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# Telemedicine in Neurological Healthcare: A Literature Review and Experience from a Neurology Department

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## ABSTRACT

**Background:** Telemedicine has emerged as a transformative tool in neurological care, providing remote access to specialized consultations in regions with limited resources. While acute stroke has dominated the literature, the broader role of telemedicine in other neurological subspecialties requires equal emphasis.
**Objective:** To review the evidence supporting telemedicine in neurological care, evaluate the reliability of virtual neurological examinations, and describe the practical implementation of a weekly teleneurology clinic in Meknes, Morocco.
**Methods:** A narrative literature review was conducted, including publications from 2010–2025 on telemedicine in epilepsy, movement disorders, multiple sclerosis, headache, and neuro-oncology. A descriptive case study of the Thursday telemedicine clinic in Meknes is also presented.
**Results:** The literature demonstrates that many components of the neurological examination are reliable when performed remotely, particularly assessments of cognition, speech, motor function against gravity, coordination, and gait. Telemedicine has proven valuable in the long-term management of epilepsy, Parkinson's disease, multiple sclerosis, headache, and neuro-oncology, supporting follow-up, medication adjustments, and patient counseling. The Meknes clinic illustrates the feasibility of structured telemedicine in a middle-income country, improving continuity of care while highlighting challenges such as digital inequities and limitations in examination fidelity.
**Conclusion:** Telemedicine represents a durable and effective complement to in-person neurology, especially for chronic disease management. Structured workflows, adequate training, and supportive legislation are essential to ensure sustainability and patient safety.

## KEYWORDS

teleneurology, epilepsy telemedicine, Parkinson's disease, multiple sclerosis, headache, neuro-oncology, neurological examination, digital health, Morocco, telehealth

# MAIN ARTICLE

## Introduction

Neurological diseases represent a major burden worldwide, and access to specialist care is particularly constrained in low- and middle-income countries. Telemedicine, defined as the delivery of healthcare services at a distance using information and communication technologies, has progressively integrated into neurological practice. The COVID-19 pandemic accelerated its adoption, but its potential extends far beyond emergency contingencies.

Most of the literature on teleneurology has concentrated on acute stroke, where remote decision-making has been validated extensively. However, chronic neurological conditions such as epilepsy, Parkinson's disease, multiple sclerosis (MS), migraine, and neuro-oncology also stand to benefit greatly from structured virtual care. These conditions require longitudinal management, frequent medication adjustments, and monitoring of functional status, all of which can be facilitated by telemedicine.

This article reviews the evidence for telemedicine in non-stroke neurological practice, emphasizing chronic disease management and patient follow-up. It also describes the experience of a weekly telemedicine clinic in Meknes, Morocco, where neurological examinations are performed every Thursday, offering a real-world example of implementation in a middle-income setting

## Methods

- A narrative review of the literature was performed, focusing on articles published between 2010 and 2025. Databases searched included PubMed, Scopus, and Google Scholar. The keywords used were: *telemedicine*, *teleneurology*, *epilepsy telemedicine*, *Parkinson's disease telehealth*, *multiple sclerosis telemedicine*, *headache telemedicine*, and *neuro-oncology telemedicine*. Priority was given to systematic reviews, meta-analyses, randomized controlled trials, consensus statements, and major guidelines from professional societies such as the American Academy of Neurology (AAN) and World Health Organization (WHO).

- The second component of this article is a descriptive case study of the Thursday telemedicine clinic in Meknes, Morocco. The clinic is presented in terms of its structure, workflow, benefits, and challenges, based on programmatic observations.

## Results

### Remote Neurological Examination

The neurological examination, although traditionally hands-on, has been shown to translate partially into the virtual environment. Cognitive and language assessments are readily feasible, including orientation, memory, naming, repetition, and fluency tasks. Cranial nerve functions such as extraocular movements, facial symmetry, and tongue deviation can be reliably assessed by video. Motor testing against gravity, coordination (finger-to-nose and heel-to-shin), and gait observation are also reproducible.

Limitations persist for reflex testing, assessment of tone, subtle pyramidal signs, and fundoscopy. These elements generally require in-person evaluation. Patient preparation—such as camera positioning, adequate lighting, and caregiver assistance—significantly enhances the reliability of remote examinations .

### Epilepsy

Telemedicine has been particularly effective in the management of epilepsy. Virtual visits allow neurologists to collect seizure histories, review adherence, counsel patients on safety, and adjust medication regimens. Several studies have confirmed high levels of patient satisfaction and equivalent seizure control compared to in-person care . While diagnostic EEG and pre-surgical evaluations remain in-person procedures, telemedicine is especially useful in chronic follow-up and counseling.

### Movement Disorders

Patients with Parkinson's disease and other movement disorders benefit substantially from telemedicine. Bradykinesia, tremor, and overall mobility can be observed via video. Virtual consultations have been used effectively to adjust levodopa dosing, monitor response to therapy, and support deep brain stimulation follow-up . However, rigidity and postural reflex testing are not easily replicable, necessitating periodic in-person evaluations. Telemedicine also plays an important role in caregiver education and multidisciplinary team integration.

### Multiple Sclerosis

For multiple sclerosis, telemedicine enables regular monitoring of relapses, review of medication adherence, and management of symptoms such as fatigue, pain, and spasticity. Remote consultations have been integrated with electronic patient-reported outcome measures, allowing neurologists to track functional scores and quality of life. Several pilot

studies have shown that telemedicine can reduce hospital visits while maintaining clinical outcomes .

Headache and Migraine

Headache disorders are highly suitable for virtual care. Migraine management relies heavily on detailed history rather than physical examination, making it an ideal candidate for telemedicine. Virtual consultations allow review of triggers, optimization of preventive and acute regimens, and monitoring of disability through standardized questionnaires such as the MIDAS score. Red-flag symptoms, however, must be carefully triaged for in-person assessment .

Neuro-Oncology

In neuro-oncology, telemedicine facilitates follow-up consultations, symptom monitoring, and survivorship care. Patients with malignant brain tumors often experience fatigue, mobility limitations, and immunosuppression, making travel to tertiary centers challenging. Virtual visits allow oncologists and neurologists to monitor treatment-related toxicities, coordinate supportive care, and maintain continuity between imaging intervals . In-person visits remain necessary for imaging review and procedures.

Case Study: The Meknes Thursday Clinic

In Meknes, a telemedicine clinic dedicated to neurology has been held every Thursday, offering structured virtual consultations. The initiative was developed to extend specialist care to patients in urban and rural areas who otherwise face barriers to access.

Patients are contacted days in advance with clear instructions: ensuring a well-lit environment, preparing a space for gait examination, and arranging for a family member to assist. On the day of the consultation, a medical assistant verifies patient identity, confirms informed consent, and ensures technical readiness. The neurologist then conducts a structured neurological exam, adapted to the virtual format.

The clinic has demonstrated significant benefits. Patients with epilepsy, migraine, Parkinson’s disease, and multiple sclerosis receive timely follow-up without the burden of travel. Caregivers are engaged in the process, increasing adherence to treatment plans. The clinic also functions as a triage point: patients with red-flag symptoms are rapidly directed to emergency services or in-person evaluation. Challenges include variability in internet connectivity, disparities in digital literacy, and the limitations of remote examination.

## Discussion

This review and departmental case study demonstrate that telemedicine has become a practical and reliable complement to in-person neurological care. Although its adoption was accelerated by the COVID-19 pandemic, the accumulated evidence now shows that teleneurology has a role well beyond crisis management [1]. Neurology, a discipline traditionally anchored in bedside examination, has demonstrated surprising adaptability to virtual platforms, particularly when supported by structured workflows and clear protocols [2].

### Comparison with Existing Literature

Much of the early literature in telemedicine focused on acute stroke, but as shown in this review, the field has expanded significantly into chronic neurological diseases. Epilepsy follow-up, migraine management, and Parkinson's disease consultations are particularly well-suited to virtual care because they rely heavily on patient history and observable motor features [1,3]. Studies consistently report high patient satisfaction, suggesting that telemedicine is not only acceptable but in many cases preferable for patients who must otherwise travel long distances or face long waiting times [3].

Multiple sclerosis and neuro-oncology highlight another important dimension: the ability of telemedicine to reduce the burden of frequent follow-up visits for patients who are often immunosuppressed or physically limited [2]. These applications underscore that telemedicine is not merely a substitute for in-person care but rather a strategic adaptation to patient needs that enhances quality of life [3].

### Strengths and Limitations

The strength of telemedicine lies in its ability to provide continuity of care, reduce travel, and involve caregivers directly in consultations. In our neurology department, caregivers have become active participants during weekly consultations, assisting in examination maneuvers such as gait testing or facial symmetry evaluation. This collaborative approach strengthens adherence to treatment plans and improves patient safety [1].

Nevertheless, significant limitations must be acknowledged. Certain components of the neurological exam remain impossible to replicate virtually, such as reflex assessment, evaluation of tone, and fundoscopy. These limitations raise medico-legal and clinical questions, as missing a subtle pyramidal sign or papilledema could delay diagnosis of a serious condition [2]. For this reason, telemedicine should be positioned as a complement to, not a replacement for, in-person neurology. Clear triage protocols are therefore essential, ensuring that red-flag symptoms trigger immediate referral for face-to-face assessment [2,3].

### Implications for Low- and Middle-Income Countries

In Morocco and other middle-income countries, the uneven distribution of neurologists poses a major barrier to care [4]. Urban centers often have neurology departments, while rural and peripheral regions are underserved. Telemedicine offers a realistic solution to reduce this gap. The weekly clinic in Meknes has shown that even with limited resources, structured telemedicine programs can expand access to patients who might otherwise be lost to follow-up [4,6].

However, digital inequities remain a major challenge. Many patients in rural Morocco lack stable internet connections or adequate devices. Digital literacy can also be a barrier, particularly among elderly patients who are most in need of neurological care. Addressing these inequities requires public investment in digital infrastructure, simplified platforms, and support services for patients and families [4,5].

**Ethical, Legal, and Policy Considerations**

Telemedicine also raises critical ethical and legal issues. Confidentiality, informed consent, and data protection must be safeguarded. In Morocco, the existence of Law No. 131-13 provides a framework for telemedicine, but further operational guidelines are needed to standardize practices across neurology departments . Internationally, frameworks such as the WHO digital health strategy and the European GDPR highlight the importance of patient autonomy, interoperability, and data security. Departments implementing telemedicine must integrate these principles into daily workflows, ensuring patients understand the limitations and risks of virtual consultations .

**Future Directions and Research Gaps**

Several important gaps remain in the evidence base. First, large-scale comparative studies are still needed to evaluate long-term outcomes of teleneurology across diverse populations [2,3]. Second, more research is required on cost-effectiveness in low- and middle-income settings, where telemedicine may reduce travel but requires investment in infrastructure and training [4]. Third, the role of artificial intelligence and digital biomarkers in supporting neurological examinations remains largely unexplored. Wearable devices and smartphone-based assessments may, in the near future, allow remote measurement of tremor amplitude, gait speed, or seizure detection, further enhancing the scope of telemedicine [7].

Finally, there is a need for rigorous quality-improvement frameworks. Neurology departments adopting telemedicine should measure patient outcomes, safety events, satisfaction, and equity of access on a regular basis. Such data can be used to refine protocols and inform national policy [2].

## Conclusion

Telemedicine is reshaping neurological practice, extending its role far beyond acute stroke into chronic disease management. The evidence supports its feasibility and effectiveness in epilepsy, Parkinson’s disease, multiple sclerosis, headache, and neuro-oncology. The Meknes Thursday clinic illustrates how structured, protocol-driven telemedicine can be successfully implemented in a middle-income setting, improving access and continuity of care. To ensure sustainability, health systems must invest in digital infrastructure, patient education, and regulatory frameworks that protect both clinicians and patients.

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