



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Contents lists available at ScienceDirect

## Journal of the Neurological Sciences

journal homepage: [www.elsevier.com/locate/jns](http://www.elsevier.com/locate/jns)

Clinical short communication

## Preparedness and impact of COVID 19 infection at tertiary care neurology centers in Pakistan



Dureshshahwar Kanwar<sup>a</sup>, Safia Awan<sup>a</sup>, Ali Sajjad<sup>a</sup>, Anjum Farooq<sup>b</sup>, Lal Chand<sup>c</sup>, Awais Bashir Larak<sup>d</sup>, Abdul Malik<sup>e</sup>, Mohammad Wazir<sup>f</sup>, Adnan Aslam<sup>g</sup>, Husnain Hashim<sup>h</sup>, Farheen Niazi<sup>i</sup>, Mohammad Fateen Rasheed<sup>j</sup>, Fozan Khan<sup>k</sup>, Mazhar Hamdani<sup>l</sup>, Fahad Saleem<sup>m</sup>, Athar Iqbal<sup>n</sup>, Ahmed Asif<sup>o</sup>, Naila Shahbaz<sup>p</sup>, Haris Majid<sup>q</sup>, Mohammad Wasay<sup>a,\*</sup>

<sup>a</sup> Aga Khan University, Karachi, Pakistan<sup>b</sup> Bolan University of Medical and Health Sciences, Quetta, Pakistan<sup>c</sup> Mehar Medical college and civil hospital, Sukkur, Pakistan<sup>d</sup> Peoples Medical university, Nawab Shah, Pakistan<sup>e</sup> Liaquat College of Medicine and Dentistry, Karachi, Pakistan<sup>f</sup> Shaikh Zayed Hospital, Rahim Yar Khan, Pakistan<sup>g</sup> Services Hospital, Lahore, Pakistan<sup>h</sup> Fouji Foundation Hospital, Rawalpindi, Pakistan<sup>i</sup> Pakistan air forces hospital, Islamabad, Pakistan<sup>j</sup> Federal General hospital chak Shehzad, Islamabad, Pakistan<sup>k</sup> Rehman Medical Institute, Peshawar, Pakistan<sup>l</sup> Muzaffar abad Medical college, Muzaffarabad, Pakistan<sup>m</sup> Nishter Medical college, Multan, Pakistan<sup>n</sup> Shaikh Zayed Hospital, Lahore, Pakistan<sup>o</sup> Liaquat National Hospital, Karachi, Pakistan<sup>p</sup> Dow University of Health Sciences, Pakistan<sup>q</sup> Pakistan Institute of Medical sciences, Islamabad, Pakistan

## ARTICLE INFO

## Keywords:

Health care workers  
Personal protective equipment  
Neurology training  
COVID -19  
Pakistan  
Tertiary care centers

## ABSTRACT

**Objective:** We aimed to assess the response and impact of covid 19 pandemic at tertiary care centers in Pakistan especially pertaining to neurological care, facilities and training.

**Methods:** A pre-tested survey form was sent to 40 neurology tertiary care centers in all the provinces in the country in the first week of July 2020. 33 filled forms were received, out of which 18 were public (government) and 15 were private hospitals.

**Results:** Estimated 1300 HCW (faculty, medical officers, trainees and nurses) work at these 33 participating centers. There were 17 deaths among HCW (1.3%) at ten centers. Sufficient personal protective equipment (PPE) were provided to 158 HCW (12%). 129 (10%)HCW tested positive for COVID 19 at 31 centers including trainees/medical officers (39), consultants (29) and nursing and other staff (61). Due to low neurology admissions, 23/33 hospitals (70%) posted neurology trainees in COVID 19 units to contribute to covid care. Less than 50% hospitals did covid screening PCR before admission to neurology wards. Only 10% hospitals provide training and regular update to HCW. Neurology tele-health services were started for clinically stable patients at 15 (45%) centers. Only 60% neurology training programs were able to start online training. Ongoing research studies and trials focusing neurological manifestations of COVID-19 were done at 10 (30%) centers. Modification of facilities for COVID patients showed that 24(72%) hospitals strictly reduced the number of attendants accompanying patients. Only 10 (30%) centers had neurophysiological tests being conducted on COVID-19 patients. Mental health support services to HCW were provided at 12 (36%) centers.

**Conclusions:** Among HCW 10% tested positive for covid and 1.3% died. Mental health support services offered for HCW were available in 36% institutions. Neurology training was substantially affected due to low admissions, limited ward rounds and limited availability of online training.

\* Corresponding author.

E-mail address: [Mohammad.wasay@aku.edu](mailto:Mohammad.wasay@aku.edu) (M. Wasay).<https://doi.org/10.1016/j.jns.2021.117462>

Received 12 April 2021; Accepted 15 April 2021

Available online 17 April 2021

0022-510X/© 2021 Elsevier B.V. All rights reserved.

## 1. Introduction

There are number of published studies on various aspects of impact of COVID 19 on tertiary care centers. These studies include data related to patients being admitted to primary Neurology services, patients visiting the outpatient clinic amidst lockdown, impact on critical care requirement, resources available for Personal protective equipment (PPE), health care workers (HCW) affected by COVID 19, impact on the mental health and education and more importantly the preparedness and response to deal with the multitude of problems in health care facilities. Most of these publications are from Europe, USA, China and other developed countries. 1–6.

China's National Health Commission data shows that more than 3300 health-care workers have been infected as of early March, and at least 22 had died. In Italy, 20% of responding health-care workers were infected, and some have died.<sup>3</sup> In the Neurology Division at NYU Langone Hospital Brooklyn A total of 5/21 (25%) trainees and advanced practice providers, and 2 /15 full-time faculty (13%) were tested positive for SARS-CoV-2 infection.<sup>4</sup> Number of stroke related admissions and procedures decreased substantially across pandemic affected areas. Total number of thrombolysis and thrombectomy cases dropped 26.7% and 25.3%, respectively, in February 2020 as compared with February 2019 at 227 hospitals.<sup>2</sup> The capacity for stroke care was also reduced in the majority of the hospitals. Data related to response and impact of covid on neurology services is limited. Reported data from USA, Europe and China is indicative of low admissions and huge modifications in facilities, training and teaching methodologies. No published data available from developing countries especially South Asian countries related to impact and response of tertiary care neurology centers.

Pakistan is a middle-income country with population more than 210 million. At the time of this survey in July 2020, Pakistan had already more than 200,000 confirmed cases of COVID 19 with more than 4500 deaths in the country. Neurological care is limited in Pakistan with less than 240 neurologists and around 40 tertiary care neurology centers in country. The COVID 19 pandemic has compelled all health care facilities to restructure provision of clinical care and training programs worldwide. We aimed to assess the response and impact of this pandemic at tertiary care centers in Pakistan.

## 2. Methodology

This survey was conducted in the first week of July 2020. Survey form was pre-tested at Aga Khan university and then sent to 40 neurology tertiary care centers in all the provinces in country. 33 (83%) completed forms were received. The list of centers participating in this national survey is in annexure 1.

Survey collected basic information about hospitals/institutions followed by four sections including; (1) COVID 19 exposure to HCW (2) COVID19 care and provision of facilities (3) Changes in neurology training program and (4,5,6) Modification of facilities for COVID patients.

A descriptive analysis was done for demographic features. Qualitative variables were reported as number (Percentage). All analyses were conducted by using the Statistical package for social science SPSS (Release 19.0, standard version, copyright © SPSS; 1989–02).

## 3. Results

33 out of 40 tertiary care centers (83%) in the country participated in study, out of which 18 were public and 15 were private hospitals. Estimated 1300 HCW (faculty, medical officers, trainees and nurses) work at these 33 participating centers. Since February 2020 when the first few cases emerged, hospitals have made changes at every level. Contribution by each employee to deal with the dire situation have been tremendous from the doctors, nurses, para medics to the janitors, security, administrative staff every person has had to adapt quickly and

efficiently to the changed working environment.

### 3.1. COVID 19 exposure to HCW (Tables 1,2)

30 out of 33 centers (93%) reported HCW exposure to covid and HCW acquired covid infection. Ten centers reported death of 17 HCW due to covid. Only 12% centers provided sufficient PPEs to HCW and 11% provided training on use of PPEs. Most centers did not provide regular updated information as guidelines to HCW. These factors probably led to high infection rate (10%) among HCW at these centers. We believe that most of these deaths could be prevented by providing sufficient PPEs, training of staff, early detection and aggressive treatment. Another important issue was availability of covid PCR testing for HCW. Only one third hospitals provided this testing for free to HCW. Less than half (42%) patients admitted to Neurology services were screened for covid. This was largely due to availability of PCR kits in hospitals and labs. Only one hospital mandated a negative covid PCR before admission to a Neurology ward. Many patients admitted to neurology wards (not designed for covid patients) with stroke and other diagnosis tested positive for covid after few days. HCW were exposed to these patients leading to high rate of infections. Most of neurology trainees posted at covid wards were not properly trained for PPE use and infection control.

### 3.2. COVID19 care and provision of facilities (Table 3)

Only 10–12% hospitals managed to provide PPE, training of PPE use and updated information related covid pandemic to their staff. These factors lead to high infection rate among HCW.

Ideally, all patients admitted to ER or hospitals should be tested for covid. If testing not available to all patients then these patients should be cared as covid patients. Majority of non covid wards (especially neurology wards) did not follow strict guidelines for PPE in most of surveyed hospitals. At many centers, they had to pay for PCR testing if they were exposed to covid patients. Almost 10% HCW tested positive for covid over four months period. This led to huge mental and psychological stress among HCW. Physical/mental health support services offered from hospital administration for HCW was lacking in majority of hospitals in country, which may have dire consequences in the long term and needs further attention.

Neurology out-patients volumes dropped to almost 25–30%. After few months hospitals adapted to this new reality. About 45% centers started tele neurology services within three months. Out-patients clinics

**Table 1**  
COVID 19 exposure data related to hospitals.

	Total hospitals = 33	Public hospitals; n = 18	Private hospitals; n = 15
Number of hospitals in which HCW died of covid	10(30.3)	9(50)	1(6.7)
Number of hospitals in which HCW required mechanical ventilation of covid	10(30.3)	6(33.3)	4(26.7)
Number of hospitals in which HCW required oxygen or bipap for covid	26(78.8)	15(83.3)	11(73.3)
Number of hospitals in which HCW admitted in hospital for covid	28(84.8)	16(88.9)	12(80)
Number of hospitals in which HCW tested positive of covid PCR	31(93.9)	18(100)	13(86.7)
Number of hospitals in which HCW isolated/ quarantined for covid	28(84.8)	15(83.3)	13(86.7)
Number of hospitals in which HCW exposed directly to covid patients	31(93.9)	16(88.9)	15(100)

**Table 2**  
COVID 19 exposure to health care workers (HCW).

	Total hospitals; HCW = 1300	Public hospitals; HCW = 780	Private hospitals; HCW = 520
HCW died of covid	17(1.3%)	9 (1.1%)	8 (1.5%)
HCW requiring ventilation for covid	23(1.7%)	9 (1.1%)	14(2.6%)
HCW required oxygen or bipap for covid	77(5.9%)	49(6.2%)	28(5.3%)
HCW admitted in hospital for covid	86(6.6%)	46(5.8%)	40(7.6%)
HCW tested positive for covid PCR	129 (10%)	68(8.7%)	61(11.7%)
HCW exposed to covid patients	140 (10.7%)	78(10%)	62(11.7%)

**Table 3**  
COVID 19 care and provision of facilities.

	Total hospitals = 33 HCW = 1300	Public hospitals; n = 18 HCW = 780	Private hospitals; n = 15 HCW = 520
Sufficient PPE provided to HCW by hospitals	158(12%)	88(11%)	70(13%)
Health care staff trained for PPE (mask use, donning and doffing, mask fitting) done	138 (11%)	72(9%)	66(13%)
HCW were frequently updated regarding latest Covid-19 statistics, treatment protocols and prevention measures by hospital	126(10%)	60 (8%)	66(13%)
hospital provided facility of serum Covid antibody testing	19(57%)	6(33%)	13(86%)
serum Covid antibody testing were provided free of cost for hospital health care providers	21(63%)	14(78%)	7(46%)
hospital provided facility of Covid PCR testing through nasal swab	30(91%)	16(89%)	14(93%)
nasal swab Covid PCR testing was provided free of cost for hospital health care providers	11(33%)	4(22%)	7(46%)
hospital provided designated screening area/counter in emergency, OPD, ward and/or ICU to screen patients for Covid-19	24(73%)	11(61%)	13(86%)
neurology tele-health (web based/telephonic) services been started for clinically stable patients	15(45%)	9(50%)	6(40%)
patients admitted to neurology services screened for Covid-19 as per WHO/CDC history and exam algorithm	14(42%)	4(22%)	10(66%)

adopted social distancing, disinfection policies, reduced number of attendants etc. over few months.

**3.3. Changes in neurology training program (Table 4)**

Neurology admissions especially stroke admissions were reduced. Neurology on call rota was changed, neurology teaching sessions were switched to online lectures, webinars etc. Neurology trainees were posted to covid wards in 70% hospitals. On one hand this exposed neurology trainees to covid but on the other hand it was a unique learning experience. Research is an integral part of neurology training but only 30% hospitals managed for research contribution focusing on neurological manifestations and outcome of these patients. Aside from

**Table 4**  
Modifications in neurology training program.

	Total hospital;33	Public hospital; 18	Private hospital; 15
neurology trainees were posted to serve in Covid-19 isolation units (wards/special care/ICU) either inside hospital or outside in field hospitals	23(69.7)	12(66.7)	11(73.3)
daily duty rota been switched to on-call schedule only for residents/ interns to ensure limited exposure to Covid-19 patients	22(66.7)	12(66.7)	10(66.7)
regular teaching sessions and discussion forums for students and neurology trainees been switched to online lectures, webinars and conferences	20(60.6)	10(55.6)	10(66.7)
physical/mental health support services being offered by hospital administration for health care providers	12(36.4)	9(50)	3(20)
ongoing research studies and trials focused on neurological manifestations, complications, outcomes and treatment options of Covid-19 patients in neurology unit	10(30.3)	6(33.3)	4(26.7)

the clinical aspect, the impact of COVID 19 on medical academics is unparalleled. Neurology training was drastically affected due to low admissions, limited ward rounds and limited availability of online training. Only 60% neurology training programs were able to start on-line training sessions for residents and trainees. Education was switched to an online format but not all institutes in the country have sufficient facilities to provide so.

**3.4. Modification of facilities for COVID patients (Table 5)**

Neurophysiological procedures e.g. EEG, EMG/NCS and VEPs being conducted on COVID positive/suspected patients declined in 70% centers. Outpatient procedures in non covid patients also declined due to lockdown and availability of slots in neurophysiology lab. Only one center has allocated separate machines for covid patients. One third centers trained neurophysiology staff for disinfecting testing apparatus. (Table 5) Many labs did not have guidelines and protocols for

**Table 5**  
Modification of facilities for covid patients.

	Total hospital;33	Public hospital;18	Private hospital;15
hospital administration strictly reduced the number of attendants accompanying patients in neurology OPD/ Ward/HDU	24(73%)	11(61%)	13(87%)
neurophysiological procedures e.g. EEG, EMG/NCS and VEPs being conducted on Covid positive/suspected patients	10(30%)	4(22%)	6(40%)
separate EEG and EMG/NCS apparatus been specified for Covid-19 suspected/confirmed patient	1(3%)	1(6%)	0
neurophysiology staff was trained for disinfecting testing apparatus as per international or local hospital based guidelines after use in Covid positive/suspected patients	12(36%)	6(33%)	6(40%)
HCW were trained for proper nasal swab testing for Covid-19	15 (45%)	10 (55%)	5 (33%)

neurophysiology testing of covid patients at start. Neurophysiology staff was not provided sufficient PPE and was not trained for PPE use and infection control at many centers. Many labs were fearful of providing these services to covid patients. This lack of preparedness seriously compromised functioning and finances of Neurophysiology labs throughout country.

#### 4. Discussion

Literature is limited on impact and preparedness of covid 19 in developing countries especially related to neurological care and training. There are only few reports from neurology centers covering preparation and impact at neurology departments from developed countries. A report from Columbia University, USA outlined preparations for covid 19 at Neurology department. (7). our study is first national survey of neurology departments throughout country with good participation from centers. This study highlights deficiencies and lack of preparation across all centers for pandemic. This information may be valuable in preparing for next epidemic in future.

Mortality was very high among health care workers (17 out of 140; 13%) as compared to general population (2%). This is in contrast to many reports that identified higher mortality among non HCWs (social care) as compared to HCWs. It is possible that only symptomatic HCWs were tested for PCR at hospitals as compared to general population with number of asymptomatic subjects.

This observational study also has some limitations. It was participated in by a certain number of facilities providing neurological care in Pakistan. Some HCW may have suffered asymptomatic COVID 19 after exposure and hence the actual numbers with disease may have been more. Rarely, some HCW may not have disclosed information to avoid mandatory quarantine in some designated hospitals. Despite these limitations, our data originated from a large number of HCW that include all provinces of Pakistan covering a large geographical area with a diverse exposure to patients with COVID 19. This data could represent a developing, low middle-income country response to pandemic.

It is possible humankind may face similar or worse pandemics in future. Valuable lessons have been learnt. These lessons should be properly documented for future generations. Our response to pandemic has evolved over last one year and it will continue to evolve over next one to two years until we reach an end of this pandemic. This whole experience has changed dynamics of neurological care and training across globe especially in developing countries. We should rapidly adapt to changes and continue our strive for better neurological care and training in these countries.

#### Appendix: Co- investigators

1. Sara Khan; Aga Khan University, Karachi; site investigator; data acquisition
2. Bashir Soomro; Ziauddin Medical University, Karachi; site investigator; data acquisition
3. Asad Akram Raja; Patel hospital, Karachi site investigator; data acquisition;
4. Nadir Ali syed; South city hospital, Karachi; site investigator; data acquisition
5. Sadia Nishat; Sind institute of urology and transplantation Karachi; site investigator; data acquisition

6. Mighis Sheerani; Sind institute of urology and transplantation Karachi; site investigator; data acquisition
7. Manzoor Lakhair; Liaquat University of Medical sciences, Jamshoro; site investigator; data acquisition
8. Alam Ibrahim Siddiqi; Shaheed Benazir Bhutto Medical university, Larkana; site investigator; data acquisition
9. Mohammad Imran; Shifa hospital, Karachi; site investigator; data acquisition
10. Ehtesham Khalid; Mukhtar hospital, Multan; site investigator; data acquisition
11. Sajjad Naseer; Gujranwalla Medical College, Gujranwalla; site investigator; data acquisition
12. Ahsan Numan; King Edward Medical University, Lahore; site investigator; data acquisition
13. Mohsin Zaheer; Allama iqbal hospital, Lahore; site investigator; data acquisition
14. Amer Ikram; Doctors hospital, Lahore; site investigator; data acquisition
15. Maimoona Siddiqi; Shifa international, Islamabad; site investigator; data acquisition
16. Mohammad Subhan; Kuwait teaching hospital, Peshawar; site investigator; data acquisition
17. Mohammad Farooq; Bolan University of Health Sciences, Quetta; site investigator; data acquisition
18. Saleem Barech; Bolan University of Health Sciences, Quetta; site investigator; data acquisition
19. Wasim Alamgir; Military hospital, Rawalpindi; Mohammad Farooq; Bolan University of Health Sciences, Quetta; site investigator; data acquisition
20. Akhter Sherin; Kohat Medical college, Kohat; site investigator; data acquisition

#### References

- [1] L. Carenzo, E. Costantini, M. Greco, F.L. Barra, V. Rendiniello, M. Mainetti, R. Bui, A. Zanella, G. Grasselli, M. Lagioia, A. Protti, Hospital surge capacity in a tertiary emergency referral Centre during the COVID-19 outbreak in Italy, *Anaesthesia*. 4 (2020 Apr).
- [2] J. Zhao, H. Li, D. Kung, M. Fisher, Y. Shen, R. Liu, Impact of the COVID-19 epidemic on stroke care and potential solutions, *Stroke* 51 (2020 May 20) 1996–2001. [STROKEAHA-120](#).
- [3] The Lancet Null, COVID-19: Protecting health-care workers, *Lancet* 395 (2020) 922.
- [4] A.S. Lord, N. Lombardi, K. Evans, D. Deveaux, E. Douglas, L. Mansfield, E. Zakin, K. Jakubowska-Sadowska, K. Grayson, M. Omari, S. Yaghi, 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, *Clin. Neurol. Neurosurg.* 17 (2020 Aug) 106156.
- [5] L.S. McAlpine, A.S. Zubair, J. Moeller, J. Baehring, S. Spudich, Lessons from a neurology consult service for patients with COVID-19, *Lancet Neurol.* 19 (10) (2020 Oct 1) 806–807.
- [6] A.M. Zha, L.S. Chung, S.S. Song, J.J. Majersik, A.L. Jagolino-Cole, Training in neurology: adoption of resident teleneurology training in the wake of COVID-19: telemedicine crash course, *Neurology*. 95 (9) (2020 Sep 1) 404–407.
- [7] G. Waldman, R. Mayeux, J. Claassen, S. Agarwal, J. Willey, E. Anderson, P. Punzalan, R. Lichtcsien, M. Bell, S. Przedborski, C. Ulane, K. Roberts, O. Williams, A.B. Lassman, L. Lennihan, K.T. Thakur, 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, *Neurology*. 94 (20) (2020 May 19) 886–891.