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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Correspondence

E-Rehabilitation: One solution for patients with Parkinson's disease in COVID-19 era

Dear Sir,

Neurorehabilitation is hampered due to social distancing and fear due to the chance of getting coronavirus disease, 2019 (COVID-19). Home-based or community-based and outpatient-based rehabilitation are restricted temporarily to protect both patients and caregivers from COVID-19 infection. Lack of physical activities during lockdown may lead to worsening of various motor and non-motor symptoms in patients with Parkinson's disease (PD) [1]. Therefore, to reduce the spread of the virus, digital rehabilitation (E-Rehabilitation) strategies should be adopted as an alternative mode to deliver rehabilitation services at the community level. The main advantage of E-Rehabilitation is that it provides clinical and rehabilitation support to community by overcoming geographical barriers through the electronic communication mode [2]. Advanced rehabilitation techniques are difficult to access by patients living in rural areas due to its high cost, which eventually lead to failures in maintaining the intensity and frequency of rehabilitation. Use of E-Rehabilitation might enhance the outcomes, quality of life and proven its efficacy in many conditions [3].

E-Rehabilitation is vital for planning and providing services for prevention of further complication and disease risk. E-rehabilitation might be a unique method to provide services based on web-based, virtual networks and to provide opportunities for education and research. Three major types of E-Rehabilitation tools are used, virtual rehabilitation (VR) platform, exergaming and immersive reality. VR platforms provide game-based exercises in virtual environment to elicit greater improvement in gait, balance, ADL function and quality of life as compared to other passive interventions in PD [4]. The major advantages of VR platform-based exercises are that they stimulate movement utilizing computer-based games in a VR environment which then allows for skills practice, motivation, motor and cognitive learning in an interactive and safe environment. This enhances adaptability and reduces medical costs. By engage in long-term exercises at home with goal-oriented practice and intensive therapy, it improves adherence and helps patients who are prone to dropping out from regular rehabilitation protocol. VR has certain limitations, such as reduced safety due to minimal direct supervision, cybersickness, cognitive overload, an inappropriate level of context of exercise and loss of human touch. To increase game performance, the patient might start using compensatory movements, thereby reducing true training effects. Therefore, to achieve successful results, VR should be applied with guidance on duration, frequency, intensity and targeted motor skills. E-virtual rehab helps to increase self-practice by use of advance games, graphics, sensors, immersive technologies and enables real-life activity by providing guidance and immersing the patients into therapeutic activity with remote access.

The role of android mobile or iPhone Operating System (iOS) based mobile health applications are found to be more useful during this COVID-19 era of PD rehabilitation. The list of mobile health applications used for treatment in patients with PD are tabulated in Table 1. Video consultation at regular intervals might motivate patients to indulge in rehabilitation exercise and boasts their self-confidence.

Exergaming is a gesture-based interaction training combining automated game instructions as well as auditory and haptic inputs to correct performance and sustain motivation levels during and after the gameplay. Home-based E-virtual rehab assists in improving overall mobility, balance, dexterity of upper limb, short-term improvement in motor functions and non-motor symptoms such as speech and voice, dysphagia (difficulty in swallowing), quality of life and satisfaction in patients with PD [5]. The major limitations of E-rehabilitation are high-cost for purchase of android mobile or iPhone Operating System (iOS) based mobile phone, reduced confidentiality, lack of appropriate level of education to use available mobile apps, age-related comorbidities, such as dementia, impaired vision and hearing, lack of face-to-face relationship between patients and rehabilitation team members and poor network connectivity at rural areas which hamper overall E-Rehab services.

Furthermore, the use of E-Rehabilitation in patients with PD might help to increase treatment compliance by enhancing home-based rehabilitation with promising outcomes and accessibility. It might provide long-term benefits and easy access by rural community as an effective method to deliver rehabilitation care at their doorsteps. Hence, E-Rehabilitation is the foremost solution available in rehabilitating the patient with PD in COVID-19 era.

CRediT authorship contribution statement

Adarsh Kumar Srivastav: Data curation, Formal analysis, Investigation, Methodology, Resources, Software, Writing - original draft. **Asir John Samuel:** Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing - review & editing.

Declaration of competing interest

None of the authors have conflict of interest to declare.

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Table 1
List of Mobile phone based application used in E-Rehabilitation of Parkinson's disease.

E-Treatment/E-Rehabilitation mobile phone based Applications (E-Rehab Apps)	Brief description
DAF professional lite (Improve the speech) https://play.google.com/store/apps/details?id=co.speechtools.DAFPro&hl=en	Assists in improving speech and language, who have problems with stutter/stammer. Help people to speak more slowly
Word or color dot (cognitive exercise) https://play.google.com/store/apps/details?id=appinventor.ai_omlesna75.palavras&hl=en_IN	Improves coordination, reaction time and attention
uMotif (Follow-up of symptoms, medication and activity) https://play.google.com/store/apps/details?id=com.umotif.umotif_wellbeing&hl=en_IN	Helps to monitor the daily activity, medication schedule, symptoms record and to record the tremors activity
PD Warrior (Exercises) https://play.google.com/store/apps/details?id=com.pd.warrior&hl=en_IN	Enhances physical activity by performing daily exercises
ListenMee (Gait queing) https://play.google.com/store/apps/details?id=com.brainmee.listenmee&hl=en_IN	Gait training by auditory queuing. Provide queuing to improve walking speed, cadence and stride length
Peak brain training (Cognition) https://play.google.com/store/apps/details?id=com.brainbow.peak.app&hl=en_IN	Cognitive functions improvement by training memory, attention and problem solving
Parkinson mPower study app (Gait, balance, tremor) https://apps.apple.com/us/app/parkinson-mpower-2/id1375781575	Helps in monitoring and manage the symptoms of Parkinson's disease such as gait, balance and, tremor
Parkinon Home exercise (Home exercises) https://apps.apple.com/us/app/parkinson-home-exercises/id473641730	Set of home exercises to improve balance, gait, and activities of daily living
Tippy Tap-Alfabeto (tremor, coordination) https://apps.apple.com/us/app/tippy-tap/id853590523	Improves coordination and minimizes hand tremor by finger tapping game
Swallow prompt (drooling) https://apps.apple.com/us/app/swallow-prompt/id574942154	Manages the difficulty in salivation

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