Brief Communications

Telemedicine in Parkinson's Disease:
How to Ensure Patient Needs and Continuity of Care
at the Time of COVID-19 Pandemic

Giuseppina Miele, MD,[1,*] Giulia Straccia, MD,[1,*]
Marcello Moccia, MD, MD(Res), PhD,[2] Letizia Leocani, MD,[3–5]
Gioacchino Tedeschi, MD,[6] Simona Bonavita, MD,[1]
Luigi Lavorgna, MD[6] and on behalf of the Digital
Technologies, Web and Social Media Study Group
of the Italian Society of Neurology.

[1]Department of Advanced Medical and Surgical Sciences, II Clinic
  of Neurology, University of Campania "Luigi Vanvitelli," Naples,
  Italy.
[2]Department of Neuroscience, Reproductive Science and Odon-
  tostomatology, Federico II University of Naples, Italy.
[3]Department of Neurorehabilitation, IRCCS San Raffaele Hospital,
  Milan, Italy.
[4]Experimental Neurophysiology Unit, Division of Neuroscience,
  Institute of Experimental Neurology (INSPE), San Raffaele
  Scientific Institute, Milan, Italy.
[5]University Vita-Salute San Raffaele, Milan, Italy.
[6]Department of Advanced Medical and Surgical Sciences,
  University of Campania "Luigi Vanvitelli," Naples, Italy.
*These authors contributed equally to this study.

Abstract

Introduction: With the spread of the SARS-CoV2 pandemic, telemedicine has become the safest way to guarantee care continuity, especially for chronic disabling diseases requiring frequent medical consultations and therapeutic adjustments, such as Parkinson's disease (PD). The age-related prevalence of PD, combined with increased vulnerability due to age-related comorbidities, makes PD patients protection a priority.
Methodology: We reviewed potentials and limitations of teleneurology in PD and suggested a specific battery of tests, including patient-reported outcomes, smartphone applications, and neurological examination through telemedicine.
Conclusions: These tools can provide full neurological consultations, with the engagement of both patients and caregivers, and can support clinicians in defining whether patients need to access diagnostic and therapeutic procedures. Telemedicine will also carry a value in the future,

within conventional health care, to support clinicians in decision making, enabling more efficacious follow-up, reducing burden for caregivers, and delivering neurological expertise to local realities. These advantages are very important when there is physical distance between patients and neurologists, and when patients are not recommended to attend in-person consultations.

Introduction

The risk of infection from SARS-CoV-2 has raised global public health concerns. The World Health Organization (WHO) has declared COVID-19 pandemic on March 11, 2020.[1] To date, several studies showed that older adults[2] and patients with chronic neurological disorders may be at increased risk of infection because of either the disease itself or for disruptions in health care provision.[3]

Parkinson's disease (PD) is the second most common neurodegenerative disorder with an increasing prevalence with aging, configuring a condition predisposing to a higher risk of COVID-19.

In this emergency, outpatient appointments have been cancelled or postponed, making telemedicine[4] a useful tool to ensure continuity of care[5] and to reduce the risk of infection. Therefore, digital health could provide people with PD (pwPD) with customized consultations from movement disorders specialists and general neurologists.[6]

Consultations for pwPD include both motor and nonmotor symptoms (NMSs) evaluation. In outpatient settings, models of care in PD are based on interview of patients and/or caregivers, and targeted neurological examination. In the current context, teleconsultations may help in overcoming outpatient clinic restrictions.[6]

Indeed, over the past years, several studies have highlighted the utility of e-health measures and wearable sensors to assess patients remotely, providing objective parameters of motor

and NMSs and connecting movement disorders or rehabilitation specialists to local health care providers.[7]

In pwPD, Beck et al. reported that telemedicine evaluation is no less efficacious than in-person consultations, even with more patient satisfaction.[8]

Methodology

In PD, the smart applications of standardized motor scales, such as the Movement Disorder Society Unified Parkinson Disease rating scale–part III–IV (MDS-UPDRS-III/IV), have demonstrated to be almost as reliable as in typical outpatient visits, although the evaluation of some clinical signs is precluded (i.e., rigidity) or can be checked only if safe and with the help of caregivers.[9] The app MDS-UPDRS® (Doctot, Limerick, Ireland) it is available in the European Union (EU) for free at the Apple store and could be used with medical professional guidance during teleconsultation.[9] Similarly, in smartphones using the Android operating system, another app named CloudUPDRS® app (Birkbeck College, University of London, London, UK) can be downloaded free of charge from the Google store.[10]

In clinical practice, NMSs of PD may be sought in clinical history with patient-reported outcomes (PROs), including questionnaires assessing patients' quality of life and functional independence in daily living activities. PROs are feasible online, positively perceived by patients and their caregivers, and can help physicians in decision making.[11,12] Moreover, standardized acquisition of PROs could enable early recognition of NMSs and other potentially life-threatening symptoms, such as falls, autonomic dysfunction, dysphagia, and neuropsychiatric/cognitive symptoms.

The NMS Scale (NMSS) is the most applied tool to assess NMSs. It consists of a 30-item rater-based scale to assess severity and frequency of NMSs. It can be compiled in 10–15 min and is available in multiple languages.[13]

The Conley Scale is a 6-item scale and could be performed to promptly identify the risk of house falls, it can be completed in 2 min and is available in several languages.[14] Caregiver-administered ADL/IADL (Activities of Daily Living/Instrumental Activities of Daily Living)[15] could be informative about rapid deterioration of patients' autonomy. Questionnaire for Impulsive-Compulsive Disorders in Parkinson's Disease (QUIP)[16] and Scales for Outcomes in Parkinson's Disease-Psychiatric Complications (SCOPA-PC)[17] could be used and may help recognizing the onset of neuropsychiatric symptoms, which could reflect adverse effects of ongoing pharmacological therapy or intercurrent medical complications that prompt rapid medical intervention.

Alongside with conventional outcome measures for motor and nonmotor evaluation of PD, digital technology represents a key support for remote monitoring. The use of an easy to fulfill electronic diary could be recommended. The Parkinson's Diary® (FieC &YL MIT Lab, Cambridge, Massachusetts) presents a free application available on iOS and Android platforms, may be very useful to record daily activities, feelings, and general health status and is available in the EU.[9,18] Other smartphone applications, with strong correlation with MDS-UPDRS-III total score, could be considered to monitor pwPD and to evaluate some clinical signs otherwise not assessable remotely: Lift Pulse®, available for free on iOS and Android (Lynx Design, National Institutes of Health [NIH], Bethesda, Maryland), may be used to record resting tremor. PD ME® (Belles Farm LLC, University of California Los Angeles, San Francisco Art Institute, California), available free of charge at the Apple store can be used to test memory, balance, reaction time, and time perception.[9]

Table 1. Suggested Battery for Assessing Parkinson's Disease Disability on Telemedicine

TOOL	ADVANTAGES	LIMITATIONS
Before consultation		
Parkinson's Diary® APP	Available in multiple languages Largely feasible remotely Available for self-assessment Available on iOS/Android system Free download	To own a smartphone Caregiver's help
NMSS	Available in multiple languages Available for self-assessment	Not validated in online format
Conley Scale	Available in multiple languages Available for self-assessment Small number of items	To be integrated with anamnesis Not validated in online format
Lift Pulse® and PD ME® Apps	Available in multiple languages Largely feasible remotely Available for self-assessment Available on iOS system Free download	To own a smartphone Caregiver's help
During consultation		
Full neurological examination	Flexible (depending on patients' symptoms)	Specific setup Caregiver's help Time consuming
MDS-UPDRS®/ CloudUPDRS® APPs	Available in multiple languages Available, respectively, on iOS/Android system Free download	Specific setup Caregiver's help

Suggested tools for assessing PD disability on telemedicine and suggested algorithm of administration.

MDS-UPDRS, Movement Disorder Society Unified Parkinson Disease rating scale; NMSS, nonmotor symptoms scale; PD, Parkinson's disease.

Therefore, we suggest that pwPD should fulfill an electronic diary monitoring physical and mental status and might use the NMSS tool and the Conley scale to assess NMSs and the risk of falls (*Table 1*).

Finally, when performing the teleconsultation, (1) movement disorders specialists may acquire further anamnestic details, such as symptoms of autonomic dysfunction, dysphagia, and rapid deterioration of cognitive status; (2) motor symptoms can be evaluated with smartphone applications MDS-UPDRS/CloudUPDRS, Lift Pulse, and PD ME; and (3) caregiver-administered ADL/IADL could reveal reduction or loss of patient's autonomy in daily living.

Conclusions

We acknowledge that telemedicine has many limitations, both device related (access to technology, webcam quality, high-speed internet connection, *etc.*) and not device related (limited neurological examination, data protection regulation, *etc.*); however, we foresee that the overall benefits of this approach will render telemedicine progressively part of neurological clinical practice.[19]

The current global emergency from COVID-19 has boosted the rapid reorganization of health care systems toward telemedicine, with the priority to defend safety while allowing the patient to continue his or her diagnostic-therapeutic process.

Medical examination remains the cornerstone of practice, but telemedicine decreases the number of patient attendances as consultations take place through telephone, video calls, exchanges of photographic documentation, mobile phone messages, e-mail, or other applications for computers or mobile phones. Neurologists should be encouraged to use telemedicine, as it could reveal as a useful tool to improve quality of care in patients with chronic neurological disorders. Even after the COVID-19 emergency, telemedicine will be essential to streamline outpatient visits, while at the same time limiting costs.

In conclusion, telemedicine can offer a support to the doctors' activity by facilitating their work. In this sense, the COVID-19 pandemic represents a positive input for the acceleration and enhancement of these tools.

Authors' Contributions

G.M. and G.S. equally contributed to the conception of the study, literature revision, and article drafting; M.M. and L.L. contributed to the conception of the study and revised the article and table for intellectual content; G.T., S.B., and L.L. contributed to the conception of the study and final revision of the article and table. All authors equally contributed to the final approval of the version to be submitted.

Disclosure Statement

No competing financial interests exist.

Funding Information

No funding was received for this article.

REFERENCES

1. Bonavita S, Tedeschi G, Atreja A, Lavorgna L. Digital triage for people with multiple sclerosis in the age of COVID-19 pandemic. *Neurol Sci* **2020;**41:1007–1009.

2. Petretto DR, Pili R. Ageing and COVID-19: What is the Role for Elderly People?. *Geriatrics (Basel)* **2020;**5:E25.

3. de Lau LM, Giesbergen PC, de Rijk MC, Hofman A, Koudstaal PJ, Breteler MM. Incidence of parkinsonism and Parkinson disease in a general population: The Rotterdam Study. *Neurology* **2004;**63:1240–1244.

4. Lavorgna L, Brigo F, Moccia M, et al. e-Health and multiple sclerosis: An update. *Mult Scler* **2018;**24:1657–664.

5. Hollander JE, Carr BG. Virtually perfect? Telemedicine for Covid-19. *N Engl J Med* **2020;**382:1679–1681.

6. Espay AJ, Bonato P, Nahab FB, Maetzler W, Dean JM, Klucken J, Eskofier BM, Merola A, Horak F, Lang AE, Reilmann R, Giuffrida J, Nieuwboer A, Horne M, Little MA, Litvan I, Simuni T, Dorsey ER, Burack MA, Kubota K, Kamondi A, Godinho C, Daneault JF, Mitsi G, Krinke L, Hausdorff JM, Bloem BR, Papapetropoulos S; Movement Disorders Society Task Force on Technology, Technology in Parkinson's disease: Challenges and opportunities, *Mov Disord* **2016;**31:1272–1282.

7. Cramer SC, Dodakian L, Le V, See J, Augsburger R, McKenzie A, Zhou RJ, Chiu NL, Heckhausen J, Cassidy JM, Scacchi W, Therese Smith M, Barrett AM, Knutson J, Edwards D, Putrino D, Agrawal K, Ngo K, Roth EJ, Tirschwell DL, Woodbury ML, Zafonte R, Zhao W, Spilker J, Wolf SL, Broderick JP, Janis S; National Institutes of Health StrokeNet Telerehab Investigators, Efficacy of home-based telerehabilitation vs in-clinic therapy for adults after stroke: A randomized clinical trial. *JAMA Neurol* **2019;**76:1079–1087,

8. Beck CA, Beran DB, Biglan KM, Boyd CM, Dorsey ER, Schmidt PN, Simone R, Willis AW, Galifianakis NB, Katz M, Tanner CM, Dodenhoff K, Aldred J, Carter J, Fraser A, Jimenez-Shahed J, Hunter C, Spindler M, Reichwein S, Mari Z, Dunlop B, Morgan JC, McLane D, Hickey P, Gauger L, Hegeman Richard I, Mejia NI, Bwala G, Nance M, Shih LC, Singer C, Vargas-Parra S, Zadikoff C, Okon N, Feigin A, Ayan J, Vaughan C, Pahwa R, Dhall R, Hassan A, DeMello S, Riggare SS, Wicks P, Achey MA, Elson MJ, Goldenthal S, Keenan HT, Korn R, Schwarz H, Sharma S, Stevenson EA, Zhu W. Connect. Parkinson Investigators. National randomized controlled trial of virtual house calls for Parkinson disease. *Neurology* **2017;**89:1152–1161.

9. Linares-Del Rey M, Vela-Desojo L, Cano-de la Cuerda R. Mobile phone applications in Parkinson's disease: A systematic review. *Neurologia* **2019;**34:38–54.

10. Stamate C, Magoulas GD, Kueppers S, Nomikou E, Daskalopoulos I, Jha A, Pons JS, Rothwell J, Luchini MU, Moussouri T, et al. The cloudUPDRS app: A medical device for the clinical assessment of Parkinson's Disease. *Pervasive Mob Comput* **2018;**43:146–166.

11. Damman OC, Verbiest MEA, Vonk SI, Berendse HW, Bloem BR, de Bruijne MC, Faber MJ. Using PROMs during routine medical consultations: The perspectives of people with Parkinson's disease and their health professionals. *Health Expect* **2019;**22:939–951.

12. Lavorgna L, Miele G, Petruzzo M, Lanzillo R, Bonavita S. Online validation of the Italian version of the patient determined disease steps scale (PDDS) in people with multiple sclerosis. *Mult Scler Relat Disord* **2018;**21:108–109.

13. Chaudhuri KR, Martinez-Martin P, Brown BG, Sethi K, Stocchi F, Odin P, Ondo W, Abe K, Macphee G, Macmahon D, Barone P, Rabey M, Forbes A, Breen K, Tluk S, Naidu Y, Olanow W, Williams AJ, Thomas S, Rye D, Tsuboi Y, Hand A, Schapira AH. The metric properties of a novel non-motor symptoms scale for Parkinson's disease: Results from an international pilot study, *Mov Disord* **2007;**22:1901–1911.

14. Guzzo AS, Meggiolaro A, Mannocci A, Tecca M, Salomone I, La Torre G. Conley Scale: Assessment of a fall risk prevention tool in a General Hospital. *J Prev Med Hyg* **2015;**56:E77–E87.

15. Shulman LM, Gruber-Baldini AL, Anderson KE, Vaughan CG, Reich SG, Fishman PS, Weiner WJ. The evolution of disability in Parkinson disease. *Mov Disord* **2008;**23:790–796.

16. Evans AH, Okai D, Weintraub D, et al. Scales to assess impulsive and compulsive behaviors in Parkinson's Disease: Critique and recommendations. *Mov Disord* **2019;**34:791–798.

17. Visser M, Verbaan D, van Rooden SM, Stiggelbout AM, Marinus J, van Hilten JJ. Assessment of psychiatric complications in Parkinson's disease: The SCOPA-PC. *Mov Disord* **2007;**22:2221–2228.

18. Vizcarra JA, Sánchez-Ferro Á, Maetzler W, Marsili L, Zavala L, Lang AE, Martinez-Martin P, Mestre TA, Reilmann R, Hausdorff JM, Dorsey ER, Paul SS, Dexheimer JW, Wissel BD, Fuller RLM, Bonato P, Tan AH, Bloem BR, Kopil C, Daeschler M, Bataille L, Kleiner G, Cedarbaum JM, Klucken J, Merola A, Goetz CG, Stebbins GT, Espay AJ; MDS Technology Task Force and the MDS Rating Scales Program Electronic Development Ad-Hoc Committee. The Parkinson's disease e-diary: Developing a clinical and research tool for the digital age. *Mov Disord* **2019;**34:676–681.

19. Bloem BR, Dorsey ER, Okun MS. The coronavirus disease 2019 crisis as catalyst for telemedicine for chronic neurological disorders. *JAMA Neurol* **2020;** [Epub ahead of print]; doi:10.1001/jamaneurol.2020.1452.

Address correspondence to:
Luigi Lavorgna, MD
Department of Advanced Medical and Surgical Sciences
University of Campania "Luigi Vanvitelli," Naples, Italy
Piazza Miraglia 2
Naples 80138
Italy

E-mail: luigi.lavorgna@policliniconapoli.it