Teleneurology for Physicians
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INTRODUCTION

World Health Organization defines telemedicine as “the provision of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies to exchange valid information for the diagnosis, treatment, and prevention of diseases and injuries, research and evaluation, and continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities.”1–5 Although telemedicine has been available since the late 18th century, the concept of teleneurology gained momentum with the emergence of the COVID-19 pandemic, with most countries adopting the mandatory practice of social distancing and interruption of public transportation facilities.6 In the case of teleneurology, even before the pandemic, the scarcity of tissue plasminogen activator (tPA)—enabled hospital programs had already propelled the development of telestroke networks utilizing Internet technology in the late 1990s and early 2000s.7 Closer to home, Bahrami et al. working at AIIMS, New Delhi, had published the results of a randomized control trial in 2017, impressing the potential of telemedicine. Their investigation documented that for outpatients with epilepsy, telephone review was superior to face-to-face review in terms of costs and the number of patients retained in follow-up.8,9 Although telemedicine has been used for many years in India, the government of India released detailed guidelines for the use of telemedicine in March 2020 to provide healthcare professionals with precise do’s and don’ts of teleconsulting, a detailed discussion of which is beyond the scope of this review.

In countries like India, where there is a shortage of trained medical professionals, telemedicine provides a medium for expert neurological services to remote and underserved areas and reduces the disparity between availability and the need for neurological care.6–10 The use of telemedicine in the field of neurology, “teleneurology,” has been gaining impetus in the last few years, especially in the management of conditions such as stroke, epilepsy, Parkinson’s disease, etc., and its scope continues to expand.10–14

Ways of Delivering Teleneurology

Teleneurology can be used in various forms (Flowchart 1), such as real-time video conferencing, which has been increasingly used with features of media such as WhatsApp or Zoom calling since the emergence of the Internet and the COVID pandemic. Other forms include asynchronous store and forward technology or remote monitoring.15–20

Telemedicine can be used in neurology for the following purposes.
• Consultations
• Rehabilitation
• Education
• Research

Teleconsultations

The most widespread use, as expected, is for teleconsultations for conditions such as stroke, epilepsy, movement disorders, headache, etc. With experience, telemedicine can provide adequate information for certain areas of neurological assessments like history taking, higher mental function and cranial nerves examinations, power testing, cerebellar and gait examinations, etc. (Flowchart 2). On the contrary, for modalities like examination of tone, reflexes, sensory examination, and fundus testing, teleconsults are likely to be suboptimal.9,21

Virtual neurological examination:22,23 Now, we discuss the current use of teleconsultations in some of the important areas of neurology. We begin with stroke as it is perhaps the most vital area for teleconsultations

Stroke: Since intravenous thrombolysis has found its place in the treatment of acute strokes, evaluation and emergency treatment of acute strokes have become one of the most frequent uses of teleneurology.27–29 Telestroke networks provide expertise to hospitals in remote areas where there is an unavailability of trained neurologists or stroke specialists.30–33 Patients treated with intravenous (IV) tPA through telestroke consults had similar positive results compared to those with in-person consultations and identical rates of intracerebral hemorrhage.31,33–37 In 2014, a telestroke program was started in Himachal Pradesh under the guidance of Prof Padma Srivastava of AIIMS, New Delhi, where more than 150 stroke patients have received IV thrombolysis therapy without the need for additional infrastructure and manpower.28,29 Dr Amit Kumar Pande and his team have made available a telestroke service throughout Maharashtra since the last 2.5 years, at the beginning of the COVID pandemic (unpublished data). They started to use telestroke thrombolysis in remote places where access to a neurologist was rarely or never possible. Physicians and neurologists were enthusiastic about the idea of providing access to a stroke patient

Flowchart 1: Types of teleneurology

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Tele-education

As of 2022, the number of neurologists in India is not enough when faced with the vast population of India. Moreover, a large proportion of them is in metropolitan cities, leaving further smaller numbers to cater to the rural and semi-urban settings. Therefore, a significant proportion of neurological diseases in India are treated by internal medicine physicians and family practitioners. There is a continuing need for interaction between neurologists and physicians for the exchange of knowledge regarding neurological diseases and therapies. Tele-education provides these avenues, and it is noteworthy that the Indian Association of Neurology, along with the Association of Physicians of India (API), in a joint venture, are currently offering a webinar series that has attracted hundreds of physicians from all over India. Similarly, API and the Indian College of Physicians organize webinar series-educational programs to update physicians all over India by experts in different fields and provide certificate/credit hours. Such joint ventures can be conducted in the virtual world with great ease and with wide benefits to various specialties.
Teleresearch
At this point in time, the potential for multicentric work using telemedicine has not been well utilized in India. One of the strengths of the Indian situation is the high numbers of afflicted individuals, and studying them cohesively on uniform platforms can provide the much-required information about therapies, their cost effectiveness, long-term quality of life, and other related issues. Teleresearch can be used to enhance awareness and applicability of research methodology and reviews of the literature for new and experienced researchers. Online ethics committee meetings can be held for the approval of research topics. Data collection, either telephonically or through video calls via different media, can form the substrate for research projects. We do hope that these get utilized by Indian physicians.

Practice Points and Pitfalls
From the above discussion, it can be surmised that teleneurology can be utilized by physicians and family practitioners in their daily work as enumerated below (Fig. 2).
- To obtain an opinion from a neurologist to guide ongoing treatment.
- Help to arrive at decisions for acute situations, for example, stroke thrombolyis.
- For physicians to follow up on their chronic neurology patients, for example, epilepsy and Parkinson's disease.
- For physiotherapists to guide and monitor progress.
- Conferences among multiple consultants to formulate action plans.
- Updating one's knowledge base.

In the future, the scope will extend to teleresearch as well. However, there are some cautions that need to be mentioned. An in-person examination can unearth much more details than is feasible in the online mode, and some neurological cases require that type of examination for diagnostic purposes. This is particularly true for some parts of the neurological examination such as the sensory examination, tendon reflexes, and optic fundi. In some instances, the human touch works well for the interaction. A sector of the population cannot relate to or navigate through an electronic consultation. All these factors should also be considered in the broad view of the telesystem.
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CONCLUSIONS

Teleneurology has been an integral part of the care and clinical practice of neurological patients in recent times. Although teleneurology is being used in the service sector and for updating one's knowledge base, it is still in its early days. The potential is enormous. Teleneurology can be used by clinicians for tele-education and telereferencing and by patients to obtain teleconsultation or seek information. It is particularly useful in the guidance for acute stroke management, especially with regard to thrombolysis. Timely follow-up can be ensured, which can improve compliance and adherence. Teleradiology and telepathology can be used for remote follow-up can be ensured, which can improve guidance for acute stroke management, information. It is particularly useful in the references in recent times. Although teleneurology