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Vaccine programme, Siemens Diagnostics Clinical Advisory Board, Siemens Healthineers Clinical Advisory Board, Data Safety Monitoring Committee of the GlaxoSmithKline Study to Evaluate the Safety and Immunogenicity of a Candidate Ebola Vaccine in Children GSK3390107A (ChAd3 EBO-Z) vaccine, during the conduct of the study. TS has a patent test for bacterial meningitis based on a blood test, filed for patent pending (GB 1606537.7). All other authors declare no competing interests. ASW and SK contributed equally.

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- 1 Mao L, Jin H, Wang M, et al. Neurologic manifestations of hospitalized patients with coronavirus disease 2019 in Wuhan, China. *JAMA Neurology* 2020; published online April 12. DOI:10.1001/jamaneuro.2020.1127.
- 2 Helms J, Kremer S, Merdji H, et al. Neurologic features in severe SARS-CoV-2 infection. *N Engl J Med* 2020; published online April 15. DOI:10.1056/NEJMc2008597.
- 3 Wu Y, Xu X, Chen Z, et al. Nervous system involvement after infection with COVID-19 and other coronaviruses. *Brain Behav Immun* 2020; published online March 30. DOI:10.1016/j.bbi.2020.03.031.
- 4 Helmich RC, Bloem BR. The impact of COVID-19 on Parkinson's disease: hidden sorrows and emerging opportunities. *J Parkinsons Dis* 2020; **10**: 351–54.
- 5 COVID-19 Clinical Research Coalition. Global coalition to accelerate COVID-19 clinical research in resource-limited settings. *Lancet* 2020; published online April 2. **395**: 1322–25.

## COVID-19 international neurological registries

The pandemic of coronavirus disease 2019 (COVID-19) due to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has already affected more than 2.7 million people and caused more than 192 000 deaths worldwide. Respiratory symptoms are the most common, and neurogenic breathing failure is suspected to be involved.<sup>1</sup> Symptoms such as anosmia, dysgeusia, headache, and muscle pain have been noted, along with reports of central and peripheral nervous system involvement. Mao and colleagues<sup>2</sup>

reported on 214 patients who were admitted to hospital in Wuhan, China, with acute COVID-19. Symptoms were severe in 59% (mean age 58.7 years) of these patients, and non-severe in 41% (mean age 49.9 years). In total, 78 (36%) of 214 patients had neurological compromise, which was more common in severe (46%) than in non-severe (30%) cases and included stroke, impaired consciousness, myopathy, and neuralgic pain. Viral meningoencephalitis with presence of SARS-CoV-2 in CSF by viral genome sequencing has been reported in patients in China<sup>3</sup> and Japan.<sup>4</sup> In the USA, a woman aged between 50 and 60 years developed COVID-19 and altered mental status. Brain MRI on this patient showed bilateral haemorrhagic rim-enhancing lesions within thalami, medial temporal lobes, and subinsular regions characteristic of acute haemorrhagic necrotising encephalopathy.<sup>5</sup> This condition also, but rarely, occurs in influenza and other encephalitides in association with cytokine storm syndrome.

Amid confronting a severe outbreak of COVID-19, the Spanish Neurological Society (Sociedad Española de Neurología) implemented a registry of neurological manifestations in patients with confirmed COVID-19. We applaud this initiative and propose to expand these efforts globally to define the nervous system involvement in COVID-19. The Environmental Neurology Specialty Group of the World Federation of Neurology (ENSG-WFN) is encouraging neurological societies around the world to develop national or regional neuroepidemiological databanks to report all cases of new-onset, acute, delayed, and any long-latency neurological disorders associated with SARS-CoV-2 infection during the COVID-19 pandemic. Late parkinsonism occurred among survivors of the 1918–20 influenza pandemic. Therefore, neurologists must be prepared for the occurrence of delayed neurological manifestations of COVID-19.

For the Spanish Neurological Society registry see <http://www.sen.es/covid-19>



The worldwide response to the pandemic indicates that neurologists and other physicians, government authorities, and scientists with expertise in public health, epidemiology, infectious diseases, virology, and other relevant fields will be willing to advise and assist their local neurological societies to create databases of neurological manifestations related to COVID-19. These databases will also encourage much needed peer-reviewed publications of the neurological implications of the pandemic. The ENSG-WFN will work to assure that the results of the national and regional registries are collected, posted, and become freely available on the WFN website. This global effort should help develop an understanding of the neurological impact of COVID-19.

The members of the World Federation of Neurology Environmental Neurology Specialty Group and their affiliations are listed in the appendix. All authors are

members of the Environmental Neurology Specialty Group of the World Federation of Neurology and declare no competing interests.

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- 1 Li Y-C, Bai W-Z, Hashikawa T. The neuroinvasive potential of SARS-CoV2 may play a role in the respiratory failure of COVID-19 patients. *J Med Virol* 2020; **92**: 552–55.
- 2 Mao L, Jin H, Wang M, et al. Neurologic manifestations of hospitalized patients with coronavirus disease 2019 in Wuhan, China. *JAMA Neurol* 2020; published online April 10. DOI:10.1001/jamaneurol.2020.1127.
- 3 Wu Y, Xu X, Chen Z, et al. Nervous system involvement after infection with COVID-19 and other coronaviruses. *Brain Behav Immun* 2020; published online March 30. DOI:10.1016/j.bbi.2020.03.031.
- 4 Moriguchi T, Harii N, Goto J, et al. A first case of meningitis/encephalitis associated with SARS-Coronavirus-2. *Int J Infect Dis* 2020; **94**: 55–58.
- 5 Poyiadji N, Shahin G, Noujaim D, Stone M, Patel S, Griffith B. COVID-19-associated acute hemorrhagic necrotizing encephalopathy: CT and MRI features. *Radiology* 2020; published online March 31. DOI:10.1148/radiol.2020201187.

For the **World Federation of Neurology website** see <https://wfneurology.org>

See [Online](#) for appendix