

The Outcome of Telemedicine Usage in Neurology: A Systematic Review

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Abstract— The field of telemedicine is developing rapidly with teleneurology being one of the branch. The use of teleneurology has helped patients gain easier access to medical care. Various studies have studied the effect of teleneurology on medical care. Thus, this systematic review is created to evaluate the outcome of teleneurology usage. Literature search was performed via PubMed, Cochrane Library, ScienceDirect, Wiley Online Library, and EBSCOhost databases. Studies selected were studies that evaluated the outcome of teleneurology from inception to June 11, 2022. Five studies were selected from literature search. Three of the studies found that teleneurology helps patient gain easier access and reduction of cost usage. The studies also found that teleneurology satisfies patients' and caregivers' needs. Teleneurology helps with easier access to healthcare, reduction of cost in healthcare, and fulfills the needs of patients and caregivers.

Keyword: neurology, outcome, telemedicine

1. Introduction

The use of telecommunication technology to deliver medical care or telemedicine has been growing ever since it was first introduced. The advance of telemedicine offers easy access to medical care through e-mails, video calls, access to medical information, and care for patients in rural areas. As it makes medical care easier for medical provider and patients, medical consultations and advice can now be obtained locally, saving up time of travels, and giving ease of receiving medical care.^{1,2}

Teleneurology, a branch of telemedicine, has been developing rapidly with many studies researching on its effectivity. Several studies have shown that teleneurology can help with early diagnosis of patients with neurological symptoms and unable to travel to hospital or clinic to receive medical care. Thus, teleneurology has been useful to prevent patients from receiving late medical care which may lead to complications.^{3,4} However, as this field is still developing, there are many studies with varying outcomes and may confuse clinicians on teleneurology. Therefore, this study is conducted to create a systematic review to clear things regarding the outcome of teleneurology.

2. Methods

2.1 Literature Search Strategy

The preferred reporting items for systematic reviews and meta-analysis (PRISMA) was used to create this systematic review. Relevant studies were retrieved from PubMed, Cochrane Library, ScienceDirect, Wiley Online Library, and EBSCOHost from inception to June 11, 2022. The

search terms are as follows: (“telemedicine” AND “neurology” [All Fields]) OR “teleneurology [All Fields]) AND (“Outcome” [All Fields]). The search included clinical studies with no language restrictions. However, studies included in this systematic review were restricted to English which were the only language readable by the reviewers. Figure 1 shows the details of the literature search strategy.

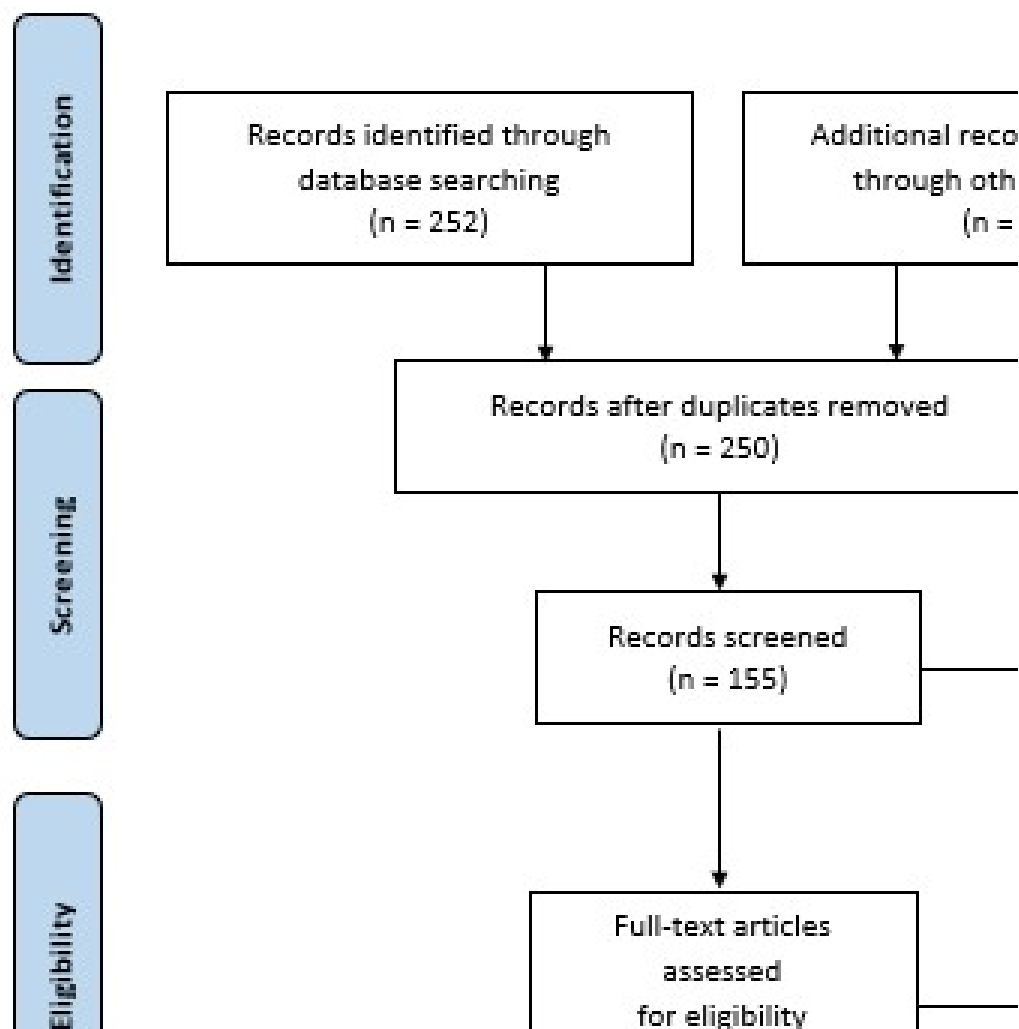


Figure 1. Literature search strategy.

2.2 Inclusion and Exclusion Criteria

The inclusion criteria for the included studies were: (1) study design: clinical study; (2) language: English; (3) comparison and intervention: the use of teleneurology in diagnosis and treatment of patients; (4) outcome parameter: patient satisfaction, clinical outcome, and cost. Moreover, the exclusion criteria were (1) no extractable data and (2) irretrievable full-text articles.

2.3 Study selection

The study selection process is shown in figure 1. Initial search yielded 252 studies of which 95 studies were irrelevant and removed. 89 studies were further excluded after screening the title and/or the abstract. 66 studies were assessed for eligibility with 61 being excluded. 5 studies were included in this systematic review.

2.4 Data Extraction

Literature search and data extraction were performed by Nurul Rakhmawati independent reviewers. Disagreements were solved through discussion. The following information were extracted from the studies: authors name and title of the study, study design, intervention methods used, results, and conclusion of the study.

3. Results

3.1 Characteristics of the Studies

The characteristics of the included studies are shown in appendix 1. The studies mostly aimed to study the satisfaction of the patient, fulfilling the need of the patient, and accessibility of patient to medical care.

3.2 Studies Outcome

Three studies studied that telemedicine in neurology reduces the barrier of healthcare access for patients and reducing the cost of healthcare access. Of all the studies, patients are mostly satisfied with teleneurology and feel their needs of healthcare access fulfilled. Not only does it benefit the patient, a study found that caregivers needs are also fulfilled to help caring for patients with dementia.⁵⁻⁹

4. Discussion

The use of telemedicine in neurology have expanded access of medical care in underserved regions. The five studies included in this systematic review agreed on the matter of teleneurology being able to reach poorly accessible populations. Moreover, study by Lacritz et al found that the reason why patients choose telemedicine in neuropsychological care is to avoid exposure from disease and the flexibility and convenience it offers.⁸ However, there are still challenges in teleneurology which could not replace in-person doctor-patient meeting.^{10,11}

A study by Hanna GM et al found that building a doctor-patient relationship is harder through teleneurology and patients are less able to express their feelings and complaints through teleneurology.⁵ This is further supported by the study of Lacritz LH et al on neuropsychological services which found that 67.7% of the patients prefer in-person doctor-patient meeting compared to teleneurology.⁸ Patients in the study must have felt this way because physicians will have a harder time understanding body language through telemedicine which actually comprises of about 80% of the message the patient is trying to convey.¹¹ By not being understood, building trust in a doctor-patient relationship will be harder to achieve and may hinder overall patient's outcome.¹² Although doctor-patient relationship is a challenge in teleneurology, further studies are needed to compare doctor-patient relationship between teleneurology and in-person doctor-patient meeting and ways to maximize doctor-patient relationship in teleneurology.

Not only does teleneurology break the barrier of accessing neurology care, teleneurology also saves up on cost and time usage. Study by Caze et al found that the use of teleneuropsychological care

saves up approximately \$500 per evaluation and reduction in time. Reduction in time of neuropsychological service for in-person meeting compared to teleneurology differs up to 6 hours of time. The effectiveness in time can give more neuropsychological services to patients in a day which expands the medical care to more patients.⁶ Not only that, but the effectiveness in cost also eliminates the economic barrier patients usually face in accessing medical care.

Two studies by Lacritz et al and Lindauer et al assessed whether teleneurology fulfill the needs of the patients. Caregivers caring for dementia patients in Lindauer et al study feels their needs fulfilled as caregivers can access guidance and support through telemedicine. Moreover, stress assessment on caregiver stress shows that caregivers with access to telemedicine has reduced overall stress assessment.^{8,9}

5. Conclusion

Overall, the use of teleneurology breaks the barrier of accessing healthcare, saves up on time and cost, and fulfills the needs of caregivers and patients. However, teleneurology still has its challenges especially regarding the doctor-patient relationship. Not many studies have assessed the doctor-patient relationship outcome in teleneurology and ways to maximize teleneurology. More studies are still needed to solve the challenges in teleneurology.

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Appendix 1

No.	Authors	Title	Study Design	Intervention	Result	Conclusion
1	Hanna GM et al, 2016	Development and patient satisfaction of a new telemedicine service for pain management at Massachusetts General Hospital to the Island of Martha's Vineyard	Clinical study	Patients at Martha's Vineyard Hospital (MVH) were seen in telepain clinic 3 days per month by a physician located at Massachusetts General Hospital (MGH) for initial consultations and follow-up visits. Communication was mediated by live videoconference controlled by the physician at MGH. - The telepain experience were then evaluated using a 14-question Likert-scale survey.	<ul style="list-style-type: none"> - In the first 13 months, 238 virtual telepain evaluations were performed (185 initial consultations and 53 follow-up visits). - The most common procedures were epidural steroid injections (N = 48) and medial branch blocks (N = 29). - 49 patients agreed to be surveyed after their telepain visit. Mean score for the survey was > 4.57 with mean of each individual questions were > 4.3, indicating the favorable impression towards the telepain experience. - Lowest mean scores were found when respondents were asked to compare the care by telepain vs in-person and whether they were able to develop a friendly relationship with the doctor. 	<p>Telemedicine can be used as a tool to reach out to a poorly accessible population and to achieve high patient satisfaction with the services provided.</p> <ul style="list-style-type: none"> - There's still a challenge of building a patient-physician relationship remotely. - The program will collect objective data in the future to compare the efficacy of telemedicine with in-person visits using pain scores comparison between randomized patients to receive each intervention.

2	Caze et al, 2020	Can You Hear Me Now? Telephone-Based Teleneuropsychology Improves Utilization Rates in Underserved Populations	Clinical study	<p>174 patients were scheduled for neuropsychological services from November 2019 to June 2020 and starting March 18, 2020, all patients were seen via TeleNP.</p> <ul style="list-style-type: none"> - To compare clinical utilization rates, data for in-person were retrospectively analyzed during the 4-month prior to Covid-19. - The evaluation consisted of record review, clinical interview, neuropsychological testing, and interactive feedback on the same day. 	<ul style="list-style-type: none"> - 90 patients were scheduled for in-person evaluations between November 2019 and February 2020. 84 patients were scheduled via TeleNP from March to June 2020. The mean age was 53.06 (SD = 16.24) and mean education of 10.9 (SD = 3.76). - There were no differences between visit types in age ($p = 0.473$), or education ($p = 0.435$). - Show rates improved by 24% (55.6% vs 79.8%) using TeleNP vs in-person. - A random 20 patients were selected, the mean number of minutes per in-person evaluations was 574 whereas TeleNP's mean was 166 min. In-person evaluations averaged 9.57 hr and TeleNP averaged 2.76 hr. 	<p>TeleNP increased show rates by 24% across all races, indicating that type of service delivery could be a contributing factor to health access equity.</p> <ul style="list-style-type: none"> - TeleNP resulted in shorter barriers and approximately \$500 saved per evaluation. - TeleNP is poised to provide more affordable services to diverse population without compromising quality of care.
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3	Chalouhi N et al, 2013	Intravenous tissue plasminogen activator administration in community hospitals facilitated by telestroke service	Clinical study	<p>Telemedicine consultations are delivered through Remote Presence robotic technology, which allows patient evaluation through video communications. Anytime a patient with suspected AIS presents to the ED, the ED physician calls a “stroke alert” and an operator immediately pages the physician on call then the physician will maneuver a robot in the patient’s room, assess the patient’s neurological status, review vital signs/laboratory values, and interact with the patient, family, and ED staff. If a recommendation is made to proceed with treatment, intravenous thrombolysis is performed. Patients then transferred to a primary stroke center.</p>	<p>- 1643 telemedicine stroke consultations were completed during January 2011 and June 2012. Mean time interval from consultation request to telemedicine response was 12 minutes.</p> <p>- Overall IV-tPA use was 14% among all telestroke consultations.</p> <p>- 14.4% (237) patients of 1643 were determined to be eligible for IV-tPA based on AHA guidelines. 97% of 237 patients received IV-tPA at the spoke hospitals. IV-tPA were failed to be administered to the remaining patients due to family/patient preference, labile blood pressure, and symptom improvement.</p> <p>- 3 hospitals who joined the network < 1 year were excluded. 17 of 25 hospitals provided data on IV-tPA usage before telestroke. 82% of 17 hospitals reported a net increase in the annual use of IV-tPA after joining the telestroke network (mean increase of 55%). 6 hospitals administered IV-tPA for the first</p>	<p>Implementation of telestroke system facilitates high rates of IV-tPA in patients who have had a stroke at community hospitals in a relatively short time frame.</p> <p>- These rates are well above the national average of IV-tPA use (3.4% - 5.2%).</p> <p>- The results support the implementation of telestroke networks for wider access to stroke expertise in underserved regions.</p>
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time. 3 hospitals established a dedicated stroke unit after joining the network.- Proportion of patients who were transferred to primary stroke center after teleconsultation decreased from 44% in first 2 quarters of 2011 to 19% in the first 2 quarters of 2012 ($p < 0.001$). There was a significant linear decrease in the proportion of transfers ($p < 0.001$).

4	Lacritz LH et al, 2020	Patient Satisfaction with Telephone Neuropsychological Assessment	Clinical study	<p>Neuropsychological services at PHHS were converted to telephone-only in March 2020.</p> <ul style="list-style-type: none"> - A patient satisfaction survey was developed to assess the utility/feasibility and satisfaction of TeleNP services on campus. - 81 TeleNP participants were patients referred for neuropsychological assessment at PHHS. Patients who completed a TeleNP between March and July 2020 were contacted by phone between May and July 2020 by clinic staff familiar with TeleNP process. 	<ul style="list-style-type: none"> - Out of 81 TeleNP participants, 53% agreed to complete the survey on telephone. Mean age of participants was 52.2. Majority of respondents had 12 years of education or greater (mean = 12.1). - 97.7% of survey responses were provided by the patient, though 1 patient were represented by a family member. 55.8% patients had participated in a virtual visit with another provider. - All participants felt they were given adequate information about how to connect with their neuropsychology provider, and almost all of the participants felt comfortable using the technology (93.0%). - Most patients felt the telephone visit met their needs (79.1%) and were satisfied with the amount of time their provider spent with them (83.7%). When asked to rate overall satisfaction with their visit (Not Satisfied, Somewhat Satisfied, Satisfied, Very Satisfied), 97.7% indicated they were “Very Satisfied” (44.2%), 	<p>The TeleNP was well accepted by patients who were overall satisfied with their experience and generally felt the telephone visit met their needs, irrespective of age, sex, education, and race/ethnicity.</p> <ul style="list-style-type: none"> - Patients indicated a preference for in-person visits in general, and second of their choice was telephone visits.
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“Satisfied” (34.9%), or
“Somewhat Satisfied” (18.6%),
and only one respondent reporting
being “Not Satisfied” with the
visit.

- The majority of respondents
(67.7%) indicated a preference
for an in-person encounter.

- When asked about the
advantages and disadvantages of
TeleNP, patients answered
“Avoid potential exposure to
illness” (76.7%) and
“Flexibility/Convenience”
(67.4%).

5	Lindauer A et al, 2017	Dementia Care Comes Home: Patient and Caregiver Assessment via Telemedicine	Clinical study	<p>Persons with AD and their caregivers received an identical battery of tests both in the clinic setting and via telemedicine, approximately 2 weeks apart. To control for clinical effect, one clinician for each site switched sites after half of the sample completed the study. To control for order effect, participant dyads were randomized to receive either in-clinic or telemedicine visit first.</p>	<p>- 33 persons with AD and their 33 caregivers consented to this study, with 28 completing both an in-clinic and telemedicine visit.</p> <p>- Mean age of persons with AD was 71.6 (SD = 11.6) and 65.3 (SD = 9.6) for their caregivers.</p> <p>- Of the 28 dyads who completed the visits, four patients (14%) were unable to complete the telemedicine MoCA due to frustration or problems with comprehension. All 28 caregivers completed the in-clinic and telemedicine batteries. Mean administration time for in-clinic visits was 41.4 minutes (SD = 13) and 47.5 minutes (SD = 12.6) for telemedicine.</p> <p>- MoCA measurement had excellent reliability, ICC = 0.93. The RMBPC had excellent test-retest reliability, ICC = 0.77. The caregiver assessments of patients on the CDR had good reliability (k = 0.75), as did the GDS (ICC = 0.67). Caregiver assessments also proved to be reliable when used with the telemedicine interface, with the MMCGI-SF and the ZBI</p>	<p>Telemedicine has the potential to meet the needs of many families living with ADRD.</p> <p>- The measures can be used remotely, directly to the homes of with persons with AD, gerontologists may expand their care across barriers for easier access to dementia care.</p>
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having excellent reliability (ICC
= 0.87 and 0.79).

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