Telemedicine for Outpatient Neurosurgical Oncology Care: Lessons Learned for the Future During the COVID-19 Pandemic.

LC Daggubati
DG Eichberg
ME Ivan
S Hanft
A Mansouri

See next page for additional authors

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Authors
LC Daggubati, DG Eichberg, ME Ivan, S Hanft, A Mansouri, RJ Komotar, RS D'Amico, and BE Zacharia
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.

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BACKGROUND: The coronavirus 2019 (COVID-19) pandemic has drastically disrupted the delivery of neurosurgical care, especially for the already at-risk neuro-oncology population. The sudden change to clinic visits has rapidly spurred the implementation of telemedicine. A recommendation care paradigm of neuro-oncologic patients limited by telemedicine has not been reported.

METHODS: A summary of a multi-institution experience detailing the potential benefits, pitfalls, and the necessary considerations to outpatient care of neurosurgical oncology patients.

RESULTS: There are limitations and advantages to incorporating telemedicine into the outpatient care of neuro-oncology patients. Telemedicine-specific considerations for each step and stakeholder of the appointment (physician, patient, scheduling, previsit, imaging, and physical examination) are examined.

CONCLUSIONS: Telemedicine, pushed to prominence during this COVID-19 pandemic, is a powerful and possibly preferential tool for the future of outpatient neuro-oncologic care.

INTRODUCTION
The emergence of the novel coronavirus disease 2019 (COVID-19) has drastically impacted the delivery of medical care worldwide. Its long incubation period, high transmission rate, and estimated 3% mortality has quickly made it a global pandemic. As physical distancing measures take hold and medical resources are directed toward COVID-19, the traditional patient—physician visit has been revisited with the rapid acceleration of telemedicine.

TELEMEDICINE DURING THE COVID-19 PANDEMIC
An emerging technology for more than 25 years, telemedicine uses electronic and digital platforms to exchange medical information for improved consumer health. Widespread use had been restricted, in part, by limitations in reimbursement, which curtailed the adoption for clinic visits. The abrupt disruption of in-person medical care by COVID-19, however, has forced the Centers for Medicare & Medicaid Services to provide an emergency waiver for telemedicine as billable consultations. Codes 99201–99215 for outpatient telemedicine visits were approved into Medicare within days of the federal state of emergency announcement. In addition to established patients, the waiver allows for new patient consultations to be billed with these codes. Historically resistant, but currently mobilized by the COVID-19 pandemic, some of the largest health insurance providers (Aetna, Cigna, and Humana) have announced telehealth

Key words
- Brain tumor
- Coronavirus
- COVID-19
- Neuro-oncology
- Telehealth
- Telemedicine

Abbreviations and Acronyms
COVID-19: Coronavirus disease 2019
EHR: Electronic health record

From the 1Department of Neurosurgery, The Pennsylvania State University, College of Medicine, Hershey, Pennsylvania; 2Department of Neurosurgery, University of Miami, Miami, Florida; 3Sylvester Comprehensive Cancer Center, Miami, Florida; 4Department of Neurosurgery, Rutgers—Robert Wood Johnson Medical School, New Brunswick, New Jersey; 5Penn State Cancer Institute, Hershey, Pennsylvania; and 6Department of Neurosurgery, Lenox Hill Hospital/Northwell Health, New York, New York, USA

To whom correspondence should be addressed: Brad E. Zacharia, M.D., M.S.
[E-mail: bzacharia@pennstatehealth.psu.edu]

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reimbursement to parallel the evolving Centers for Medicare & Medicaid Services reimbursement structure. The reimbursement structure of private insurance still vary on a state level, and local guidelines should be reviewed by practitioners. Before this, neurosurgical use of telemedicine has been limited, albeit extremely successfully, to telestroke programs. Its use in neurosurgical oncology has been limited to institutional collaborations, rehabilitation, and psychological support. This knowledge gap poses a challenge to optimal delivery of outpatient care, particularly in the current pandemic. Given our institutions’ early adoption of telemedicine, we summarize the necessary capabilities and recommendations for the incorporation of telemedicine in outpatient surgical neuro-oncology sparked by the COVID-19 pandemic, with the expectation that this technology continues to be optimized and used beyond this period.

PATIENT-SPECIFIC ADVANTAGES OF TELEMEDICINE IN NEUROSURGICAL ONCOLOGY

The current recommendations for neuro-oncology during the COVID-19 pandemic have focused on disease prioritization, inpatient management, and health care worker protection. Consensus regarding optimal evaluation of new patients and established follow-up has yet to be reached. In these rapidly changing times, approaches have included limiting visits to urgent patients only, incorporating telemedicine, and complete cancelation of outpatient neurosurgery clinics. With limited previous experience, lessons learned in telemedicine practices adopted during this pandemic will dictate protocols for neuro-oncology in the future.

Especially critical during the COVID-19 pandemic, telemedicine visits reduce external exposure of these immunocompromised patients, family, care partners, and staff. For individuals with a neuro-oncologic diagnosis, challenges before the pandemic have included neurologic impairments—often requiring accompanyment by care partners—and long-distance travel for tertiary neurosurgical oncology care. Thus, the availability of telemedicine capabilities presents a clear advantage for these individuals, as it facilitates complete consultations and follow-up visits from the comfort of their homes. Although legislation does not currently allow multiple subspecialty practitioners to bill simultaneously for a visit, patient care teams of various subspecialties may be consolidated into consecutive appointments to optimize patient-centered care. This reduces total time dedicated to the appointments as well as unnecessary wait times, which are frequently quoted as the worst components of a clinic visit. In addition, telemedicine can decrease reliance on care partners. Current in-person appointments can present a unique cost to the patient and family though care partner loss of productivity during the appointment and external transport services. Moreover, telemedicine offers unparalleled flexibility; care partners can be either at the patient’s side or physically distant and easily be conferenced via voice or video into the visit.

LIMITATIONS OF TELEMEDICINE IN NEUROSURGICAL ONCOLOGY

Despite the clear advantages of telemedicine, concerns remain regarding adverse effects to patient privacy, physician—patient relationship, and completion of a thorough physical and neurologic examination. Telemedicine is an obstacle for those with limited access to telemedicine platforms and experience with Internet-based technologies. The proliferation of smartphone ownership, improved broadband coverage, and a technologically adapt population has broken down the traditional barriers to telemedicine. In the long run, the benefits of providing telemedicine services to neuro-oncology patients likely outweigh these limitations, but studying the effects on patient outcome and patient—provider satisfaction will be paramount. We encourage a thoughtful approach to the continuous evaluation of telemedicine in the neuro-oncology patient to ensure optimal patient care.

TELEMEDICINE PLATFORMS

Synchronous platforms allow for the patient and the neurosurgery team (physician, advanced practice clinician, nurse, resident, and/or fellow) to connect at the same time, whereas asynchronous platforms afford distant electronic communication and monitoring at different times. Asynchronous forms of telemedicine, including e-mail and secure messaging, have been increasingly used, but the rapid expansion of video conferencing capabilities and smartphones have paved the way for synchronous forms of telemedicine. The current platforms available range from simple telephone voice conferences to more immersive video conferencing. Although billing waivers allow for voice-only telephone visits, the inability to perform a neurologic examination and lack of direct patient—provider visualization is limiting. We feel these should be reserved for the most routine follow-up visits when alternative means are not feasible. Video conferencing affords improved communication, the ability to perform a reasonable neurologic examination, sharing of imaging directly with the patient, and likely leads to a better rapport and patient satisfaction.

We foresee a rapid rise of platforms as telemedicine becomes an established option. There are important criteria that each system must fulfill before enabling safe medical alternatives. Although relaxed regulations during the current COVID-19 pandemic allow non-Health Insurance Portability and Accountability Act—compliant interfaces (i.e., Facetime), we strongly recommend the transitioning to a Health Insurance Portability and Accountability Act—compliant platform (i.e., OhMed, Doxy.me, American Well, Mend, VSee) for the continued use of telemedicine following the COVID-19 crisis. Useful additional features offered include E-prescribing capabilities, billing capabilities, integration with internal electronic health records (EHRs), and digital patient intake. Blood work, medications, and imaging orders will remain similar to in-person visits; they will be ordered electronically via the EHR and communicated directly to the patient.

Vital to neuro-oncologic disease evaluation, neuroimaging needs to be available for comprehensive care. Current standard practice is in-system imaging before a clinic visit. Although varied by region, the COVID-19 pandemic has likely decreased overall neurosurgical oncology visits and has limited access to timely imaging. Patient triage is being performed on a case-by-case basis, and those requiring urgent imaging evaluation have not been delayed. Noncritical, benign surveillance imaging, however, has been rescheduled for patient safety and optimization of resource use. Patients also may obtain imaging at centers closer and more...
convenient to their homes and transfer the images to their physician before the appointment. This is most often completed via mail, but cloud-based secure imaging systems are becoming more commonplace. In addition, incorporation of imaging onto a shared screen during the appointment, offered by many platforms, improves patient satisfaction and understanding of the pathology and plan.

**BEST PRACTICES: RECOMMENDATIONS FROM THE COVID-19 PANDEMIC**

The following best practices discussed in this section are also shown in Table 1.

**Scheduling**

New consultations and transitioning patients to telemedicine visits should be contacted by office staff to confirm willingness to participate in a virtual visit and that the patient’s software and hardware meet the necessary requirements for the proposed platform. Patients are notified that these visits are billable to insurance and they will incur a co-pay similar to an in-person visit. Patients who are unable to complete a video-based visit and require wound evaluation should be instructed to provide digital pictures, if possible. Patients with concerning neurologic or imaging findings should be referred to the medical staff for an additional screening. Those with urgent clinical or imaging findings (hydrocephalus, hemorrhagic lesions causing significant acute mass effect, signs of decreased arousal or concern for airway protection) should be directed for urgent evaluation. Thus, telemedicine encounters should be thoroughly screened for patients who can be managed remotely.

**Previsit Preparation**

Before the appointment, all backend administrative procedures should be completed by the appropriate office staff. All patient imaging and documentation should be available and reviewed by the physician. Selecting cloud-based imaging and intake platforms that readily integrate with native EHRs and hospital technologies would enable the most optimal workflow. These steps are aimed at preventing unnecessary technical delays and affording appropriate time during the televisit.

**Provider/Patient Setting**

The role of the provider is to offer a professional, safe, and private environment to discuss potentially serious and life-altering pathology. The provider should select a well-lit and clean office for the appointment with minimal external noise or distractions.

In turn, the patient should do likewise in terms of lighting and noise. The patient also can plan space for actions that would replace a traditional physical examination. Care partners and/or family also should be available if needed/wanted to streamline the appointment. If the patient has underlying neurologic issues that limit their understanding or ability for self-care, a care partner is necessary during the visit. Translators from home, or traditional translator services, can be incorporated as necessary. These instructions can be provided to the patient during scheduling.

**Physical Examination**

A potential weakness of telemedicine is the neurologic examination. The provider is limited to observable actions such as coordination, gait, tremor, and gross elicitable actions. Several studies, however, have validated the neurologic examination in telemedicine. The National Institutes of Health Stroke Scale is a standardized and replicable neurologic examination (Table 2) and satisfies many of the relevant neurologic examinations for a neuro-oncology patient. For skull-base tumors, a more elicitable cranial nerve examination is recommended. Anisocoria can be seen with a close-up of the patient’s eyes, whereas reaction could be crudely examined via the care partner’s assistance with a flashlight, but a detailed pupillary evaluation is limited. If critical for decision-making, the patient should be requested to have an in-person visit. For preoperative patients, a thorough examination should be documented before surgery on the day of surgery. For spinal oncology patients, a more thorough examination may necessitate an in-person evaluation or assistance from a caregiver/family member. When limited to portions of the National Institutes of Health Stroke Scale or observable tasks, telemedicine can provide the basic elements of a neurologic examination.

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**Table 1. Checklist for Optimized Outpatient Neuro-Oncology Telemedicine Visits**

| Previsit                                                                 |                                                                 | Setting                                                                 |                                                                 |
|------------------------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------------|
| Previsit forms, imaging, and outside medical records are available for review | Review imaging for high-risk, unstable patients                 | Use telephone appointments as a last resort                             |                                                                 |
| Review imaging for high-risk, unstable patients                        | Use telephone appointments as a last resort                     | Use telephone appointments as a last resort                             |                                                                 |
| Use telephone appointments as a last resort                            | Use telephone appointments as a last resort                     | Use telephone appointments as a last resort                             |                                                                 |
| Provider/Patient Setting                                               | Previsit Preparation                                            | Previsit Preparation                                                   | Previsit Preparation                                            |
| Provider                                                               | Patient                                                         | Setting                                                                | Setting                                                         |
| Professional, clean, and well-lit office                               | Well-lit and large setting                                      | Professional, clean, and well-lit office                               | Well-lit and large setting                                      |
| No background noises                                                   | No background noises                                             | No background noises                                                   | No background noises                                             |
| Secure setting                                                         | If needed, care partner or family present                       | Secure setting                                                         | Secure setting                                                   |
| Physical examination and imaging (Table 2)                             | Physical examination and imaging (Table 2)                      | Physical examination and imaging (Table 2)                             | Physical examination and imaging (Table 2)                      |
| Pay attention to red flags (decreased arousal, unsecure airway, significant/ disproportionate mass effect, and hydrocephalus) | Pay attention to red flags (decreased arousal, unsecure airway, significant/ disproportionate mass effect, and hydrocephalus) | Pay attention to red flags (decreased arousal, unsecure airway, significant/ disproportionate mass effect, and hydrocephalus) | Pay attention to red flags (decreased arousal, unsecure airway, significant/ disproportionate mass effect, and hydrocephalus) |
| Visit                                                                  | Visit                                                           | Visit                                                                  | Visit                                                           |
| Confirm patient consent for telemedicine visit                         | Visit                                                           | Confirm patient consent for telemedicine visit                         | Visit                                                           |
| Build rapport                                                          | Build rapport                                                   | Build rapport                                                          | Build rapport                                                   |
| Focused clinical history                                               | Focused clinical history                                         | Focused clinical history                                               | Focused clinical history                                         |
| Focused physical examination                                           | Focused physical examination                                    | Focused physical examination                                           | Focused physical examination                                    |
| Imaging review with patient                                            | Imaging review with patient                                     | Imaging review with patient                                            | Imaging review with patient                                     |
| Plan of care/surgery                                                   | Plan of care/surgery                                            | Plan of care/surgery                                                   | Plan of care/surgery                                            |
| Documentation and billing                                              | Documentation and billing                                       | Documentation and billing                                              | Documentation and billing                                       |
| Limitations                                                            | Limitations                                                     | Limitations                                                            | Limitations                                                     |
| Detailed physical examination                                          | Limitations                                                     | Detailed physical examination                                          | Limitations                                                     |
| Lack of telemedicine accessibility                                     | Limitations                                                     | Lack of telemedicine accessibility                                     | Limitations                                                     |
| Patient preference                                                     | Limitations                                                     | Patient preference                                                     | Limitations                                                     |
Ultimately, provider discretion is required to determine when a more detailed face-to-face examination is warranted.

**Documentation and Billing**

Telehealth visits require the physician document patient consent to the virtual appointment and billing, date of the visit, the location of the provider and the patient, and the amount of time spent face-to-face. Currently, codes 99201–99205 allow for new outpatient visits, whereas 99211–99215 apply for established patients. Telehealth visits require the physician document patient consent for the virtual appointment and billing.

**Table 2. Neurologic Examination Components Assessable During Telemedicine Visit**

| Mentation       | Extremities                                  |
|-----------------|---------------------------------------------|
| Level of consciousness | Gross strength (antigravity/drift)         |
| Memory assessment | Sensation (with care partner/family)        |
| Ability to follow tasks | Muscle bulk *                              |
| Face examination | Tremor*                                     |
| Extracranial movements | Gait*                                      |
| Visual fields and anisocoria (with care partner/family) |                                         |
| Facial palsy    | Coordination                                |
| Hearing (with care partner/family or phone) | Dysdiadochokinesia *                      |
| Shoulder shrug  | Heel-to-knee or finger-to-nose (with care partner/family)* |
| Tongue movement | Walk-on-toes*                               |
| Language        | Walk-on-heel*                               |
| Aphasia         | Romberg test (with care partner/family)*    |
| Dysarthria      |                                             |

The components were tabulated from relevant National Institutes of Health Stroke Scale (NIHSS) tests and observable tests. *The components are observable tests not included in the NIHSS. The test should be used as necessary for the particular pathology.

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