The rapid spread of the COVID-19 pandemic has resulted in prompt, comprehensive action across the Sutter Health Network. For the Neuroscience Service Line, our goal of providing integrated care across geographies and patient populations remains unchanged. While neuroscience clinicians may play more of a supportive role to our pulmonary and cardiac colleagues in many cases, there are both general and more specific neurologic guidelines that can help drive thoughtful decision-making. Additionally, more data has emerged demonstrating that COVID-19+ patients may present with neurologic symptoms early, or even in the absence of typical fever/respiratory distress. This makes close communication with our colleagues even more important. Some recommendations may require modification based on local circumstances. Actions must be taken based on up-to-date information and the frequently changing recommendations from the Centers of Disease Control and Prevention (CDC) and governmental agencies. This document will be updated accordingly.

**Need-to-know Neurologic-specific COVID-19 Information:**

Neurologic conditions, such as multiple sclerosis (MS), Parkinson's disease, Alzheimer's disease, amyotrophic lateral sclerosis (ALS), and myasthenia gravis, should be considered when determining which patients are high risk for severe illness due to COVID-19.

Viral infection of the central nervous system was reported with other coronaviruses such as SARS (severe acute respiratory syndrome) and MERS (Middle East respiratory syndrome), and may be possible with COVID-19. Neurologic symptoms have been reported with COVID-19 such as headache, altered consciousness, seizures and weakness (see complete list below). Reports are mounting of anosmia (and dysgeusia, likely secondary to anosmia) as an initial symptom of COVID-19. There have been suggestions of possible viral meningitis and encephalitis due to COVID-19, and there are some reports indicating a possible association between COVID-19 and stroke. The severe respiratory failure associated with COVID-19 has been theorized as possibly being due to brainstem involvement of the virus. The neurologic effects of COVID-19 virus are not fully understood, but it is important to remain aware of these possible neurological implications.

Neurologic symptoms/syndromes possibly associated with COVID-19:

- Altered mental status
- Anosmia
- Ataxia
- Cognitive impairment (dysexecutive)
- Dizziness
- Dysgeusia
- Encephalitis
- Guillain-Barre syndrome
- Headache
- Intracranial hemorrhage
- Myalgia
- Myositis
- Neck ache
- Numbness
Ophthalmoparesis
Polyneuritis Cranialis
Meningitis
Miller-Fisher syndrome
Seizure
Stroke (ischemic)
Weakness

COVID-19 Presenting with Neurologic Symptoms: The latest information of concern is that these neurologic symptoms may precede other typical symptoms of COVID-19, so COVID-19 should be considered with any patient presenting with new, unexplained neurologic symptoms. Furthermore, neurologic symptoms have been associated with more severe courses of COVID-19.

Alert Regarding COVID-19 Encephalitis: All providers should be aware that there have been more reports of COVID-19 presenting with altered mental status. A case of COVID-19 acute hemorrhagic necrotizing encephalopathy was published in *Radiology* (see images below). Please include COVID-19 encephalitis as a possible diagnosis when assessing patients presenting with confusion or acute cognitive-behavioral changes. Ensure proper safety precautions and PPE when examining or performing procedures (such as lumbar puncture) on patients under investigation.

Update Regarding COVID-19-Related Strokes: In a single center study of 221 patients with COVID-19, 11 developed acute ischemic stroke, 1 cerebral venous sinus thrombosis and 1 cerebral hemorrhage. COVID-19 patients with new onset of stroke were significantly older, more likely to have cardiovascular risk factors (especially hypertension) and more likely to present with severe COVID-19. Also noteworthy, they were more likely to have an increased inflammatory response as reflected by an elevated C-reaction protein and a hypercoagulable state as reflected by an elevated D-dimer.
Recommendations for Re-escalation of Neuroscience Care at Sutter Health:

As our system returns, when triaging patients for surgeries, procedures, studies and in-office visit we recommend considering the following parameters:

Prioritization of neurological surgeries, procedures and neurodiagnostic studies:

- **Priority 1**: Emergency/urgent. Surgery, intervention or study must be undertaken immediately.
- **Priority 2**: Medically necessary, time-sensitive. Extended delay would result in higher risk of neurological disability, impairment of function, intractable pain or death.
- **Priority 3**: Procedure/study is needed but is not time-sensitive or alternative non-interventional treatment is available. Low risk of harm if postponed. Study is unlikely to change clinical management.

Assess risk of COVID complications to patients:

- **Higher risk**: age over 65, immunocompromised, cancer, pulmonary disease, cardiovascular disease, hypertension, obstructive sleep apnea, neurologic disease (multiple sclerosis, Parkinson's disease, dementia, amyotrophic lateral sclerosis and myasthenia gravis), COVID-19 + or COVID-19 symptoms/exposure.
- **Medium risk**: age 40-64; mild/well controlled chronic medical problems; mild/well controlled neurologic condition, possible COVID-19 exposure.
- **Low risk**: age under 40, healthy; COVID-19 negative.

Assess risk of COVID-19 exposure to patient and treatment team:

- **Higher risk**: prolonged procedure/study time (>3 hours) and long length of stay (>3 days) or ICU stay
- **Medium risk**: medium procedure/study time and short length of stay
- **Low risk**: short procedure/study and no need for hospitalization

Recommendations for Inpatient Clinical Teams:

- Decrease potential exposure by using appropriate PPE or other staffing measures, as appropriate for each inpatient service. Appropriately clean instruments (e.g., reflex hammers and stethoscopes) between patients.
- Scheduling of neurosurgical or neurointerventional procedures, and other non-essential procedures or diagnostics (e.g., EEG) should follow guidelines as outlined by SHEMS/other local facility guidelines.
- In the case of a surge, avoid unnecessary ICU admissions to conserve material and human resources needed for COVID-19 patients. Expedite transfer to step-down or floor status. Partner with non-ICU units to monitor non-ventilated patients, for example neuro checks in mild-moderate stroke patients post tPA. Review protocols so that neuro checks are requested no more frequently than is essential for good care. Review systemwide protocols and order sets for possible revision in the setting of COVID-19 surge, if this occurs.
- Develop system wide back up plans for best deployment of clinical expertise in the event physicians are unable to work because of illness or quarantine.
- Utilize the expertise of team members who may be working from home, for example stroke coordinators working on protocol revisions.

**Acute Neurologic Symptoms with COVID-19:**
- For all patients presenting with unexplained new neurologic symptoms, assume a patient may be COVID-19+ until appropriate screening is completed and use appropriate PPE and precautions per the inpatient guidelines above.

**Acute Stroke with COVID-19:**
- Please refer to Stroke Operating Committee Guidelines
- For acute ischemic stroke with COVID-19 with high D-dimer, consider anticoagulation.
- For control of hypertension or other cardiovascular conditions in COVID-19 patients, consider continuing ACE inhibitors and ARBs if the patient is already taking these medications per most recent guidelines, until further data are available. Consider discussing with cardiology colleagues if required for cardiac reasons.
- In the evaluation of stroke patients who lack the typical stroke risk factors, COVID-19 should be considered.

**Update for Cranial Surgery and Spine Surgery**
- During the initial phase of the COVID-19 pandemic, Sutter Health facilities limited procedures to those that were emergent or urgent - where a delay could result in a compromised long-term outcome for the patient. We are taking a phased, safety-first approach to gradually broader clinical service, recognizing that there is a need to safely resume care for patients who have conditions that are Medically Necessary and Time Sensitive (MeNTS). Protocols are in development on a system wide basis utilizing pre-op testing and best PPE practices. This will allow re-escalation in a manner that provides best surgical care safely for patients and staff while also stewarding resources. Specific scheduling procedures will vary between affiliates. Should there be questions about a specific case, please contact the local medical director or the area medical director for review.

**Recommendations for Outpatient Clinical Teams:**
- Triage patients for in-office versus telemedicine based on risks related to COVID-19 (see above)
- Utilize telemedicine when appropriate (see above) and virtual meetings, both between clinicians/patients and between clinicians/staff.
- Assess risks related to COVID-19 versus benefits when scheduling elective out-patient procedures including NIR, interventional pain, EMG studies, botox injections, sleep studies, EEG, Lumbar Puncture (e.g. for NPH).
- Limit non-urgent outpatient diagnostic studies to those necessary for clinical decision making
- Postpone research visits or perform via telemedicine/phone.
- Limit neurologic exam, appropriately clean instruments (e.g. reflex hammers and stethoscopes) between patients.
- Use appropriate PPE, wash hands for 20 seconds between each patient encounter.

**Acute Neurologic Symptoms with COVID-19:**
- For all patients presenting with unexplained new neurologic symptoms, consider a patient may be COVID-19+ until appropriate screening is completed. Consider using video visits when appropriate. Recommend COVID-19 screening/testing prior to in-office consultation. Use appropriate PPE and precautions per the outpatient guidelines above.

**Re-escalation of Neurology/Neurosurgical Office Visits:**

Recommend continued video visits for high-risk patients (see above). Recommend considering in-office visits for patients with neurological symptoms requiring urgent attention. Recommend considering in-office visits for patients requiring a complete neurological exam which cannot be performed via video (e.g., fundoscopic examination and assessment of pupillary abnormalities, subtle motor deficits, tone abnormalities, sensory deficits or abnormal reflexes).

**Recommendations for Patients:**
- High-risk patients should remain home if possible.
- Those who are high risk; seek help from family, neighbors, friends, to obtain needed items from outside the home (groceries, medications, etc.).
- Continue disease-modifying therapies (e.g., MS medications) unless instructed otherwise by the patient’s treating neurologist.
- Seek emergency care by calling 911 if they are experiencing a stroke or other acute disabling and/or life threatening neurological emergency.
- Encourage patients and families to have contingency plans in the event of care givers being sick or quarantined.
- Encourage continued “virtual” family contact for patients in isolation (e.g., inpatients, SNF/nursing home patients), such as FaceTime with family.
- Promote good mental health; see practical tips to reduce anxiety.

**Recommended Resources:**

https://svn.bmj.com/content/early/2020/04/01/svn-2020-000382
https://pubs.rsna.org/doi/10.1148/radiol.2020201187
https://www.entuk.org/sites/default/files/files/Loss%20of%20sense%20of%20smell%20as%20marker%20of%20COVID.pdf
https://www.sutterhealth.org/newsroom/practical-tips-to-reduce-anxiety-during-uncertain-times
https://n.neurology.org/content/neurology/early/2020/04/24/WNL.0000000000009673.full.pdf

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