COVID-19

Did the role of the neurologist in the emergency department change during the COVID-19 pandemic? Evidence from an Italian nationwide survey

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Abstract

Objective This study aims to assess whether the role of neurologists in the emergency department changed during the coronavirus (COVID)-19 pandemic.

Methods Data from an Italian national survey investigating the role of neurologists in the emergency room conducted in December 2020 were compared with those of the same survey of the previous year. These surveys involved a questionnaire being completed filled in for patients who received a neurological consultation following a visit to the emergency room. Information gathered included demographic characteristics, triage level according to both the emergency physician and neurologist, reason for the consultation, neurological evaluation, and discharge mode.

Results In both years, approximately half of the patients were women, and the median age was 61 years. More patients in 2020 arrived by ambulance and had a greater need for assistance based on triage level than in 2019. During 2020, the proportion of consultancy requests judged by the neurologist was higher than that in 2019 (77% vs. 73%). Moreover, in 2020, fewer patients required consultation for headache, muscle pain, fever, and neurological signs, whereas coma was more prevalent. The diagnosis of ischemic stroke was the most prevalent in both years, followed by transient ischemic attack. In 2020, the status epilepticus increased and discopathy decreased.

Conclusion This study showed the significant role played by neurologists in emergency activities, especially during the COVID-19 pandemic, and highlighted the differences in patients admitted between the year of the epidemic and the year previous.

Keywords COVID-19 · Neurologist · Emergency room · Survey

Introduction

Several neurological diseases have an acute onset and require timely intervention; these often necessitate admission to the emergency room (ER). In addition, many other conditions may present as nervous acute manifestations.

Therefore, neurological disorders account for a considerable proportion of admissions to the ER [1]. Because outcomes in these patients are affected by the medical interventions implemented in the first hours of onset [2, 3], an accurate assessment must be performed to identify the best treatment strategy and provide an optimal prognosis. However,

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diagnosing these patients can be challenging because acute neurological conditions are characterized by a complex clinical evaluation [4]. Thus, some patients who are admitted to the ER require consultation with a neurologist specialist for effective patient management.

The COVID-19 outbreak had a significant impact on the access to health facilities and the delivery of outpatient services [5]. This phenomenon involved patients with chronic diseases [6] as well as those experiencing an acute event [7]. For acute events specifically, several studies have shown a reduction in the access of emergency departments during the COVID-19 pandemic, which was also the case for neurological disorders [8–10].

To investigate opportunities for appropriate neurological evaluations and the relevance of neurologists in ERs across Italy, the Italian Association for Emergency Neurology (ANEU) carried out a national survey investigating the role of neurologists in the ER in Italy with the following aims: (i) estimating the rate of consultation, (ii) assessing the reason for the consultation, (iii) evaluating the appropriateness of the consultation, and (iv) assessing the outcomes of patients who had a neurologic consultation [1]. We used the data gathered from this survey to assess whether and to what extent the role of neurologists in the emergency department changed during the COVID-19 pandemic by comparing survey data of December 2020 with those of the previous year (2019).

Methods

NEUDay survey

The data used for the present study were retrieved from two surveys carried out on November 25, 2019 (NEUDay 2019), and December 14, 2020 (NEUDay 2020), promoted by ANEU and endorsed by the two Italian neurological societies (*Società Italiana di Neurologia* and *Società di Neuroscienze Ospedaliere*). All hospitals that had an emergency department were invited to participate in the survey. A referring neurologist was identified in each facility, and a questionnaire was administered to acquire information about the clinical activities carried out at each hospital.

Questionnaire

For both years, a questionnaire was completed for each patient who received a neurologic consultation after accessing the ER. Data included:

– Demographic characteristics (age and sex)
– Arrival mode (ambulance vs. self-presentation; accompanied vs alone)

– Triage level according to the emergency physician and neurologist on a four-item scale: red/emergency, yellow/urgent, green/slightly urgent, and white/ambulatory complaints
– Time at which the request for consultation was made and time of consultation
– Reason for the consultation
– Neurological evaluation (exams performed, final diagnosis, and appropriateness of the consultation)
– Discharge mode (home vs. hospitalization, recommendations, and ward of hospital admission)

Moreover, for each facility, the total number of patients accessing the ER was collected.

Data analysis

Summary statistics are expressed as means (standard errors) or frequencies (percentages), as appropriate. Standardized mean differences for binary covariates were used when appropriate to test for differences between calendar years. Equipoise was considered to be reached when the between-group comparison of variables had a mean standardized difference of < 0.1 [11]. Agreement on triage level between emergency physicians and neurologists was assessed using the weighted Cohen kappa statistic [12].

To investigate whether the severity of patients admitted in 2020 differed from that of patients in 2019, a proportional odds logistic regression model was fitted. Triage level was the outcome variable (as a proxy of the severity of the patient), and the year of admission was the exposure of interest. Sex, age, arrival mode, and diagnosis were included in the model as covariates.

To investigate whether the propensity of hospitalization differed between the two years, a logistic model was fitted, in which the dichotomous variable of discharge mode (home vs. hospitalization) was the outcome variable, and the year of admission was the exposure of interest. The model was adjusted for sex, age, triage level, and diagnosis.

All analyses were performed using the Statistical Analysis System Software (version 9.4; SAS Institute, Cary, NC). For all hypotheses tested, a two-tailed p value < 0.05 was considered significant.

Results

Patients

During the NEUDay 2019, 1001 patients were admitted to the ER across 121 facilities (out of the 260 Italian facilities with a neurological ward) and had a neurological consultation. In contrast, 948 patients across 154 facilities were

admitted and received a neurological consultation during the NEUDay 2020. Overall, the proportions of consultations were 5.5% in 2019 and 6.7% in 2020. The median time from the request to neurological consultation was 30 min in 2019 and 32 min in 2020.

The mean age of cohort members was 61 years (standard error, 22 years) for both years, whereas 51% and 50% were women in 2019 and 2020, respectively. Almost half of the patients arrived by ambulance (48%), and almost four out of five patients were accompanied (79%) in 2019, whereas these figures were 58% and 51%, respectively, in 2020.

In 2020, 30 (3.2%) patients were positive for SARS-CoV-2 infection. Based on the triage level of neurologists, patients with a confirmed diagnosis of SARS-CoV-2 infection showed higher severity than that of other patients (Table 1).

Agreement between emergency physicians and neurologists

The distributions of triage levels determined by emergency physicians and neurologists are shown in Fig. 1. Assessments by emergency physicians were often downgraded by neurologists in both years: 16% of red codes (emergency) were reduced to 13% in 2019 and from 22 to 18% in 2020,

whereas 49% of yellow codes (urgent) were reduced to 41% by neurologists in 2019 and from 46 to 41% in 2020. The value of the weighted Cohen kappa statistic was 0.55 (95% confidence interval, 0.50–0.60) in 2019 and 0.60 (0.55–0.65) in 2020, which indicated some agreement between emergency physicians and neurologists. Overall, compared with patients admitted in 2019, those admitted in 2020 had a greater need for assistance based on triage level.
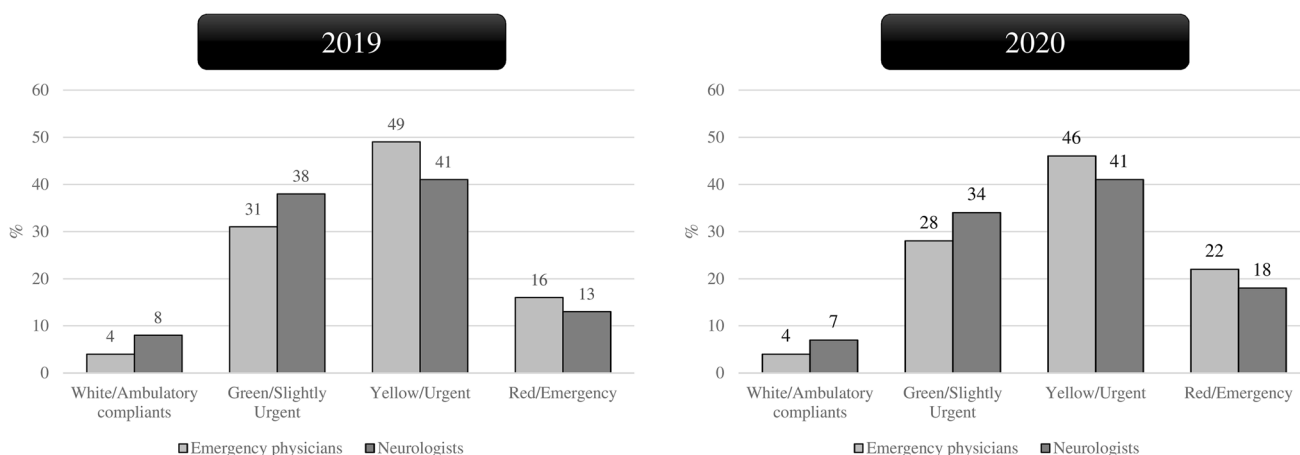
Appropriateness of the consultation

During 2019, neurologists judged 73% of consultation requests to be pertinent, 22% partially pertinent, and 5% not pertinent. Appropriateness increased during 2020, with 77% of consultations judged to be pertinent and 3% not pertinent (Fig. 2). Appropriateness was not homogeneous among the triage levels assigned by emergency physicians. The percentage of pertinent requests increased from 46% among white codes to 91% among red codes in 2019 and from 59 to 91%, respectively, in 2020.

Reasons for the consultation, diagnoses, and examinations

Reasons for consultation are reported in Table 2. During 2019, the main reasons were focal neurological deficits (21%), transient loss of consciousness (13%), headache (13%), strength deficiency or sensory disturbances (11%), and dizziness (9%). In 2020, the main reasons for consultation were largely the same as those in 2019, except for headache, muscle pain, fever, and neurological signs, which occurred in fewer patients, whereas coma was more prevalent.

The diagnoses formulated by neurologists are reported in Table 3. The diagnosis of ischemic stroke was the most prevalent in both years (16% in 2019 and 18% in 2020),

Table 1 Percentage distributions of triage level according to SARS-CoV-2 infection

Triage level	Patients with the SARS-CoV-2 infection	Other patients
White/ambulatory complaints	3%	8%
Green/slightly urgent	28%	34%
Yellow/urgent	31%	41%
Red/emergency	38%	17%

Fig. 1 Percentage distributions of triage level assigned by emergency physicians and neurologists
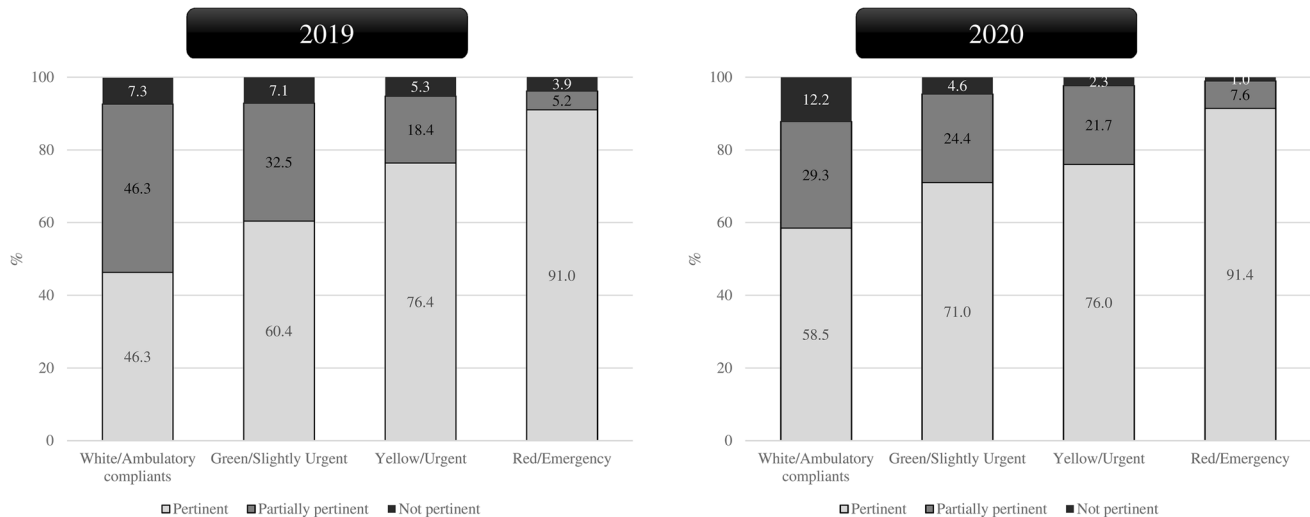
Fig. 2 Percentage distributions of request appropriateness among triage levels assigned by emergency physicians

Table 2 Distribution of the reasons for neurological consultation

Reasons for the consultation	2019	2020	SMD
Focal neurological deficits	21.2%	22.8%	0.038
Transient loss of consciousness	12.8%	11.5%	0.041
Headache	12.5%	6.5%	0.205
Strength deficiency or sensory disturbances	11.5%	9.3%	0.072
Dizziness	9.1%	7.7%	0.052
Epileptic manifestation	8.6%	10.9%	0.078
Delirium/acute confusional state	7.3%	7.6%	0.011
Head trauma	5.2%	5.2%	0.001
Acute visual disturbances	4.4%	3.9%	0.024
Muscle pain	1.9%	0.5%	0.122
Coma	1.5%	3.7%	0.141
Fever and neurological signs	1.5%	0.4%	0.108
Paraplegia/quadriplegia	1.1%	1.1%	0.001
Movement disorders (hyper- or hypokinesia)	1.0%	1.2%	0.018
Functional/psychiatric disorders	0.7%	1.7%	0.093
Other reason	0.0%	6.1%	-

SMD, standardized mean difference

Table 3 Distribution of diagnostic hypotheses formulated by the neurologists after consultations

Diagnoses	2019	2020	SMD
Ischemic stroke	16.2%	18.0%	0.048
Transient ischemic attack	9.4%	8.4%	0.035
Primary headache	8.3%	4.3%	0.163
Seizure in known epilepsy	5.7%	7.6%	0.074
Cardiogenic syncope	5.6%	3.7%	0.093
Peripheral vertigo	5.6%	5.8%	0.007
First epileptic seizure	5.3%	7.6%	0.096
Head trauma	4.8%	4.1%	0.032
Monoradiculo-plexopathy	4.2%	4.3%	0.007
Symptomatic headache	3.6%	3.4%	0.012
Psychiatric disorder	3.6%	3.4%	0.012
Delirium in dementia	3.2%	3.7%	0.026
Central vertigo	3.1%	2.0%	0.070
Neurologic syncope	3.0%	3.1%	0.003
Metabolic encephalopathy	2.0%	3.1%	0.064
Discopathy	1.9%	0.3%	0.154
Cerebral hemorrhage	1.7%	2.6%	0.068
CNS cancer	1.7%	2.3%	0.048
CNS infection (encephalitis, meningitis, meningoencephalitis, encephalomyelitis)	1.6%	0.7%	0.077
Multiple sclerosis	1.5%	1.5%	0.001
Aggravation of Parkinson's disease	1.2%	0.7%	0.044
Subdural hematoma	0.8%	1.6%	0.074
Subarachnoid hemorrhage	0.7%	1.1%	0.040
Status epilepticus	0.2%	1.5%	0.141
Other[a]	5.1%	5.2%	0.004

[a]Neurological conditions with a frequency lower than 1% in 2019 and 2020

CNS, central nervous system; *SMD*, standardized mean difference

followed by transient ischemic attack (9% in 2019 and 8% in 2020). Primary headache was the third most prevalent diagnosis in 2019 (8%), whereas it was sixth in 2020 (4%). Compared with 2019, the status epilepticus was higher and discopathy was lower in 2020.

According to the proportional odds logistic model, there was no evidence that patients in 2020 had a higher triage level than those in 2019 after adjusting for sex, age, arrival mode, and diagnosis (odds ratio, 1.00; 95% confidence interval, 0.83–1.20).

Examinations conducted by neurologists were mainly addressed using blood chemistry tests (81% in 2019 and 86%

in 2020), neuroimaging (75% in 2019 and 83% in 2020), and electrocardiogram (67% in 2019 and 78% in 2020) (Table 4). In addition, the use of blood gas tests increased during 2020 (from 24 to 34%).

Outcomes

Among patients admitted in 2019, 40% were hospitalized, whereas this figure was 49% in 2020. However, after adjusting for patient characteristics, the odds of hospitalization did not differ between the two years (odds ratio, 1.07; confidence interval, 0.83–1.39). Among patients discharged at home, 54% and 40% were scheduled for examinations, 53% and 37% were recommended for treatment, and 44% and 32% were scheduled for evaluations in 2019 and 2020, respectively.

Discussion

Our study, based on a large and representative nationwide survey that was regularly carried out over several years [1], confirmed the burden of activities of Italian neurologists in the emergency department. However, the novelty of this investigation lies in several other findings. First, although there was an overall decrease in the volume of ER attendances [8], the proportion of neurological consultations increased slightly during the COVID-19 outbreak. Second, compared with patients admitted in 2019, those admitted in 2020 differed in several characteristics. More patients arrived by ambulance, with a more compromised clinical picture, which was reflected by the greater distribution of urgent triage codes. This cannot be explained by differences in demographic characteristics or by the prolonged time from request to neurological consultation because the distributions of sex, age, and time between request and consultation were similar between the two years. Rather, the more imperative requests for a neurological consultation were due to differences in the symptomatology of patients between the two years. In our sample, we observed a significant reduction

Table 4 Tests and other consultations available at the time of diagnostic hypothesis

Tests and consultations	2019	2020	SMD
Blood chemistry tests	80.7%	86.4%	0.155
Neuroimaging	75.0%	82.6%	0.188
Electrocardiogram	67.3%	78.1%	0.244
Blood gas tests	24.0%	34.5%	0.232
Neurophysiological examinations	9.8%	12.9%	0.096
Cerebral spinal fluid analysis	1.4%	1.3%	0.008

SMD, standardized mean difference

in the proportion of patients admitted for headache and an increase in those admitted for conditions related to epilepsy.

Although our data cannot explain the reasons for such differences, we can offer several hypotheses. One possible explanation is that some patients decided to avoid hospitals (including emergency departments) because of the risk of SARS-CoV-2 infection [13]. Another hypothesis is related to the challenging management of the healthcare resources during the COVID-19 outbreak. When the pandemic became more widespread, more beds and the attention of physicians were allocated to COVID-19 patients. Therefore, there was a trend towards deferral of less urgent cases. Furthermore, another possibility is that patients with urgent neurological conditions were managed without admission to the hospital emergency department. For example, some care models implemented in Italy were inspired by the American Acute Neurology Clinic model, whereby a first neurological visit is performed to screen and assess the best care pathway for the patient: hospitalization or "neuro fast track," in which some diagnostic investigations are performed in outpatient care (to prevent hospitalization) [14]. Finally, we cannot exclude the possibility that, because of changes in lifestyles, social distancing, and the use of personal protective equipment, the incidence of some conditions changed, which may explain our observations. For example, there was a reduction in the incidence of infectious diseases [15, 16] and an increase in the incidence of functional disorders [17] during the COVID-19 pandemic.

Further three findings deserve further discussion. First, neurologists often downgraded the assessment of emergency physicians; 65% of patients admitted in 2019 received an urgent/emergency code, whereas only 54% were confirmed by the neurologist. However, the agreement between clinicians was better in 2020 (68% and 59%, respectively), which was likely due to the more critical profile of patients. Second, several requests for consultation were not pertinent or only or partially pertinent. The burden of these inefficiencies accounts for 27% of consultancy requests in 2019 and 23% of those in 2020. Therefore, although appropriateness increased during 2020, there remains room for improvement to reduce the burden on neurologists in emergency departments and improve the effectiveness and efficiency of emergency services. Third, although the survey was carried out during the so-called second wave of the pandemic when several hospitals were assigned to specifically treat COVID-19 patients, there was no evidence that the propensity of hospitalization for patients admitted to ERs differed between the two years. This suggests that the Italian healthcare system was able to manage both COVID-19 and acute neurological patients, at least during the second wave.

Our study has several limitations. We could not verify the validity of the data sent from local participants. This is particularly relevant for data obtained in 2020 because

collecting data during the pandemic was prone to errors. In addition, although all hospitals that had an emergency department were invited to participate in the survey, some did not complete the questionnaire; thus, we could not compare the clinical profiles of patients admitted to responsive and non-responsive hospitals. Finally, because of the lack of some types of information (e.g., neurological beds allocated for COVID-19 patients), we could not investigate the impact of limited healthcare resources on the propensity to admit patients to the facilities.

In summary, our study highlighted the substantial role played by neurologists in emergency activities. In addition, we revealed differences in patients admitted between the year of the COVID-19 pandemic and the previous year. Because of the limited healthcare resources during the pandemic, every effort to improve the management of the patients and maximize the efficiency of neurologists should be made. Thus, protocols aimed at better managing the care pathway of patients by harmonizing the activities of all healthcare professionals involved in neurological care (e.g., general practitioner, specialist clinician, and ER specialist) [13] and mitigating viral exposure during a pandemic [18] should be developed.

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Declarations

Ethical approval None.

Informed consent The project and execution of NEUDay 2019 and 2020 have been notified to all ethics committees of the participating units.

Conflict of interest The authors declare no competing interests.

References

1. de Falco FA, Sterzi R, Toso V, et al. The neurologist in the emergency department. An Italian nationwide epidemiological survey. Neurol Sci. 2008;29:67–75

2. Jahan R, Saver JL, Schwamm LH et al (2019) Association between time to treatment with endovascular reperfusion therapy and outcomes in patients with acute ischemic stroke treated in clinical practice. JAMA 322:252–263

3. Lees KR, Bluhmki E, von Kummer R et al (2010) Time to treatment with intravenous alteplase and outcome in stroke: an updated pooled analysis of ECASS, ATLANTIS, NINDS, and EPITHET trials. Lancet 375:1695–1703

4. Rizos T, Ringleb PA, Huttner HB et al (2009) Evolution of stroke diagnosis in the emergency room - a prospective observational study. Cerebrovasc Dis 28:448–453

5. Chang AY, Cullen MR, Harrington RA, Barry M (2021) The impact of novel coronavirus COVID-19 on noncommunicable disease patients and health systems: a review. J Intern Med 289:450–462

6. Chudasama YV, Gillies CL, Zaccardi F, Coles B, Davies MJ, Seidu S, Khunti K (2020) Impact of COVID-19 on routine care

for chronic diseases: a global survey of views from healthcare professionals. Diabetes Metab Syndr 14:965–967

7. De Rosa S, Spaccarotella C, Basso C, Calabrò MP, Curcio A, Filardi PP, Mancone M, Mercuro G, Muscoli S, Nodari S, Pedrinelli R, Sinagra G, Indolfi C; Società Italiana di Cardiologia and the CCU Academy investigators group. Reduction of hospitalizations for myocardial infarction in Italy in the COVID-19 era. Eur Heart J. 2020;41:2083–2088

8. Castoldi L, Solbiati M, Costantino G, Casiraghi E (2021) Variations in volume of emergency surgeries and emergency department access at a third level hospital in Milan, Lombardy, during the COVID-19 outbreak. BMC Emerg Med 21:59

9. Bres Bullrich M, Fridman S, Mandzia JL, Mai LM, Khaw A, Vargas Gonzalez JC, Bagur R, Sposato LA (2020) COVID-19: stroke admissions, emergency department visits, and prevention clinic referrals. Can J Neurol Sci 47:693–696

10. Bamaga AK, Alharbi O, Bajuaifer M, Batarfi A, Althobaiti KH, AlQusaibi B. The effect of the COVID-19 pandemic on emergency department visits for neurological diseases in Saudi Arabia. Cureus. 2020;12:e12200

11. Austin PC (2009) Balance diagnostics for comparing the distribution of baseline covariates between treatment groups in propensity-score matched samples. Stat Med 28:3083–3107

12. Cicchetti D, Allison T (1971) A new procedure for assessing reliability of scoring EEG sleep recordings. American Journal EEG Technology 11:101–109

13. Pessoa-Amorim G, Camm CF, Gajendragadkar P, De Maria GL, Arsac C, Laroche C, Zamorano JL, Weidinger F, Achenbach S, Maggioni AP, Gale CP, Poppas A, Casadei B (2020) Admission of patients with STEMI since the outbreak of the COVID-19 pandemic: a survey by the European Society of Cardiology. Eur Heart J Qual Care Clin Outcomes 6:210–216

14. Pezzella FR, Casertano L, Cavallini A, Micieli G. Neurological emergency services: a case for change to the model of care? In: Micieli G, Cavallini A, Ricci S, Consoli D, Edlow JA. Decision Algorithms for Emergency Neurology. Springer

15. Hatoun J, Correa ET, Donahue SMA, Vernacchio L. Social distancing for COVID-19 and diagnoses of other infectious diseases in children. Pediatrics. 2020;146:e2020006460

16. Galvin CJ, Li YJ, Malwade S, Syed-Abdul S (2020) COVID-19 preventive measures showing an unintended decline in infectious diseases in Taiwan. Int J Infect Dis 98:18–20

17. Hull M, Mered P, Jankovic J. Increased incidence of functional (psychogenic) movement disorders in children and adults amidst the COVID-19 pandemic: a cross-sectional study. Neurology: Clinical Practice. 2021. doi: https://doi.org/10.1212/CPJ.0000000000001082

18. Bhaskar S, Sharma D, Walker AH, McDonald M, Huasen B, Haridas A, Mahata MK, Jabbour P (2020) Acute neurological care in the COVID-19 era: the pandemic health system REsilience PROGRAM (REPROGRAM) Consortium pathway. Front Neurol 11:579