology without new onset neurologic conditions. This suggests a significant decrease on unnecessary referrals during the pandemic. Appropriateness of neurology consultation requests at the ER as judged by neurologists in a multi-center study in Italy was compared between 2019 and 2020 and appropriateness also increased during the pandemic while non-pertinent neurology consultations decreased.<sup>12</sup>

The ER experience in 2020 at a Korean hospital showed that the proportion of patients discharged against medical advice was only 1.8% and deaths were only 0.3%. ER admissions were 55%, 41.8% were sent home, while those who were transferred to another hospital were only 1.1%. Their pre-pandemic data were not available for comparison.<sup>4</sup> The distribution of final ER disposition changed significantly in our study. In 2020, when compared with pre-pandemic data, there were fewer patients who were admitted to regular ward and ICU (74.5%), fewer patients were sent home (13.1%) and fewer patients were transferred to another hospital (0.9%). Top admission remained to be

due to new onset stroke in 2020. Majority of patients that were sent home was related only to headache in 2019, but both headache and peripheral neuropathies were equally highest in number in 2020 among ER discharges. For both periods, majority of transferred patients are still cases of new onset stroke. Our study found that there was an increase in proportions of patient who left against medical advice (from 5% to 7.6%) and who died or expired at the ER (from 1.1% to 3.9%). Majority of cases who left against medical advice in 2019 was related to headache diagnoses followed closely by stroke. However, leaving against medical advice after new stroke diagnosis still doubled in 2020, despite our initial finding that stroke was still the leading new onset neurologic condition admitted from the ER. Leaving against medical advice could be due to the lack of available hospital bed during the initial six months of the pandemic. Diagnoses related to encephalopathy which resulted to death while at the emergency room were leading for both years; but there is also a noticeable increase in number of death related to new stroke, which tripled in number in 2020. Death due to ischemic stroke and new onset atrial fibrillation during the initial 3 weeks of lockdown doubled in another study (1.3% to 2.7%).<sup>13</sup> This may be due to the observation that many stroke patients were forced to stay at the ER for several days due to lack of room, the conversion of stroke unit into COVID ICU, worsening of stroke presentation, or delay in seeking care.<sup>14</sup>

One of the strengths of this study is the large number of subjects that were included because this study was conducted in a high volume center in Manila. However, our study is limited by non-generalizability and selection bias since it was only done in a single center, sample size was not computed and the period assessed was only the initial 6 months of the lockdown. We also acknowledge the inherent limitations of this study due to its study design. The retrospective design may have caused misclassification bias. The discordance rate in diagnosis between emergency physicians and neurologist was addressed by including only the ER diagnoses of the neurologists. Also, the COVID-19 status of the subjects was not analyzed in this study; hence, the description of the possible direct impact of COVID-19 infection on neurological symptoms was not described in this study. Some overlap of neurologic symptoms and neurologic complications has been found among COVID-19 positive patients and has been classified.<sup>15</sup> Lastly,



the impact of community quarantine on patients with prior stroke and new stroke were found significant in this study. However, we were not able to describe in details the stroke types and stroke severity (e.g. NIHSS score). These data could have better explain the impact of the initial lockdown period among stroke patients since previous studies showed contrasting data on the effects of the pandemic on mild stroke and severe stroke patients.

In conclusion, this study provided us a general view on how the pandemic changed the landscape of neurology and neurological diseases seen at the ER. This study showed that the first 6 months of the community lockdown during COVID-19 pandemic caused a significant change in the characteristics of patients referred to neurology for emergency care when compared with the pre-pandemic period. Despite the overall decline (45%) in number of neurology patients at the emergency room, the proportion of emergency room referrals remained the same conferring a relevant role of neurologists at the emergency room during the recent pandemic. Neurologic care must be continuous, timely, safe and optimal even during pandemics. The results of this study may be used as reference for making healthcare provisions to ensure better delivery of neurologic care and to mitigate the negative effects of community quarantine among diverse neurologic patients needing emergency care.

## DISCLOSURE

Ethics: This paper was approved by the Makati Medical Center Institutional Review Board on 27th October 2020 with protocol number MMCIRB 2020-12 and underwent a compliance review by the Clinical Research Center on 6th September 2021.

Conflict of interest: None

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