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COVID-19

BY BRAIN SCIENTIFIC



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Abstract

Novel Coronavirus Disease (COVID-19) has proven to be an aggressive and lethal virus. The progress of the disease has stunned doctors and epidemiologists across the nation, and the world. Medicine's understanding of the virus and its working mechanisms are unfolding daily. Recent studies indicate that COVID-19 may enter the brain (in addition to establishing itself in the upper and lower respiratory tracts) and can penetrate the blood-brain barrier to attack the neurons controlling multiple body functions including breathing, speech, and certain motor controls. Other SARS related viruses have demonstrated this ability and while initially unsuspected, COVID-19 may not be unique in this aspect. This may provide an explanation of the rapid deterioration and mortality witnessed among patients in our nation's treatment centers.

New research indicates that over one-third of COVID-19 patients presented neurological symptoms during hospitalization in China. Examination by electroencephalogram would be a standard and expected response both in China and here in the United States, further taxing hospital resources and staff and increasing the numbers of medical professionals subject to exposure. New technologies are available that significantly reduce the time required to set up EEG equipment, support remote diagnosis by neurologists and critically, do not require the deployment of certified EEG technicians to perform the examination within the Emergency Department.

Brain Scientific is a commercial-stage healthcare company with two FDA-cleared products, providing next-gen solutions to the neurology market. Our mission is to modernize the brain diagnostic market by employing cutting edge technologies to bridge the widening gap in access to neurological care. We present an advanced solution to provide electroencephalogram (EEG) examinations while reducing the opportunity of cross-contamination between patients and between patients and medical staff, support off-site neurology review and data collection, presentation, and analysis via the Internet of Things in the effort to combat COVID – 19.

Coronavirus and the Brain

First detected on November 17, 2019, in Wuhan, China, according to press accounts of unreleased Chinese government data¹. Novel Coronavirus presented itself as a SARS-like respiratory virus and early investigations indicated that the virus may have originated at a Wuhan animal/fish market. The Chinese government would not acknowledge human-to-

¹ www.livescience.com/first-case-coronavirus-found.html



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human transmission until January 21, 2020, when evidence of transmission was presented without any link to the market in *The Lancet*². Scientists speculate that the virus may have originated with bats.

Viewed initially as a particularly virulent and often deadly respiratory disease with high fevers and very rapid progress, our medical understanding of COVID-19 has been greatly expanded with the publication of a Chinese study documenting the neurological impacts of the disease on 214 patients under treatment at three Wuhan hospitals. 36.4% of the patients presented neurological manifestations including acute cerebrovascular diseases, impaired consciousness, headache, dizziness.

While research is scant, doctors at the Henry Ford Health System (Detroit, Michigan) have reported the first documented case of brain damage directly linked to COVID-19. “The pattern of involvement, and the way that it rapidly progressed over days, is consistent with viral inflammation of the brain,” Dr. Elissa Fory, a neurologist with Henry Ford Health System, said through an email. “This may indicate the virus can invade the brain directly in rare circumstances.” The patient is in critical condition³.

Information on COVID-19 and its impact on the brain is only just coming to light. Within the last few days, new reports have emerged indicating that viral infection of the brain may not be such “rare circumstances”. Multiple viruses enter the brain through the nasal passages including influenza A, West Nile, and herpes. Closely related viruses including SARS, MERS, and SARS-COV (COVID-19 is also known as SARS-CoV2) have been discovered in the brains of deceased patients during autopsies. SARS and COVID-19 both attack the same receptor in the brain, causing respiratory difficulties, high fever, and pneumonia⁴.

The impact of COVID-19 on the brain is becoming clarified on a daily basis. In response to the new evidence, the University of Brescia (Italy) has opened a NeuroCovid unit to care for patients exhibiting neurological damage from the disease⁵.

At present, reporting difficulties and inconstant cooperation make it impossible to determine either the total number of Americans hospitalized with COVID-19 or the numbers

² [www.thelancet.com/journals/lancet/article/PIIS0140-6736\(20\)30183-5/fulltext](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30183-5/fulltext)

³ COVID-19–associated Acute Hemorrhagic Necrotizing Encephalopathy: CT and MRI Features Neo Poyiadji, Gassan Shahin, Daniel Noujaim, Michael Stone, Suresh Patel, and Brent Griffith *Radiology* 0 0:0

⁴ www.psychologytoday.com/us/blog/the-new-brain/202004/neurological-implications-covid-19-raise-concerns

⁵ www.nytimes.com/2020/04/01/health/coronavirus-stroke-seizures-confusion.html

occupying ICU beds nationwide. Snapshot views from states with consistent reporting are available and it may be possible to develop tenuous estimates from there. The COVID Tracking Project⁶ undertaken by The Atlantic (the publication) in an attempt to provide current data on the progress of the Coronavirus in that absence of national data. While the reporting from each state is inconsistent (data on current and cumulative ICU admissions are often missing, it may be possible to gain a partial state-by-state understanding of the epidemic. Examples are provided here and are current as of April 16, 2020, 3:30 PM (EST):

- New York has 18,697 hospitalized COVID-19 patients with 5,225 currently in their ICUs
- New Jersey has 8,270 hospitalized with 1,705 in ICU beds
- California has 5,065 in hospital and 1,543 in ICU
- Massachusetts has 3,454 currently in hospitals and 973 in their ICU
- Michigan has 3,918 in hospital and 1,468 in ICU beds.

Many other states are reporting their data, but that is off-subject. This is an admittedly partial image but taken together, these states have 10,914 patients in their ICU beds — today. Should the neurological symptoms reported in China hold true (36.4%), these current patients may require some 3,929 electroencephalograms.

Current Technology

The Electroencephalogram (EEG) is a tried and true technology. Its use in light of the COVID-19 epidemic presents ICU staffs with a series of challenges in the delivery of treatment:

- A technician measures and marks the patient's skull, marking the locations for sensor placement with a special pencil and may scrub the locations with a granular cream to enhance the data recording.
- Conventional EEGs tests require the individual placement of multiple sensors over prescribed locations on the patient's skull.
- The sensors are placed employing an adhesive or a cap with the sensors already fitted is placed on the patient
- The technician then connects the sensors by wire to a signal amplifier for recording

Depending on the test being run, this process can take between 30 and 45 minutes per patient. A trained technician is required to perform these tasks. The emerging neurological

⁶ <https://covidtracking.com/data>



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realities of COVID-19 and the number of patients in our nation's ICU every day, it is apparent that in many hospitals and treatment centers, the administration of required EEG testing will consume full shifts within an intensive care staff that is already strained to the breaking point.

EEG sensors, wires and the machine itself can be sources of contamination and can transfer COVID-19 from one patient to the next without full sterilization. The sensors themselves can and do break down with repeated cleaning. Contamination is a grim reality for EEG technicians. For those who may not be familiar with the procedure, technicians work within 8 inches of patients for up to 45 minutes each as they apply the sensors. Doctors now believe that COVID-19 is transmissible by speech or even breathing. These technicians don't have better or more personal protective equipment than any other staff member. The risk of exposure cannot be overstated.

Hospitals have increased their Intensive Care Unit capacity as thoroughly and quickly as possible. Media accounts present doctors and nurses working in Intensive Care Units that may have accommodated 8-10 patients that now house 25 or more people suffering from the Coronavirus. They are crowded places. As the neurological impacts of COVID-19 materialize in ICUs nationwide, additional machines and technicians will work in those spaces and risk additional exposure.

A Novel Solution for Novel Coronavirus

Brain Scientific's NeuroCap™ is an FDA cleared disposable EEG headset with 22 electrodes and 19 active EEG channels. Its one-use life span minimizes cross-contamination and optimizes sanitary practice. Critically, it is available now in the battle against COVID-19.

- NeuroCap™ is a pre-gelled EEG headset. Its electrodes are embedded and fixed into position following the international 10–20 system;
- Unlike its conventional counterpart, NeuroCap can be applied in 5 minutes and can be administered by any member of the clinical staff. Nurses and aides of all grades, physician's assistants and medical assistants, and other caregivers who are already in the ICU can do this. It does not require an accredited technician and exposure is reduced;
- NeuroCap™ is fully compatible with existing amplifiers.

NeuroEEG™ is Brain Scientific's wireless (Bluetooth connectivity), portable amplifier system powered by proprietary software. The unit is light-weight, and literally fits in the palm



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of a hand and is wearable by the patient for mobile, longer duration testing. NeuroEEG features multiple montage scheme configurations, an Artifact selection mode, QEEG Analysis including power spectrum, 3-D topographic mapping, and correlative analysis, Rhythm – amplitude and indexes calculation, and a Quick-View of long recordings with an auto mark of pathological segments. Like NeuroCap, the unit is FDA cleared. The unit's lithium battery provides a full 8 hours of life.

The Coronavirus has focused our attention primarily on urban hospitals and their ICUs. The pandemic has already spread to more rural environments and as that continues, treatment will take place in an expanding array of other facilities. NeuroCap™ can be employed in urgent care facilities, nursing homes and assisted living centers, and can support remote research studies. We note that across rural America, 25% of all primary medical care is delivered by Nurse Practitioners. Rural medical treatment facilities have been under continuing financial pressure. Many have closed or have been reduced to provide minimum services.

COVID-19 cases are now materializing in rural health centers throughout the United States. Infections of the brain will be present among these patients. Providing EEG assessments is beyond the reach of Urgent Care facilities and Nurse Practitioners are and will never be expected to provide such services. As with other specialist, Neurologists are in short supply. Employing NeuroCap's™ IoT technology will support remote assessment and a handful of neurologists will be able to provide diagnostics to entire counties and do so within our secure environment.

Summary

Civilian and military medicine are joined in the need for knowledge-based decision making. The environments and causes change. The requirement for accurate and timely data does not. Brain Scientific provides an advanced cost-effective solution in the battle against COVID-19 with a technology that cuts time and greatly reduced the chance of cross-contamination. We reduce exposure and support off-sight diagnostics while expanding the knowledge base on Coronavirus and its mechanisms of lethality.