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Clinical short communication

Teleneurology during the COVID-19 pandemic: A step forward in modernizing medical care

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ABSTRACT

Background: The COVID-19 pandemic mandated rapid transition from face-to-face encounters to teleneurology visits. While teleneurology is regularly used in acute stroke care, its application in other branches of neurology was limited. Here we review how the recent pandemic has created a paradigm shift in caring for patients with chronic neurological disorders and how academic institutions have responded to the present need.

Method: Literature review was performed to examine the recent changes in health policies. Number of outpatient visits and televisits in the Department of Neurology was reviewed from Yale University School of Medicine and Johns Hopkins School of Medicine to examine the road to transition to televisit.

Results: The federal government and the insurance providers extended their supports during the COVID-19 pandemic. Several rules and regulations regarding teleneurology were revised and relaxed to address the current need. New technologies for video conferencing were incorporated. The transition to televisits went smoothly in both the institutions and number of face-to-face encounters decreased dramatically along with a rapid rise in televisits within 2 weeks of the declaration of national emergency.

Conclusion and relevance: The need for "social distancing" during the COVID-19 pandemic has created a major surge in the number of teleneurology visits, which will probably continue for the next few months. It may have initiated a more permanent transition to virtual technology incorporated medical care.

1. Introduction

Health care systems throughout the world face unforeseen challenges with the novel COVID-19 pandemic. Apart from providing acute care to the overwhelming number of patients with COVID-19 infection, it is crucial to minimize community spread while continuing necessary patient care [1,2]. To mitigate exposure of patients and to protect health care providers, reduction of any unnecessary face-to-face interaction was recommended [1]. The majority of neurology clinic visits have been either deferred or transformed into tele-health visits [1,3–5].

Tele health in neurology was initially studied in the treatment of Parkinson's disease over 20 years ago and has been widely used in acute stroke care [4,6,7]. However, implementation of teleneurology in non-stroke services has been limited [6,8–12]. Prior to the COVID-19 pandemic, telemedicine programs were gradually being integrated with medical care throughout the world [13]. It is still a relatively new platform and requires specific infrastructure.

Recognizing the need for a rapid transition to televisits, the federal government granted telemedicine services to seniors regardless of where they live, supporting a cost of $500 million for such expansion [3,14]. Many Medicare restrictions to telehealth have been relaxed, including the Health Insurance Portability and Accountability Act (HIPAA) compliance [15]. Other insurance providers also came forward and agreed to reimburse telehealth visits [16,17].

In this report, we highlight some of the recent changes in telehealth policy, challenges with the recent transition, and review such transformation in the Department of Neurology at two large academic institutions in the USA.

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2. Methods

Throughout this article, we have used teleneurology as equivalent to the application of telehealth, an umbrella term for remote healthcare not necessarily including clinical services, in neurology [13,18]. Apart from providing direct clinical care, use of store-and-forward techniques, in which clinical information (including case history, electroencephalography tracing, imaging studies) can be sent to a clinician for review and consultation were considered as part of teleneurology [4,13].

Electronic searches were conducted of PubMed, Web of Science, EMBASE, and Ovid MEDLINE for any relevant articles on teleneurology. Recent articles and policies published in electronic media were also reviewed.

The number of outpatient visits, including in-person encounters and televisits, were obtained from Yale School of Medicine and Johns Hopkins School of Medicine neurology departments over a two-month period (March–April 2020). Types of visits were also examined when available. Approval by an ethical standards committee on human experimentation (institutional or regional) was not indicated. This was not a human research or clinical study.

3. Results

3.1. Recent changes in healthcare policies

a. Insurance

In response to the COVID-19 emergency, rural and site limitations for televisits have been removed by Medicare and Medicaid [19]. In addition, the following broader coding changes were incorporated:

1. Virtual check-in codes (G2010, G2012), for established patients, for quick check-ins (5–10 min), were available even before COVID-19, and no changes were made in these codes. Similarly, no significant changes were made for interprofessional telephone/internet/EHR consults (eConsult - 99446, 99447, 99448, 99451, 99452), online digital evaluations (G2061–2063), and online medical evaluations (99421–99423).
2. Modifier 95, which indicates “Telemedicine Service Rendered via Real-Time Interactive Audio and Video Telecommunications System”, can be used for 99201-99205 (Office/outpatient visit new), 99211-99215 (Office/Outpatient visit established), 99231-99233 (Subsequent hospital care) for reporting synchronous (real-time) telemedicine services through an audiovisual media [20].

Most of the malpractice insurance carrier should cover within the state (within license area) medical care providing activities; it is recommended to ensure that the policy covers those providing care via telemedicine [16,19,21].

b. State licensing

During the COVID 19 emergency, to address the lack of physicians, many states allowed licensed providers from other states to practice televisits. It is important to ensure appropriate malpractice coverage when providing these services [16,19,21,22].

3.2. Challenges with teleneurology and some general guidelines

a. Setting up teleneurology

Despite rapid expansion of televisit capacity, it became immediately clear that current need far outstripped available standard televisit resources. Recognizing this limitation, the Office of Civil Rights at the Department of Health and Human Services (HHS) has allowed use of commonly available video conferring applications for televisits with relaxation of HIPAA related regulations during the COVID-19 nationwide public health emergency (Table 1) [15]. However, access to data generated during the encounter should be limited only to pertinent personnel [23,24].

Table 1
Selected list of video communication platforms.

HIPAA-compliant video communication applications
Skype for business / Microsoft teams
EPIC/Polycom
Updox
VSee
Vidyo
Starleaf
Zoom for healthcare
Doxy.me
Google G suite hangouts meet
Cisco webex meetings / Webex teams
Amazon chime
GoToMeeting
Other popular applications
Apple face time
Facebook messenger video chat
Google hangouts video
Zoom
Skype (regular)
Applications which are not recommended
Facebook live
Twitch
TikTok

Unlike telestroke, the majority of these visits will take place at a patient's home. A good connection with high bandwidth (preferably more than 100 kbs/s) is necessary for uninterrupted and fair quality video conferencing [9].

b. The encounter

The telemedicine service should be patient-initiated, and a verbal consent from the patient is required as Medicare coinsurance and deductibles are applicable. It is recommended to use two-factor identifier, such as name and date of birth, before starting the encounter [20].

Given the remote nature of the visit, a consent should be obtained for visit and must be integrated in the electronic health record. A sample consent template from the American Academy of Neurology website: [20].

“This is a telemedicine visit that was performed with the originating site at [INSERT PATIENT LOCATION] and the distant site at [INSERT PROVIDER LOCATION]. Verbal consent to participate in video visit was obtained. This visit occurred during the Coronavirus (COVID-19) Public Health Emergency. I discussed with the patient the nature of our telemedicine visits, that:

- I would evaluate the patient and recommend diagnostics and treatments based on my assessment.
- Our sessions are not being recorded and that personal health information is protected.
- Our team would provide follow up care in person if/when the patient needs it.”

c. Presence of a caregiver during the encounter

Having a family member or caretaker with the patient during the visit can be helpful for patients with cognitive deficits and/or significant motor impairment. They can help with adjusting the camera including the angle, zooming, adjust room lighting, adjusting the volume of audio, limit background noise (such as taking care of barking pet dogs, crying children etc.), limit distraction (switching off the television) to optimize ambiance for the televisit [25,26]. Providing a

Table 2
Teleneurology Visit Elements

Initiation of encounter	Salutation
	Two-factor identification
	Consent
	It will be easier to perform the examination in the presence of a companion
	Preferable to have a few feet of space for gait assessment
Neurological assessment	
Mental status	Routine bedside/clinic examination applicable
Speech	Comprehension, naming, repetition (ensure proper audio output and microphone)
Cranial nerves	Visual fields, and examination of palate raise and uvula can be limited
Motor exam	Non-confrontational measures:
	Pronator drift, Finger tapping, Rapid opening and closing of fist
	For lower extremity check drift, standing up unassisted (and arms crossed), squat, heel and toe walking
Sensory exam	If there is a companion, then light touch can be examined by cotton, and pin prick can be examined by a toothpick
Cerebellar	Rapid alternative movements
	Nose touch with extended upper extremities
	Heel to shin
	Gait
Reflexes	Can be difficult
	If there is a companion, attempts can be made to elicit patellar reflex with a household item such as back of the spoon, wooden spatula.
Gait	Be considerate of patient's capacity
	If no companion around, there can be fall risk.
Validated disease activity scores	Unified Parkinson's disease rating scale
	Unified Huntington's disease rating scale
	Abnormal involuntary movement scale
Partially validated disease activity score	ALS functional rating scale-revised

neurological exam sheet to the caregiver/assistance prior to the televisit can be helpful to ensure a seamless encounter (a sample is provided in Appendix 1). Similarly, a sample video instruction for neurological examination can be useful to educate the caregiver/assistance on performing some aspects of the neurological examination, such as gross motor strength testing, and sensory examination [20].

While presence of a caregiver/ assistance during the encounter can be helpful, we should be respectful to patient privacy and ensure that the patient is comfortable with the presence of a second person during the encounter (Table 2).

d. Neurological assessment

Teleneurology has been studied in a relatively smaller scale in many branches of neurology [4]. The majority of these studies focused on patient and provider satisfaction, diagnostic accuracy, and improved outcomes. Some of the studies on teleneurology have used a telepresenter/junior physician to examine the patient, and some did not require any neurological examination at all, thus providing only limited guideline on conducting neurological examination over a televisit [6,8,27].

Cognitive status, speech, some of the cranial nerves, and gait can be assessed in a relatively straightforward way over the video conference. Cerebellar signs such as dysdiadochokinesia, touching nose with finger from extended hand position, and heel-to-shin testing can also be performed with relative ease. However, proper assessment of some of the cranial nerves, muscle strength, and sensory examination would be difficult [28,29].

Gross motor examination can be performed over video to ensure that there is no pronator drift, and both proximal upper and lower extremity strengths are antigravity (as implemented in NIH stroke scale) [30]. Finger tapping, rapid opening and closing of fist, rapid alternative hand movements, and rapid heel tapping can provide some basic idea of fine motor functions and subtle weakness. Without having a trained assistant, confrontational muscle strength testing will not be accurate [20]. Apart from getting up from the chair with crossed arm, squatting, hopping, heel and toe walking can be used as surrogates of lower extremity strength.

Sensory examination will also be difficult to perform if there is no companion. But, if a companion is present, light touch with a piece of cotton and pinprick with a tooth pick/safety pin (after wiping with alcohol swab) should be possible. Similarly, a Romberg test can be helpful to assess proprioception.

Reflexes can only be examined if there is a companion who can be instructed, and probably the patellar reflex will be the easiest to elicit; however, accuracy of such exam has not been examined.

Study by Bove et al. has shown that sending the patient a kit with a Rosenbaum 14-in. vision card for vision, and 128 Hz tuning fork, safety pin, and alcohol swab (the entire kit cost $< $20) was useful to obtain sensory exam with fair accuracy in controlled settings [31]. Sending a similar kit with cotton ball/gauze, safety pin/tooth pick, tuning fork, vision card, alcohol swab can be considered for selected patients.

e. Use of scores to assess severity of disease

Some subspecialties of neurology, such as neuromuscular medicine, movement disorders, require regular neurological examination [4]. When detailed neurological examination is not feasible, use of disease severity scores can be helpful and should be encouraged during televisits. Studies have shown the reliability of the Unified Parkinson's Disease Rating Scale (rigidity was measured by a nurse clinician), Unified Huntington's Disease Rating Scale (modified-excluding rigidity and balance assessment), and Abnormal Involuntary Movement Scale over televisit encounters [7,32]. There are only limited studies on amyotrophic lateral sclerosis (ALS) and one study has validated ALS functional rating scale-revised (ALSFRS-R) score over online assessment [25,33]. Timed maintenance of a limb position as used in Quantitative Myasthenia Gravis (QMG) score can also be helpful to assess muscle strength and fatigability [34]. MG Activities of Daily Living (MG-ADL), a validated patient reported outcome measure, also has the potential to be incorporated into televisit as it does not require a physical examination. Few studies have assessed the Expanded Disability Status Scale (EDSS) in multiple sclerosis over televisits either with the help of a telepresenter or in a controlled environment [4,31].

3.3. Transition to teleneurology at Yale School of Medicine and Johns Hopkins School of Medicine

Both institutions adapted to a rapid transition, as depicted in Fig. 1. After the declaration of national emergency in the USA (March 13, 2020), face-to-face encounters were reduced to minimal numbers by week 2 and more than 98% of outpatient care was provided via

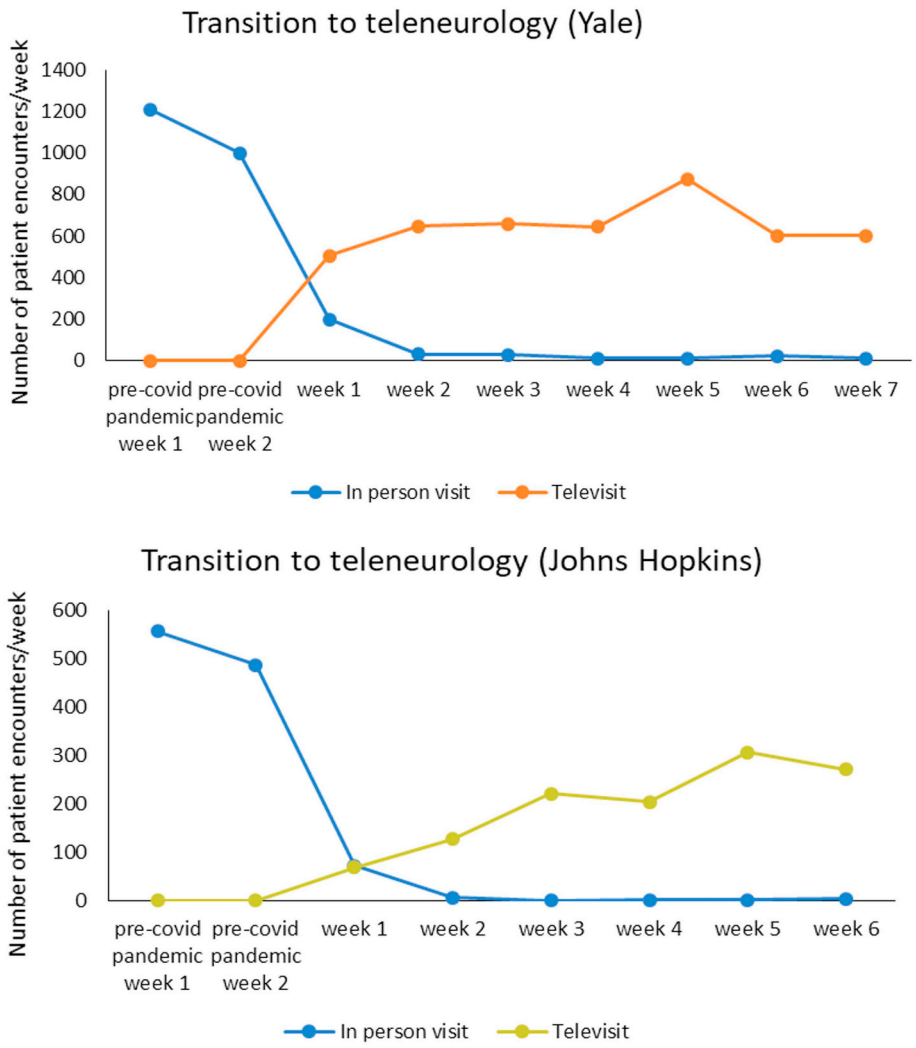

Fig. 1. Transition to teleneurology during the COVID-19 pandemic at the Yale School of Medicine and Johns Hopkins School of Medicine. Data were collected for March and April 2020 and reported as number of patient encounters per week. Nationwide emergency in the United States was declared on March 13, 2020.

teleneurology. However, the total number of outpatient encounters was reduced almost by 40–50% in both health systems. At Yale School of Medicine such reduction in volume was secondary to reduction in the number of new patient evaluations. While a detailed breakdown report was not available from Johns Hopkins, a similar reason can be presumed. As tertiary medical centers, both institutions receive a significant number of referrals from a wide territory. Such referrals often demand detailed physical examinations and thorough scrutiny of previous records, and the former was not possible during the COVID-19 pandemic. Moreover, resources from the outpatient clinic, including support staff, were relocated to more critical needs, which also may have affected the process of streamlining new appointments [5].

4. Discussion

The future course of the COVID-19 pandemic cannot be predicted with certainty, but teleneurology will probably be an integral part of neurology outpatient care for at least the next few months, and this change in care may become entrenched for the long term [2,22]. Telemedicine not only decreases non-essential (or non-critical) face-to-face encounters and potential spread of disease during this pandemic, but also provides earlier access to specialized care, reduces the burden of patient transport, and is often more comfortable for both patients and caregivers [4]. While there are clear limitations to this healthcare approach in many aspects of neurology, the benefits are also considerable. It can address the increasing demand for neurological care and cater to patients from remote and underserved areas [4,13]. Such application will continue to grow as long as insurance providers recognize such needs and continue to support teleneurology. In the past, the upfront investment of teleneurology was a concern, but advances in video conferencing and smartphone technologies have tremendously improved the accessibility of telehealth [13].

Similarly, use of smartphone tools, programs that improve medication adherence, electronic diaries for migraine/seizures, body-worn sensors to monitor falls in Parkinson's disease, “smart home” installation with ADL assistance, robotic technologies to enhance remote physical exams, application of smart devices to detect movement, can be useful in selected circumstances [13,24,35]. Many of these applications are still under investigation and are not directly applicable to the current need. However, more integration of such devices is expected in the future.

Given the nature of current technology, it is possible that teleneurology will not provide the same diagnostic accuracy as a face-to-face encounter for the initial evaluation, particularly when the diagnosis is dependent on a detailed and accurate neurological examination. For some subspecialties, such as epilepsy, where seizure control, assessment of medication adherence and medication side effects, medication adjustments, and counseling, are the focus of the follow-up visits, teleneurology can be an excellent substitute of face-to-face encounter [36,37]. Similarly, diagnostic accuracy, treatment, and outcome of

nonacute headache related visits are comparable between teleneurology and face-to-face encounters [27]. For dementia, studies have suggested similar diagnostic accuracy, outcomes, and compliance between teleneurology and regular outpatient visits [4,38].

The COVID-19 pandemic will not be the time to optimize the full potential of teleneurology. Basic video conferencing with a reasonable quality or a telephone encounter can be helpful to accommodate the present demand [20,23]. Particularly when the connection or data speed is not optimal, telephone encounter can provide information on patient wellbeing and also functional status can be estimated. Moreover, for elderly patients, who are not well oriented with new technologies and videoconferencing, and if there is not a second person around to help them, a telephone encounter is the only alternative and can help to avoid a face-to-face visit. Dialing *67 prior to placing the call, use of Doximity Dialer (which is free), or use of a hospital phone line can be used to make incognito calls [20,39].

Despite the necessity and various benefits, there are several limitations of teleneurology. Some aspects of the neurological examinations will be limited. It is important to document the observed findings as clearly as possible, and state the associated limitations [20]. “Guessing” at what the exam probably would show if completed in person adds little value. Proper telecommunication support and good data connection are essentials for teleneurology, and lack of either will limit the quality of the visit [19]. Moreover, teleneurology is not well-studied in some neurology subspecialties, such as neuromuscular medicine, neuro-oncology, neuro-ophthalmology, etc. Utility and effectiveness of teleneurology for such subspecialties will become more evident with our daily experiences during the COVID-19 pandemic, and further dedicated studies, focused on validation and the development of best practice standards, in these areas should be performed.

5. Conclusion

Teleneurology cannot replace the need for face-to-face neurological encounters, but it is playing a pivotal role in protecting many patients with neurological disorders from potential exposure to COVID-19. It also protects the physicians and puts into full effect the concept of “social distancing.” [20,23,40] The COVID-19 pandemic will likely expedite modernization of medical care and bring it into the 21st century. It represents an opportunity that we all must participate in for the optimization of health care delivery.

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Appendix 1. Teleneurology encounter sheet for patient and caregiver

Initiation of encounter	A guideline on how to start the encounter. This may vary depending on the institute and the electronic health record being use
Ensuring optimal environment for the encounter	- Optimal lighting - Proper positioning of camera (zooming function can also be utilized) - Reduce background noise to minimal - Ensure the audio and microphone is working
Expectations of the visit	- State about the audiovisual nature of the encounter. - State that a full neurological examination will not be possible. - State the limitations of the visit.
Preparedness of neurological examination	- Assess whether the caregiver/assistant will be willing to help with the neurological examination. - The caregiver/assistant can help with the visual field testing, motor strength testing, sensory examination.

References

[1] Interim Guidance for Healthcare Facilities: Preparing for Community Transmission of COVID-19 in the United States, Available from, 2020. https://www.cdc.gov/coronavirus/2019-ncov/healthcare-facilities/guidance-hcf.html.
[2] CMS Takes Action Nationwide to Aggressively Respond to Coronavirus National Emergency, Available from, 2020. https://www.cms.gov/newsroom/press-releases/cms-takes-action-nationwide-aggressively-respond-coronavirus-national-emergency.
[3] J.K. Cohen, New Telemedicine Strategies Help Hospitals Address COVID-19, Available from: https://www.modernhealthcare.com/patients/new-telemedicine-strategies-help-hospitals-address-covid-19.
[4] J.M. Hatcher-Martin, J.L. Adams, E.R. Anderson, et al., Telemedicine in neurology: telemedicine work group of the American academy of neurology update, Neurology 94 (1) (2020 Jan 7) 30–38.
[5] A.C. Guidon, A.A. Amato, COVID-19 and neuromuscular disorders, Neurology 94 (2020 Apr 13) 1–11, https://doi.org/10.1212/WNL.0000000000009566.
[6] M. Awadallah, F. Janssen, B. Korber, L. Breuer, M. Scibor, R. Handschu, Telemedicine in general neurology: interrater reliability of clinical neurological examination via audio-visual telemedicine, Eur. Neurol. 80 (5–6) (2018) 289–294.
[7] J.P. Hubble, R. Pahwa, D.K. Michalek, C. Thomas, W.C. Koller, Interactive video conferencing: a means of providing interim care to Parkinson’s disease patients, Mov. Disord. 8 (3) (1993 Jul) 380–382.
[8] F. Janssen, M. Awadallah, A. Alhalabi, et al., Telemedicine in general neurology: use of audiovisual consultation for on call back-up service in an acute care hospital, J. Neurol. 265 (4) (2018 Apr) 880–884.
[9] N. Kissani, Y.T.M. Lengane, V. Patterson, et al., Telemedicine in epilepsy: how can we improve care, teaching, and awareness? Epilepsy Behav. 103 (Pt A) (2020 Feb) 106854.

[10] K.I. Muller, K.B. Alstadhaug, S.I. Bekkelund, Headache patients' satisfaction with telemedicine: a 12-month follow-up randomized non-inferiority trial, Eur. J. Neurol. 24 (6) (2017 Jun) 807–815.
[11] R. Srinivasan, H. Ben-Pazi, M. Dekker, et al., Telemedicine for hyperkinetic movement disorders, Tremor. Other Hyperkinet. Mov. (N Y) 10 (2020).
[12] L. Wong, M. Martin-Khan, J. Rowland, P. Varghese, L.C. Gray, The Rowland universal dementia assessment scale (RUDAS) as a reliable screening tool for dementia when administered via videoconferencing in elderly post-acute hospital patients, J. Telemed. Telecare 18 (3) (2012) 176–179.
[13] E.R. Dorsey, A.M. Glidden, M.R. Holloway, G.L. Birbeck, L.H. Schwamm, Teleneurology and mobile technologies: the future of neurological care, Nat. Rev. Neurol. 14 (5) (2018 May) 285–297.
[14] Bill PSoCER, Pelosi Statement on Coronavirus Emergency Response Bill, Available from: https://www.speaker.gov/newsroom/3420.
[15] Notification of Enforcement Discretion for Telehealth Remote Communications During the COVID-19 Nationwide Public Health Emergency, Available from, 2020. https://www.hhs.gov/hipaa/for-professionals/special-topics/emergency-preparedness/notification-enforcement-discretion-telehealth/index.html.
[16] COVID-19 Telehealth Coding and Billing Practice Management Tips, Available from, 2020. https://www.acponline.org/practice-resources/business-resources/covid-19-telehealth-coding-and-billing-practice-management-tips.
[17] Medicare Will Now Cover Telehealth To Fight Coronavirus, Available from, 2020. https://www.healthcaredive.com/news/medicare-will-now-cover-telehealth-to-fight-coronavirus/574312/.
[18] R. Seewon, Telemedicine: opportunities and developments in member states: report on the second global survey on eHealth 2009 (global observatory for eHealth series, volume 2), Healthc. Inform Res. 18 (2) (2012) 153–155.
[19] Telehealth Coverage Policies in the Time Of Covid-19, Available from: https://www.cchpca.org/resources/covid-19-telehealth-coverage-policies.
[20] Telemedicine and Covid-19 Implementation Guide, Available from, 2020. https://www.aan.com/siteassets/home-page/tools-and-resources/practicing-neurologist–administrators/telemedicine-and-remote-care/20-telemedicine-and-covid19-v103.pdf.
[21] Is the Doctor In? Medical Malpractice Issues in the Age of Telemedicine, Available from, 2020. https://www.natlawreview.com/article/doctor-medical-malpractice-issues-age-telemedicine.
[22] COVID-19 | Key Policy Updates, Available from, 2020. https://info.americantelemed.org/covid-19-key-policy-updates-1.
[23] AMA Quick Guide to Telemedicine in Practice, Available from, 2020. https://www.ama-assn.org/practice-management/digital/ama-quick-guide-telemedicine-practice.
[24] B.R. Bloem, E.R. Dorsey, M.S. Okun, The coronavirus disease 2019 crisis as catalyst for telemedicine for chronic neurological disorders, JAMA Neurol. (2020 Apr 24), https://doi.org/10.1001/jamaneurol.2020.1452.
[25] A. Geronimo, C. Wright, A. Morris, S. Walsh, B. Snyder, Z. Simmons, Incorporation of telehealth into a multidisciplinary ALS clinic: feasibility and acceptability, Amyotroph Lat Scl Fr. 18 (7–8) (2017) 555–561.
[26] A. Lindauer, A. Seelye, B. Lyons, et al., Dementia care comes home: patient and caregiver assessment via telemedicine, Gerontologist 57 (5) (2017 Oct) E85–E93.
[27] K.I. Muller, K.B. Alstadhaug, S.I. Bekkelund, A randomized trial of telemedicine efficacy and safety for nonacute headaches, Neurology 89 (2) (2017 Jul 11) 153–162.
[28] M. Martin-Khan, L. Flicker, R. Wootton, et al., The diagnostic accuracy of telegeriatrics for the diagnosis of dementia via video conferencing, J. Am. Med. Dir. Assoc. 13 (5) (2012 Jun) 487 e19–24.
[29] T.G. Russell, G.A. Jull, R. Wootton, The diagnostic reliability of internet-based observational kinematic gait analysis, J. Telemed. Telecare 9 (Suppl. 2) (2003) S48–S51.
[30] NIH Stroke Scale Score, Available from, 2020. https://www.stroke.nih.gov/documents/NIH_Stroke_Scale_508C.pdf.
[31] R. Bove, C. Bevan, E. Crabtree, et al., Toward a low-cost, in-home, telemedicine-enabled assessment of disability in multiple sclerosis, Mult. Scler. 25 (11) (2019 Oct) 1526–1534.
[32] M.T. Bull, K. Darwin, V. Venkataraman, et al., A pilot study of virtual visits in Huntington disease, J Huntingtons Dis. 3 (2) (2014) 189–195.
[33] A. Maier, T. Holm, P. Wicks, et al., Online assessment of ALS functional rating scale compares well to in-clinic evaluation: a prospective trial, Amyotroph. Lateral Scler. 13 (2) (2012 Feb) 210–216.
[34] R.S. Bedlack, D.L. Simel, H. Bosworth, G. Samsa, B. Tucker-Lipscomb, D.B. Sanders, Quantitative myasthenia gravis score: assessment of responsiveness and longitudinal validity, Neurology 64 (11) (2005 Jun 14) 1968–1970.
[35] A.L.S. de Lima, T. Smits, S.K.L. Darweesh, et al., Home-based monitoring of falls using wearable sensors in Parkinson's disease, Mov. Disord. 35 (1) (2020 Jan) 109–115.
[36] K.A. Rasmusson, J.C. Hartshorn, A comparison of epilepsy patients in a traditional ambulatory clinic and a telemedicine clinic, Epilepsia 46 (5) (2005 May) 767–770.
[37] M. Reider-Demer, P. Raja, N. Martin, M. Schwinger, D. Babayan, Prospective and retrospective study of videoconference telemedicine follow-up after elective neurosurgery: results of a pilot program, Neurosurg. Rev. 41 (2) (2018 Apr) 497–501.
[38] H. Kim, J.H. Jhoo, J.W. Jang, The effect of telemedicine on cognitive decline in patients with dementia, J. Telemed. Telecare 23 (1) (2017 Jan) 149–154.
[39] Telehealth: Rapid Implementation For Your Cardiology Clinic (Updated March 24, 2020), Available from: https://www.acc.org/latest-in-cardiology/articles/2020/03/01/08/42/feature-telehealth-rapid-implementation-for-your-cardiology-clinic-coronavirus-disease-2019-covid-19.
[40] H. Manji, A.S. Carr, W.J. Brownlee, M.P. Lunn, Neurology in the time of covid-19, J. Neurol. Neurosurg. Psychiatry (2020 Apr 20), https://doi.org/10.1136/jnnp-2020323414 Epub ahead of print.