TPM Vol. 32, No. S7, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Open Access

# TELEREHABILITATION: OPTIMIZING PATIENT OUTCOMES AND ACCESSIBILITY IN POST-STROKE RECOVERY

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**Abstract**

**Background**: Stroke remains a leading cause of long-term disability worldwide, necessitating intensive and prolonged rehabilitation interventions.

**Aim:** Telerehabilitation has emerged as a promising alternative to traditional in-person therapy, offering potential solutions to barriers in accessibility, cost, and continuity of care.

**Methods:** to examine the effectiveness, accessibility, implementation challenges, and patient outcomes associated with telerehabilitation for post-stroke recovery, reveals that telerehabilitation demonstrates comparable or superior outcomes to conventional therapy across multiple domains including motor function, activities of daily living, quality of life, and patient satisfaction. Evidence indicates that synchronous video-based interventions, combined with asynchronous monitoring and virtual reality applications, yield significant improvements in functional recovery.

**Results:** shows standardized mean differences ranging from 0.42-0.68 for upper extremity function, no significant difference in ADL outcomes (SMD -0.00, 95% CI -0.15 to 0.15), and improvements in balance outcomes. Cost analyses demonstrate savings of $654-$867 per participant compared to conventional care. Accessibility benefits include 78% reduction in travel burden and enhanced service delivery to rural populations where rehabilitation access is 45% lower than urban areas. However, implementation challenges persist, including technology barriers affecting 23-35% of older adults, digital literacy gaps, and regulatory uncertainties.

**Conclusion:** This review synthesizes current evidence with detailed results tables, identifies best practices for telerehabilitation delivery, and proposes frameworks for optimizing patient outcomes while addressing existing barriers to widespread adoption.

**keywords:** telerehabilitation, stroke recovery, remote therapy, motor function, accessibility, digital health, neurorehabilitation

# 1. INTRODUCTION

## 1.1 Stroke Burden and Rehabilitation Needs

Stroke represents a critical global health challenge, ranking as the second leading cause of death and third leading cause of death and disability combined worldwide [1]. According to the World Stroke Organization Global Stroke Fact Sheet 2025, from 1990 to 2021, the global burden increased substantially with a 70% increase in incident strokes, 44% increase in deaths from stroke, 86% increase in prevalent strokes, and 32% increase in disability-adjusted life years (DALYs) [2]. Table 1 presents the comprehensive global stroke burden statistics.

**Table 1. Global Stroke Burden Statistics (1990-2021)**

| Metric | 1990 | 2021 | Change (%) |
|---|---|---|---|
| Incident strokes | 7.2 million | 12.2 million | +70% |
| Deaths from stroke | 5.7 million | 8.2 million | +44% |
| Prevalent strokes | 58.9 million | 109.4 million | +86% |
| DALYs (millions) | 111.4 | 147.2 | +32% |
| Global cost (USD) | Not available | $890 billion | - |
| % of global GDP | Not available | 0.66% | - |

*Source: Feigin et al., 2025 [2]*

Post-stroke disability is manifested in different areas, with about 50-80% of stroke survivors experiencing an upper limb impairment, about 50% continuing to have these deficits at the chronic phase six months post-stroke [3]. Cognitive impairment following stroke also affects some 75% of acute stage stroke patients, with many individuals having persistent deficits in the medium to long term [4]. Executive dysfunction is seen in as many as 75% of stroke survivors, which limits their ability to adapt to post-stroke [5].

The severe, critical need for rehabilitation after stroke is confirmed, with evidence demonstrating that intensive, repetitive, task-specific training in the acute and subacute periods maximizes functional outcome [6]. However, a range of obstacles to access to optimal rehabilitation care are present, such as geographical barriers, transportation problems, caregiver burden, cost, and capacity constraints of the healthcare system [7].

## 1.2 Telerehabilitation Emergence

Telerehabilitation, or the delivery of rehabilitation interventions through information and communication technologies, has become a viable solution to these accessibility concerns [8]. The COVID-19 pandemic fueled adoption exponentially, remaining feasible and acceptable when necessity required innovation [9].

Present telerehabilitation encompasses a range of modalities including synchronous video conference with live supervision by a therapist, asynchronous monitoring using wearable devices and smartphone applications, virtual reality (VR) and augmented reality (AR) platforms for interactive therapy experience, and hybrid models that incorporate both face-to-face and tele-supervised sessions [3,10]. Table 2 presents a summary of the key telerehabilitation modalities and features.

## 1.3 Objectives and Scope

This systematic review aims to evaluate the current status of telerehabilitation for recovery after stroke across four broad areas: clinical efficacy compared with conventional therapy, facilitation of access and population reach, issues of implementation and adoption barriers, and best practices for optimization of patient outcomes. Through the integration of evidence from recent literature (2020-2025), the review provides clinicians, healthcare managers, and policy-makers with actionable recommendations for implementing telerehabilitation into standard stroke care pathways.

**Table 2. Telerehabilitation Modalities and Characteristics**

| Modality | Description | Technology Requirements | Key Advantages | Primary Limitations |
|---|---|---|---|---|
| Synchronous Video | Real-time video conferencing with therapist | High-speed internet, webcam, video platform | Real-time feedback, therapeutic relationship | Requires scheduled appointments, internet dependency |
| Asynchronous Monitoring | Wearable sensors, mobile apps for data collection | Smartphone or tablet, sensors/wearables | Flexible timing, objective data collection | Limited immediate feedback, delayed intervention |
| Virtual Reality | Immersive VR environments for therapy | VR headset, motion controllers, gaming PC or console | High engagement, gamification, intensive practice | Equipment cost, motion sickness risk, technical complexity |
| Robot-Assisted | Robotic devices with remote supervision | Robotic equipment, internet connection | Precise movement assistance, objective measurement | High initial cost, space requirements |

| | | | | |
|---|---|---|---|---|
| Hybrid Models | Combination of in-person and remote sessions | Variable based on components | Balances benefits of both approaches | Coordination complexity, mixed reimbursement |

## 2. METHODOLOGY

### 2.1 Literature Search Strategy

A comprehensive search in several electronic databases including PubMed, Cochrane Library, Web of Science, and rehabilitation-specific databases was conducted for articles from January 2020 to October 2025. Controlled vocabulary as well as keywords related to telerehabilitation, stroke, and outcome measure were included in the search terms. A strategy was devised that sought to identify randomized controlled trials, systematic reviews, meta-analyses, and observational studies that evaluated telerehabilitation interventions in stroke recovery.

### 2.2 Inclusion and Exclusion Criteria

Inclusion criteria set studies with adult stroke patients (≥18 years) receiving telerehabilitation treatments with outcomes measuring motor function, functional independence, quality of life, cognitive function, or accessibility. The subacute (<26 weeks post-stroke) and chronic (>26 weeks post-stroke) phases were included [11]. Exclusion criteria excluded conference proceedings with no full-text access, duplicate publications, and missing control groups or comparison data.

### 2.3 Data Extraction and Synthesis

Data extraction documented study characteristics, population demographics, intervention details, outcome measures, and results. Due to extreme heterogeneity in intervention designs, technology platforms, and outcome measures across studies, data were narratively synthesized with synthesis on an outcome domain-by-domain basis [3,12]. Table 3 provides an overview of the characteristics of main systematic reviews included in this systematic review

**Table 3. Characteristics of Key Systematic Reviews (2020-2025)**

| Study | Year | Review Type | Studies Included | Total Participants | Primary Focus | Key Outcome Measures |
|---|---|---|---|---|---|---|
| Alwadai et al. [3] | 2025 | Umbrella review | 28 systematic reviews (245 primary studies) | >15,000 | Comprehensive telerehabilitation outcomes | Motor function, ADL, balance, gait, QOL |
| Stangenberg-Gliss et al. [11] | 2025 | Pyramid review | 42 studies | 1,847 | Upper extremity synchronous telerehab | FMA-UE, ARAT, WMFT, MAL |
| Pitliya et al. [23] | 2025 | Meta-analysis | 18 RCTs | 1,456 | Balance and functional outcomes | BBS, BI, TIS |
| Laver et al. [20] | 2020 | Cochrane Review | 22 studies | 1,937 | Post-discharge telerehabilitation | ADL, HRQOL, mortality |
| Chen et al. [21] | 2018 | Meta-analysis | 15 studies | 1,339 | Comprehensive telerehabilitation | BI, mRS, HRQOL |
| Hao et al. [16] | 2023 | Meta-analysis | 24 RCTs | 1,203 | VR-based telerehabilitation | FMA-UE, BBS, gait parameters |

*Abbreviations: ADL, activities of daily living; ARAT, Action Research Arm Test; BBS, Berg Balance Scale; BI, Barthel Index; FMA-UE, Fugl-Meyer Assessment Upper Extremity; HRQOL, health-related quality of life; MAL, Motor Activity Log; mRS, modified Rankin Scale; QOL, quality of life; TIS, Trunk Impairment Scale; WMFT, Wolf Motor Function Test*

## 3. Outcomes: Clinical Efficacy

### 3.1 Return of Motor Function

#### 3.1.1 Upper Extremity Function

Systematic reviews and meta-analyses published in the last few years indicate telerehabilitation has considerable impacts on motor function of the upper limb. An umbrella review of 28 systematic reviews (included 245 primary studies) identified motor function as the most commonly researched outcome category and high to moderate-

quality evidence indicating significant or no difference effects in favour of, or against, compared interventions and telerehabilitation [3].

Table 4 contain meta-analyses of upper limb outcomes after different telerehabilitation interventions with some of the highlighted findings.

### 3.1.2 Lower Limb and Gait Function

Lower limb function and gait intervention has a large to moderate effect sizes on heterogeneous outcomes. Table 6 contain new gait and mobility outcomes.

### 3.2 Activities of Daily Living and Functional Independence

A number of systematic reviews have also documented the impact of telerehabilitation on activities of daily living (ADL). Meta-analytic findings for ADL and functional independence comparisons are shown in Table 7.

Explanation: As the presence of a negative SMD value indicates that negative values are not unfavorable; they are an index of direction of the scores for certain scales. Results indicate that there is no significant between-group difference.

Breakdown of change in Barthel Index by intervention durations appears in Table 8.

### 3.3 Balance and Mobility Outcomes

Recovery in balance is among the key outcomes of telerehabilitation rehabilitation interventions. Table 9 presents overall balance outcomes in recent meta-analyses and RCTs.

### 3.4 Cognition and Communication Outcomes

Telerehabilitation after stroke-related cognitive deficit is a new area with growing evidence. Table 10 presents alphabetical listing of cognitive rehab outcomes.

### 3.5 Quality of Life and Patient Satisfaction

Improved health-related quality of life has been consistently shown in telerehabilitation trials. Outcomes on patient satisfaction and quality of life are reported in Table 11.

### 3.6 Adherence and Dropout Rates

Table 12 illustrates adherence and dropout rates for several telerehabilitation modalities.

## 4. RESULTS: ACCESSIBILITY AND COST-EFFECTIVENESS

### 4.1 Rural Populations and Geographic Access

Geographic disparities in rehabilitation access are greatly decreased by telerehabilitation. Table 13 shows evidence of geographic accessibility gains.

### 4.2 Economic Implications and Cost-Effectiveness

Fine-grain cost analyses yield robust economic advantages of telerehabilitation. Table 14 shows fine-grain cost comparison evidence.

### 4.3 Temporal Accessibility and Schedule Flexibility

Table 16 merges temporal accessibility gain with telerehabilitation.

## 5. Obstacles to Implementation and Challenges

### 5.1 Technology Impediments and Digital Divide

Albeit with encouraging outcomes, technology barriers are a real implementation challenge. Table 17 shows technology availability and barrier data by population groups.

### 5.2 Patient and Provider Barriers

Table 19 provides survey findings on patient-surveyed telerehabilitation barriers and facilitators.

### 5.3 Regulation and Reimbursement Environment

Table 21 integrates reimbursement policy and regulatory issues across jurisdictions.

### 5.4 Adverse Events and Safety Issues

Table 22 shows a summary of adverse event frequencies in telerehabilitation trials and standard rehabilitation.

## 6. Implementation Model and Best Practice

### 6.1 Patient Selection Criteria

Table 23 summarizes the evidence-based patient selection criteria for telerehabilitation candidacy.

### 6.3 Dosage Guidelines for Intervention

Table 25 presents evidence-based dosage for different stages of stroke and levels of impairment.

**Table 4. Meta-Analytic Results: Upper Extremity Function Outcomes**

| Study | Intervention Type | Outcome Measure | Studies (n) | Participants (n) | Effect Size (SMD/MD) | 95% CI | p-value | Interpretation |
|---|---|---|---|---|---|---|---|---|
| Hao et al. [16] | VR-based telerehab | FMA-UE | 18 | 892 | MD: 5.8 points | 4.2 to 7.4 | <0.001 | Significant improvement |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Hao et al. [16] | VR-based telerehab | ARAT | 12 | 634 | MD: 6.3 points | 3.8 to 8.9 | <0.001 | Significant improvement |
| Sanchez et al. [14] | CIMT-telerehab | FMA-UE | 8 | 287 | SMD: 0.68 | 0.42 to 0.94 | <0.001 | Moderate-large effect |
| Sanchez et al. [14] | CIMT-telerehab | MAL-AOU | 6 | 234 | SMD: 0.52 | 0.24 to 0.80 | <0.001 | Moderate effect |
| Stangenberg-Gliss [11] | Synchronous video | FMA-UE | 15 | 743 | SMD: 0.42 | 0.18 to 0.66 | 0.001 | Small-moderate effect |
| Stangenberg-Gliss [11] | Automated systems | FMA-UE | 8 | 412 | SMD: 0.28 | 0.02 to 0.54 | 0.034 | Small effect |

Abbreviations: ARAT, Action Research Arm Test; CIMT, constraint-induced movement therapy; FMA-UE, Fugl-Meyer Assessment Upper Extremity; MAL-AOU, Motor Activity Log Amount of Use; MD, mean difference; SMD, standardized mean difference; VR, virtual reality.Note: FMA-UE minimal clinically important difference = 5.25 points; ARAT MCID = 5.7 points

**Table 5. Task-Oriented Telerehabilitation Outcomes by Stroke Phase**

| Stroke Phase | Sample Size | Baseline FMA-UE (mean ± SD) | Post-Intervention FMA-UE | Change from Baseline | Effect Size (Cohen's d) | Clinical Significance |
|---|---|---|---|---|---|---|
| Subacute (<6 months) | 87 | 32.4 ± 12.8 | 44.7 ± 14.2 | +12.3 ± 6.4 | 0.96 | Large, exceeds MCID |
| Early chronic (6-12 months) | 124 | 38.6 ± 15.3 | 47.2 ± 16.1 | +8.6 ± 5.7 | 0.56 | Moderate, exceeds MCID |
| Late chronic (>12 months) | 93 | 41.2 ± 14.6 | 46.8 ± 15.4 | +5.6 ± 4.2 | 0.38 | Small, meets MCID |
| Overall | 304 | 37.8 ± 14.5 | 46.3 ± 15.3 | +8.5 ± 6.1 | 0.59 | Moderate, exceeds MCID |

Source: Hong et al., 2025 [13]. Note: MCID for FMA-UE = 5.25 points

**Table 6. Lower Extremity and Gait Function Outcomes**

| Study | Intervention | Outcome Measure | Sample Size | Baseline | Post-Intervention | Change | p-value | Effect Size |
|---|---|---|---|---|---|---|---|---|
| Bonanno et al. [19] | Sensor-based VR | 10-Meter Walk Test (m/s) | 42 | 0.48 ± 0.18 | 0.62 ± 0.21 | +0.14 ± 0.08 | 0.01 | d = 0.78 |
| Bonanno et al. [19] | Sensor-based VR | Timed Up-Go (seconds) | 42 | 28.3 ± 8.4 | 24.1 ± 7.2 | -4.2 ± 2.8 | 0.01 | d = 0.54 |
| Sheehy et al. [18] | Home VR training | 6-Minute Walk (meters) | 38 | 284 ± 96 | 322 ± 103 | +38 ± 24 | 0.002 | d = 0.64 |
| Sheehy et al. [18] | Home VR training | Step count (daily) | 38 | 3,420 ± 1,240 | 4,680 ± 1,580 | +1,260 ± 640 | <0.001 | d = 0.89 |
| Hao et al. [16] | VR telerehab (meta) | Walking speed (m/s) | 628 | - | - | +0.12 | <0.001 | MD: 0.12 (0.08-0.16) |
| Hao et al. [16] | VR telerehab (meta) | Cadence (steps/min) | 412 | - | - | +6.8 | 0.002 | MD: 6.8 (2.4-11.2) |

Abbreviations: MD, mean difference; VR, virtual reality

**Table 7. Meta-Analytic Results: ADL and Functional Independence**

| Study | Comparison | Outcome Measure | Studies (n) | Participants (n) | Effect Size (SMD) | 95% CI | p-value | Quality of Evidence |
|---|---|---|---|---|---|---|---|---|
| Laver et al. [20] | Telerehab vs usual care | ADL (various scales) | 12 | 1,187 | -0.00 | -0.15 to 0.15 | 0.99 | Moderate |
| Laver et al. [20] | Telerehab vs in-person PT | ADL (various scales) | 6 | 392 | 0.03 | -0.43 to 0.48 | 0.91 | Low |
| Chen et al. [21] | Telerehab vs control | Barthel Index | 15 | 1,339 | -0.05 | -0.18 to 0.08 | 0.45 | Moderate |
| Chen et al. [21] | Telerehab vs control | Modified Rankin Scale | 8 | 724 | -0.12 | -0.31 to 0.07 | 0.21 | Low-moderate |
| Pitliya et al. [23] | Telerehab vs standard care | Barthel Index | 11 | 892 | -0.34 | -1.00 to 0.32 | 0.31 | Low |
| Alwadai et al. [3] | Various telerehab | ADL outcomes | 28 reviews | >15,000 | Narrative | No difference or small positive | - | Moderate-high |

Abbreviations: ADL, activities of daily living; PT, physical therapy; SMD, standardized mean difference

**Table 8. Barthel Index Outcomes by Intervention Duration**

| Intervention Duration | Studies (n) | Participants (n) | Baseline BI (mean) | Post-Intervention BI | Absolute Change | SMD (95% CI) | Clinical Significance |
|---|---|---|---|---|---|---|---|
| ≤4 weeks | 4 | 247 | 58.3 | 66.8 | +8.5 | 0.18 (-0.12 to 0.48) | Small, not significant |
| 5-8 weeks | 8 | 632 | 62.4 | 74.8 | +12.4 | 0.32 (0.08 to 0.56) | Small-moderate, significant |
| 9-12 weeks | 6 | 418 | 64.7 | 78.2 | +13.5 | 0.38 (0.12 to 0.64) | Small-moderate, significant |
| >12 weeks | 3 | 186 | 66.2 | 80.8 | +14.6 | 0.42 (0.08 to 0.76) | Moderate, significant |

Note: Barthel Index range 0-100; higher scores indicate greater independence. MCID = 10 points

**Table 9. Balance and Mobility Outcomes**

| Study | Intervention | Outcome Measure | Sample Size | Effect Size | 95% CI | p-value | Interpretation |
|---|---|---|---|---|---|---|---|
| Lloréns et al. [22] | VR telerehab vs clinic | Berg Balance Scale | 54 | MD: -0.8 | -3.2 to 1.6 | 0.51 | Non-inferior |
| Sheehy et al. [18] | Home VR training | Berg Balance Scale | 38 | MD: +5.2 | 2.4 to 8.0 | 0.001 | Significant improvement |
| Pitliya et al. [23] | Telerehab (meta) | Berg Balance Scale | 12 studies, 734 pts | SMD: 0.08 | -0.23 to 0.40 | 0.54 | No difference vs control |
| Pitliya et al. [23] | Telerehab (meta) | Trunk Impairment Scale | 6 studies, 342 pts | SMD: -0.21 | -1.18 to 0.76 | 0.02 | Significant improvement |
| Hao et al. [16] | VR telerehab (meta) | Berg Balance Scale | 16 studies, 842 pts | MD: +4.6 | 2.8 to 6.4 | <0.001 | Exceeds MCID |
| Bonanno et al. [19] | Sensor VR | Dynamic Gait Index | 42 | MD: +3.8 | 1.9 to 5.7 | 0.003 | Clinically meaningful |

Abbreviations: MD, mean difference; MCID, minimal clinically important difference (BBS MCID = 4 points); SMD, standardized mean difference; VR, virtual reality

**Table 10. Cognitive and Communication Rehabilitation Outcomes**

| Study | Intervention | Target Domain | Sample Size | Outcome Measure | Baseline | Post-Intervention | Change | p-value | Effect Size |
|---|---|---|---|---|---|---|---|---|---|
| Barucci et al. [4] | Telerehab (protocol) | Global cognition | 120 (planned) | MoCA | TBD | TBD | Target: +2.8 pts | - | Target: d = 0.6 |
| Worthen-Chaudhari [5] | Executive function TR | Executive function | 36 | Trail Making Test-B | 142 ± 38 sec | 118 ± 34 sec | -24 ± 18 sec | 0.008 | d = 0.68 |
| Worthen-Chaudhari [5] | Executive function TR | Adaptive behavior | 36 | Goal Attainment Scale | 32.4 ± 8.6 | 44.7 ± 9.2 | +12.3 ± 6.4 | <0.001 | d = 1.42 |
| Alwadai et al. [3] | Various telerehab | Cognition (narrative) | Multiple reviews | Various | - | - | Limited evidence, positive trend | - | Insufficient data |

Abbreviations: MoCA, Montreal Cognitive Assessment; TBD, to be determined (ongoing study); TR, telerehabilitation

**Table 11. Quality of Life and Patient Satisfaction Outcomes**

| Study | Intervention | QOL Measure | Sample Size | Baseline | Post-Intervention | Change | p-value | Effect Size |
|---|---|---|---|---|---|---|---|---|
| Chen et al. [21] | Telerehab | SS-QOL | 12 studies, 687 pts | 142.8 ± 32.4 | 158.1 ± 34.8 | +15.3 ± 12.6 | <0.001 | SMD: 0.46 |
| Laver et al. [20] | Telerehab vs usual care | HRQOL (various) | 8 studies, 584 pts | - | - | - | 0.32 | SMD: 0.14 (-0.14 to 0.43) |
| Llorén s et al. [22] | VR telerehab | EQ-5D | 54 | 0.58 ± 0.22 | 0.71 ± 0.19 | +0.13 ± 0.08 | <0.001 | d = 0.65 |
| Sheehy et al. [18] | Home VR | Patient satisfaction (1-5 scale) | 38 | N/A | 4.3 ± 0.6 | - | - | 86% satisfied/very satisfied |
| Mayo et al. [24] | Telecoordination | Depression (PHQ-9) | 156 | 8.4 ± 4.2 | 5.2 ± 3.6 | -3.2 ± 2.4 | <0.001 | d = 0.82 |

Abbreviations: EQ-5D, EuroQol 5-Dimension; HRQOL, health-related quality of life; PHQ-9, Patient Health Questionnaire-9; QOL, quality of life; SS-QOL, Stroke-Specific Quality of Life Scale; VR, virtual reality

**Table 12. Adherence and Dropout Rates by Telerehabilitation Modality**

| Study | Intervention Type | Sample Size | Prescribed Sessions | Completed Sessions | Adherence Rate (%) | Dropout Rate (%) | Primary Dropout Reasons |
|---|---|---|---|---|---|---|---|
| Sheehy et al. [18] | Home VR training | 38 | 36 sessions | 31.2 ± 4.8 | 87% | 11% | Technical difficulties (45%), medical issues (36%) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hong et al. [13] | Task-oriented TR | 304 | 24 sessions | 19.7 ± 3.2 | 82% | 15% | Time constraints (38%), motivation (32%) |
| Lloréns et al. [22] | VR telerehab | 27 (TR group) | 20 sessions | 18.4 ± 2.1 | 92% | 7% | Equipment problems (50%), preference for clinic (50%) |
| Bonanno et al. [19] | Sensor VR | 42 | 30 sessions | 26.8 ± 3.6 | 89% | 12% | Technology barriers (58%), fatigue (25%) |
| Laver et al. [20] | Various (meta) | 1,937 | Variable | Variable | 64-89% | 8-28% | Technology issues, preference for in-person |

Abbreviations: TR, telerehabilitation; VR, virtual reality. Note: Adherence rates for conventional home exercise programs without telerehabilitation supervision typically range 40-64% [20,21]

**Table 13. Geographic Accessibility Outcomes**

| Metric | Rural Conventional Care | Rural Telerehabilitation | Improvement | Urban Conventional Care | Reference |
|---|---|---|---|---|---|
| Average distance to facility (miles) | 67.3 ± 42.8 | 0 (home-based) | 100% | 8.4 ± 12.6 | [26] |
| Average travel time (minutes/session) | 94 ± 38 | 0 | 100% | 18 ± 14 | [26] |
| Weekly travel burden (hours) | 3.1 ± 1.4 | 0 | 100% | 0.6 ± 0.4 | [21] |
| Weekly miles traveled | 134.6 ± 85.6 | 0 | 100% | 16.8 ± 25.2 | [21] |
| Access to rehab specialists (odds ratio) | 0.55 (vs urban) | 1.0 (parity achieved) | 82% improvement | 1.0 (reference) | [26] |
| Rehabilitation utilization rate (%) | 42% | 78% | +86% | 68% | [26] |
| Population density effect (per sq mi) | <7: 45% lower access | No effect with telerehab | Barrier eliminated | Reference | [26] |

Note: Travel burden reduction calculated as percentage of conventional care travel requirements eliminated

**Table 14. Cost Comparison: Telerehabilitation vs Conventional Care**

| Cost Category | Conventional In-Person Care | Telerehabilitation | Savings per Patient | % Reduction | Reference |
|---|---|---|---|---|---|
| **Direct Healthcare Costs** | | | | | |
| Per-session provider cost | $124 ± 18 | $72 ± 12 | $52 | 42% | [22] |
| Facility overhead per session | $69 ± 14 | $12 ± 4 | $57 | 83% | [26] |
| Total per-session cost | $193 ± 24 | $84 ± 14 | $109 | 56% | [22,26] |
| 12-week program (24 sessions) | $4,632 | $2,016 | $2,616 | 56% | Calculated |
| Initial equipment/setup | $0 | $800 (one-time) | -$800 | N/A | [22] |
| **Patient/Caregiver Costs** | | | | | |
| Transportation per session | $28 ± 12 | $0 | $28 | 100% | [21] |
| Caregiver time loss per session (hours) | 2.8 ± 1.2 | 0.3 ± 0.2 | 2.5 | 89% | [21] |
| Caregiver cost per session ($25/hr) | $70 ± 30 | $7.50 ± 5 | $62.50 | 89% | Calculated |

| | | | | | |
|---|---|---|---|---|---|
| Patient time saved per session (hours) | 2.1 ± 0.8 | 2.1 ± 0.8 | - | - | [26] |
| **Total 12-Week Program** | | | | | |
| Healthcare + patient costs | $7,080 | $2,196 | $4,884 | 69% | Calculated |
| Break-even point (sessions) | N/A | 7-8 sessions | - | - | [22] |
| **Comprehensive Analysis** | | | | | |
| Lloréns study total cost | $1,490 | $854 | $636 | 43% | [22] |
| Chen meta-analysis savings | Not reported | $867 lower | $867 | ~45% | [21] |

All costs in USD. Caregiver time valued at $25/hour (conservative estimate). Transportation costs include fuel, parking, vehicle depreciation

**Table 15. Cost-Effectiveness Analysis Results**

| Study/Analysis | Intervention | Comparator | Total Cost | QALYs Gained | ICER ($/QALY) | Cost-Effectiveness Threshold | Interpretation |
|---|---|---|---|---|---|---|---|
| Lloréns et al. [22] | VR telerehab | Usual care | $854 | 0.068 | $12,400 | $50,000-100,000 | Highly cost-effective |
| Chen et al. [21] | Telerehab (pooled) | Standard care | Lower by $867 | 0.052 | Dominant* | N/A | Cost-saving |
| Laver et al. [20] | Telerehab | In-person PT | Similar | 0.041 | $15,800 | $50,000-100,000 | Cost-effective |
| Modeled analysis | Hybrid telerehab | Clinic-based | $2,196 | 0.078 | $28,200 | $50,000-100,000 | Cost-effective |

*Dominant = less costly and more effective *ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life year; VR, virtual reality*

**Table 16. Temporal Accessibility Metrics**

| Accessibility Metric | Conventional Outpatient | Telerehabilitation | Improvement | p-value |
|---|---|---|---|---|
| Evening sessions available (%) | 23% | 67% | +191% | <0.001 |
| Weekend sessions available (%) | 18% | 64% | +256% | <0.001 |
| Same-day scheduling availability (%) | 12% | 48% | +300% | <0.001 |
| Average wait time for appointment (days) | 14.3 ± 6.8 | 4.2 ± 2.6 | -70% | <0.001 |
| Session rescheduling flexibility (1-5 scale) | 2.3 ± 0.8 | 4.1 ± 0.6 | +78% | <0.001 |
| Total therapy time per week (minutes) | 90 ± 20 (supervised) | 180 ± 45 (supervised + asynchronous) | +100% | <0.001 |
| Therapy dosage adherence (%) | 64% | 87% | +36% | <0.001 |

*Data synthesized from references [18,21,26]*

**Table 17. Technology Access and Barriers by Demographic Group**

| Demographic Group | Sample Size | Reliable Internet Access (%) | Smartphone/Tablet Ownership (%) | Digital Literacy (adequate) (%) | Technology Barrier Rate (%) | Primary Barriers |
|---|---|---|---|---|---|---|
| Age <65 years | 428 | 94% | 96% | 89% | 12% | Cost, connectivity issues |
| Age 65-74 years | 634 | 82% | 78% | 67% | 23% | Digital literacy, equipment |

| | | | | | | |
|---|---|---|---|---|---|---|
| Age 75-84 years | 512 | 68% | 62% | 48% | 35% | Digital literacy, confidence |
| Age ≥85 years | 187 | 54% | 44% | 31% | 52% | Multiple barriers |
| Urban residents | 892 | 91% | 88% | 76% | 15% | Cost, digital literacy |
| Suburban residents | 643 | 86% | 84% | 72% | 19% | Digital literacy |
| Rural residents | 526 | 64% | 71% | 58% | 34% | Infrastructure, connectivity |
| Income <$25K/year | 418 | 62% | 58% | 52% | 41% | Cost, equipment access |
| Income $25-50K | 687 | 81% | 79% | 68% | 24% | Equipment, digital literacy |
| Income >$50K | 734 | 95% | 94% | 87% | 11% | Minimal barriers |

*Data synthesized from studies examining telerehabilitation implementation barriers [9,11,18]*

**Table 18. Technical Difficulties During Telerehabilitation Sessions**

| Type of Technical Issue | Frequency (% of sessions affected) | Average Duration (minutes) | Resolution Rate (same session) | Impact on Therapy |
|---|---|---|---|---|
| Poor video quality | 12-18% | 4.2 ± 2.6 | 78% | Moderate |
| Audio delays/echoes | 8-14% | 3.8 ± 2.1 | 85% | Moderate |
| Complete connection loss | 5-8% | 8.6 ± 4.3 | 62% | Severe |
| Software/app crashes | 4-7% | 6.2 ± 3.4 | 71% | Moderate-severe |
| Device compatibility | 3-6% | 12.4 ± 6.8 | 45% | Severe |
| User error (patient) | 15-22% | 5.4 ± 3.2 | 92% | Mild-moderate |
| Platform access issues | 2-4% | 9.8 ± 5.6 | 68% | Severe |
| Any technical difficulty | 18-25% | Variable | 74% | Variable |

*Impact ratings: Mild = <5min therapy time lost; Moderate = 5-15min lost; Severe = >15min lost or session cancellation*

**Table 19. Patient-Reported Barriers and Facilitators**

| Factor | Barrier (%) | Neutral (%) | Facilitator (%) | Mean Rating (1-5 scale) | SD |
|---|---|---|---|---|---|
| **Barriers** | | | | | |
| Technology complexity | 31% | 24% | 45% | 3.2 | 1.2 |
| Lack of hands-on assistance | 28% | 32% | 40% | 3.1 | 1.1 |
| Internet connectivity | 27% | 18% | 55% | 3.4 | 1.4 |
| Privacy concerns at home | 19% | 41% | 40% | 3.3 | 1.0 |
| Equipment availability | 18% | 22% | 60% | 3.6 | 1.2 |
| Digital literacy | 35% (age >75) | 28% | 37% | 3.0 | 1.3 |
| **Facilitators** | | | | | |
| Convenience/no travel | 6% | 12% | 82% | 4.3 | 0.8 |
| Flexible scheduling | 8% | 15% | 77% | 4.2 | 0.9 |
| Home environment comfort | 11% | 19% | 70% | 4.0 | 1.0 |
| Family involvement | 9% | 24% | 67% | 3.9 | 1.0 |
| Cost savings | 7% | 21% | 72% | 4.1 | 0.9 |
| Time savings | 5% | 11% | 84% | 4.4 | 0.7 |

*5-point scale: 1=strong barrier, 3=neutral, 5=strong facilitator. Data from patient satisfaction surveys [9,18,21]*

Table 20 presents provider-reported challenges in delivering telerehabilitation.

**Table 20. Provider-Reported Challenges in Telerehabilitation Delivery**

| Challenge Domain | % Providers Reporting | Severity (1-5) | Training Need (1-5) | Impact on Care Quality |
|---|---|---|---|---|
| Remote physical assessment limitations | 84% | 3.8 ± 0.9 | 4.2 ± 0.7 | Moderate |
| Inability to provide manual therapy | 78% | 4.1 ± 0.8 | 3.6 ± 0.9 | Moderate-high |
| Safety monitoring concerns | 72% | 3.6 ± 1.0 | 4.4 ± 0.6 | Moderate |
| Building therapeutic rapport | 68% | 3.2 ± 1.1 | 3.8 ± 0.8 | Moderate |
| Technology troubleshooting | 65% | 3.4 ± 1.0 | 4.6 ± 0.5 | Low-moderate |
| Documentation burden | 58% | 3.0 ± 1.0 | 3.4 ± 0.9 | Low |
| Inadequate reimbursement | 76% | 4.2 ± 0.8 | N/A | System-level |
| Insufficient training | 62% | 3.7 ± 0.9 | 4.8 ± 0.4 | Moderate |
| Time management | 54% | 2.9 ± 1.0 | 3.6 ± 0.8 | Low-moderate |
| Patient selection criteria | 49% | 2.8 ± 0.9 | 3.9 ± 0.7 | Low |

*Severity: 1=minimal challenge, 5=severe challenge. Training need: 1=no training needed, 5=extensive training needed Survey of 324 physical therapists, occupational therapists, and speech-language pathologists [9,11]*

**Table 21. Telerehabilitation Reimbursement Status by Region/Payer (2024-2025)**

| Region/Payer | Pre-COVID Policy | Pandemic Emergency Policy | Current Permanent Policy | Payment Parity | Key Restrictions |
|---|---|---|---|---|---|
| Medicare (USA) | Limited coverage | Expanded coverage | Partial expansion maintained | ~85-90% of in-person | Geographic restrictions loosened |
| Medicaid (USA, varies by state) | Variable, limited | Expanded | Mixed (15 states permanent, 35 temporary) | 70-100% varies by state | State-specific |
| Private insurance (USA) | Minimal (<30% covered) | Required by emergency orders | Variable by insurer (60% now covered) | 80-100% varies | Prior authorization often required |
| Medicare (Australia) | Limited | Expanded | Permanent expansion | 100% parity | Patient location restrictions |
| NHS (United Kingdom) | Pilot programs | Widely adopted | Integration ongoing | 100% parity | Equity concerns |
| Canada (provincial) | Variable | Emergency expansion | Mixed provincial policies | Variable 70-100% | Provincial variation |
| European Union | Variable by country | Variable expansion | Country-specific policies | Variable | Cross-border restrictions |

*Data from policy analyses and healthcare system reports [9,20,26]*

**Table 22. Adverse Event Rates: Telerehabilitation vs Conventional Care**

| Type of Adverse Event | Telerehabilitation Rate (per 1000 sessions) | Conventional Care Rate (per 1000 sessions) | Relative Risk | 95% CI | Statistical Significance |
|---|---|---|---|---|---|
| Falls during therapy | 2.4 | 3.1 | 0.77 | 0.48-1.24 | NS |
| Falls within 24 hours post-session | 4.8 | 4.2 | 1.14 | 0.82-1.59 | NS |
| Musculoskeletal pain (minor) | 12.6 | 15.8 | 0.80 | 0.66-0.96 | p=0.02 |
| Cardiovascular events | 0.3 | 0.4 | 0.75 | 0.21-2.68 | NS |
| Equipment-related injuries | 0.8 | 1.2 | 0.67 | 0.29-1.54 | NS |
| Serious adverse events | 0.6 | 0.7 | 0.86 | 0.35-2.11 | NS |
| Session termination due to safety | 3.2 | 2.8 | 1.14 | 0.76-1.71 | NS |
| Any adverse event | 18.4 | 21.6 | 0.85 | 0.74-0.98 | p=0.03 |

*NS = not significant. Data pooled from safety analyses in multiple RCTs [18,19,20,22] Total sessions analyzed: Telerehabilitation = 8,426; Conventional = 9,238*

**Table 23. Telerehabilitation Candidacy Assessment Framework**

| Selection Criterion | Essential | Preferred | Assessment Method | Alternative/Accommodation |
|---|---|---|---|---|
| **Medical Factors** | | | | |
| Medical stability | Yes | - | Physician clearance | In-person assessment first |
| Cardiovascular stability | Yes | - | Recent cardiac evaluation | Monitored sessions initially |
| Cognitive function | MoCA ≥18 or caregiver support | MoCA ≥22 independent | MoCA, clinical interview | Caregiver-assisted participation |
| Communication ability | Basic comprehension | Fluent | Speech assessment | Visual demonstrations, simplified language |
| Seizure control | Stable (>6 months) | No history | Medical history | Close monitoring, emergency protocol |
| **Functional Factors** | | | | |
| Sitting balance | Moderate (30+ min) | Independent | Clinical observation | Modified seating, supervision |
| Standing ability | Can stand with assist | Independent standing | Functional assessment | Seated exercises alternative |
| Hearing | Adequate with aids | Normal | Audiometry/clinical | Captioning, visual cues |
| Vision | Adequate to see screen | Normal | Vision screening | Large display, high contrast |
| **Technology Factors** | | | | |
| Internet access | Broadband or 4G/5G | High-speed broadband | Speed test | Mobile hotspot, community resources |
| Device availability | Tablet/computer | Large screen device | Equipment check | Loaner device program |
| Digital literacy | Basic navigation | Proficient | Observation assessment | Pre-training, simplified interface |
| Technical support | Available (caregiver/family) | Patient independent | Support assessment | 24/7 helpline |
| **Environmental Factors** | | | | |
| Exercise space | 6x6 ft clear | 8x8 ft clear | Video home assessment | Modified exercises |
| Fall risk mitigation | Removed hazards | Optimal safety | Environmental checklist | Seated protocols |
| Privacy | Private space available | Dedicated room | Discussion with patient | Scheduling accommodation |
| Emergency protocol | Identified emergency contact | Multiple contacts | Emergency plan review | Connected monitoring |

### 6.2 Technology Platform Selection Criteria

Table 24 outlines criteria for selecting appropriate telerehabilitation technology platforms.

**Table 24. Technology Platform Evaluation Matrix**

| Platform Feature | Weight (%) | Scoring Criteria (1-5) | Minimum Acceptable Score | Priority Tier |
|---|---|---|---|---|
| **Technical Performance** | | | | |
| Video quality consistency | 15% | 1=frequent drops, 5=consistent HD | 3 | Essential |
| Audio clarity | 12% | 1=poor quality, 5=clear | 4 | Essential |
| Connection stability | 15% | 1=frequent disconnects, 5=stable | 4 | Essential |
| Bandwidth efficiency | 8% | 1=high bandwidth, 5=low requirement | 3 | High |
| Cross-device compatibility | 10% | 1=single device, 5=all devices | 3 | High |
| **Usability** | | | | |

| | | | | |
|---|---|---|---|---|
| User interface simplicity | 12% | 1=complex, 5=intuitive | 4 | Essential |
| Setup time | 6% | 1=>30 min, 5=<5 min | 3 | High |
| Technical support quality | 8% | 1=poor support, 5=excellent | 4 | High |
| **Clinical Features** | | | | |
| Assessment tools integration | 7% | 1=none, 5=comprehensive | 3 | Medium |
| Progress tracking | 5% | 1=manual, 5=automated | 3 | Medium |
| Exercise library | 4% | 1=limited, 5=extensive | 2 | Medium |
| **Administrative** | | | | |
| Documentation capabilities | 6% | 1=poor, 5=excellent | 3 | High |
| EMR integration | 4% | 1=none, 5=seamless | 2 | Low |
| Scheduling functionality | 3% | 1=manual, 5=automated | 2 | Low |
| **Security & Compliance** | | | | |
| HIPAA/privacy compliance | 15% | 1=non-compliant, 5=certified | 5 | Essential |
| Data encryption | 10% | 1=none, 5=end-to-end | 5 | Essential |
| **Cost** | | | | |
| Setup cost | 8% | 1=>$1000, 5=<$200 | 2 | Medium |
| Per-session cost | 7% | 1=>$20, 5=<$2 | 3 | High |
| Maintenance cost | 5% | 1=high, 5=minimal | 3 | Medium |

*Minimum acceptable weighted score: 70/100. Essential tier features must all meet minimum scores.*

**Table 25. Telerehabilitation Dosage Recommendations by Stroke Phase**

| Stroke Phase | Impairment Severity | Synchronous Sessions/Week | Session Duration (min) | Asynchronous Practice/Day (min) | Total Weekly Therapy (hours) | Evidence Level |
|---|---|---|---|---|---|---|
| **Subacute (<6 months)** | | | | | | |
| Mild | 3-5 | 45-60 | 30-45 | 6.5-9.5 | High (RCT) | |
| Moderate | 4-5 | 60 | 45-60 | 9-12 | High (RCT) | |
| Severe | 5 | 60 | 60 | 11-14 | Moderate (observational) | |
| **Early Chronic (6-12 months)** | | | | | | |
| Mild | 2-3 | 45 | 20-30 | 4-6 | Moderate (RCT) | |
| Moderate | 3-4 | 45-60 | 30-45 | 6-9 | High (RCT) | |
| Severe | 4-5 | 60 | 45-60 | 9-12 | Moderate (RCT) | |
| **Late Chronic (>12 months)** | | | | | | |
| Mild | 2 | 30-45 | 20-30 | 3-5 | Moderate (observational) | |
| Moderate | 2-3 | 45 | 30-45 | 5-7 | Moderate (observational) | |
| Severe | 3-4 | 45-60 | 45 | 7-10 | Low (observational) | |

Synchronous = real-time video session with therapist. Asynchronous = independent practice with app/sensor monitoring Evidence levels based on Oxford Centre for Evidence-Based Medicine criteria

## 7. Future Directions and Research Priorities

### 7.1 Emerging Technologies

**Table 26. Emerging Technologies in Telerehabilitation**

| Technology | Current Development Stage | Potential Applications | Expected Benefits | Key Challenges | Timeline to Clinical Use |
|---|---|---|---|---|---|
| AI-powered movement analysis | Pilot studies | Automated gait/movement assessment | Real-time feedback, reduced | Validation, regulatory approval | 2-3 years |

| | | | | | |
|---|---|---|---|---|---|
| | | | therapist burden | | |
| Markerless motion capture | Early adoption | Remote kinematic assessment | No wearables needed, comprehensive data | Processing power, accuracy | 1-2 years |
| Haptic feedback devices | Research phase | Sensory rehabilitation | Enhanced proprioception | Cost, complexity | 3-5 years |
| Brain-computer interfaces | Preclinical | Motor learning enhancement | Direct neural modulation | Safety, accessibility | 5-10 years |
| 5G-enabled VR | Implementation | High-fidelity immersive therapy | Reduced latency, better quality | Infrastructure, cost | 1-2 years |
| Predictive analytics/ML | Pilot validation | Outcome prediction, personalization | Optimized treatment plans | Data requirements, interpretability | 2-4 years |
| Wearable biosensors | Early adoption | Physiological monitoring | Safety, dosage optimization | Accuracy, integration | 1-2 years |
| Natural language processing | Research phase | Cognitive/communication therapy | Automated assessment, feedback | Language complexity | 3-5 years |

### 7.2 Research Gaps and Priorities

**Table 27. Research Priorities in Telerehabilitation for Stroke**

| Research Domain | Current Evidence Level | Key Gaps | Priority Level | Recommended Study Design | Sample Size Needed |
|---|---|---|---|---|---|
| Long-term outcomes (>12 months) | Low | Maintenance effects, sustainability | High | Prospective cohort, RCT | n=300-500 per arm |
| Cost-effectiveness across systems | Moderate | Healthcare system variation, payer perspectives | High | Health economics analysis | Multi-site, n=1000+ |
| Optimal hybrid models | Low | Balance of in-person vs remote | High | Factorial RCT | n=400-600 |
| Acute phase telerehabilitation | Very low | Safety, efficacy in acute setting | High | Safety/feasibility RCT | n=150-200 |
| Cognitive rehabilitation protocols | Low | Standardized approaches, dosing | High | RCT with neuroimaging | n=200-300 |
| Implementation science | Low | Adoption barriers, sustainability factors | High | Mixed methods, multi-site | n=20-30 sites |
| Comparative platform effectiveness | Very low | Technology platform differences | Medium | Pragmatic RCT | n=300-400 |
| Personalization algorithms | Very low | Predictive models, treatment matching | Medium | Machine learning cohort | n=2000+ |
| Caregiver outcomes | Low | Burden, training needs, satisfaction | Medium | Longitudinal cohort | n=300-400 |
| Health equity impacts | Low | Disparities, access barriers | High | Population-based study | n=1000+ |
| Pediatric stroke telerehab | Very low | Developmental considerations | Low | Feasibility studies | n=50-100 |
| Aphasia-specific protocols | Low | Communication-adapted delivery | Medium | RCT | n=150-200 |

*Evidence levels: Very low = <3 studies; Low = 3-10 studies; Moderate = >10 studies with limitations; High = multiple high-quality RCTs*

**Table 28. Summary of Evidence: Telerehabilitation vs Conventional Care**

| Outcome Domain | Number of Studies Reviewed | Total Participants | Effect Size Summary | Quality of Evidence | Clinical Interpretation |
|---|---|---|---|---|---|
| Upper extremity motor function | 42 studies | 3,890 | SMD: 0.42-0.68, favoring telerehab or equivalence | Moderate-High | Effective alternative, some advantages with VR |
| Lower extremity/gait | 18 studies | 1,456 | MD: +0.12 m/s walking speed | Moderate | Clinically meaningful improvements |
| Activities of daily living | 35 studies | 4,263 | SMD: -0.00 to 0.03, no difference | Moderate | Equivalent effectiveness |
| Balance | 28 studies | 2,134 | SMD: 0.08-0.46, variable | Low-Moderate | Variable results, VR shows promise |
| Quality of life | 20 studies | 1,847 | SMD: 0.14-0.46, positive trends | Moderate | Comparable or improved |
| Cognition | 6 studies | 387 | Insufficient data for meta-analysis | Low | Emerging evidence, positive trends |
| Cost-effectiveness | 8 studies | 1,124 | $636-$867 savings per patient | Moderate | Consistently cost-saving |
| Patient satisfaction | 25 studies | 2,645 | 82-89% satisfaction rates | Moderate | High acceptance |
| Safety (adverse events) | 15 studies | 1,732 | RR: 0.85, fewer events | Moderate | Safe when properly implemented |

## 8. DISCUSSION

### 8.1 Summary of Key Findings

This systematic review synthesizes evidence from the literature (2020-2025) that telerehabilitation is an effective and acceptable substitute for conventional stroke rehabilitation in the domains of outcomes. Overall findings offer some number of key findings listed in Table 28.

### 8.2 Clinical Implications

Synthesis of the evidence produces several important clinical conclusions. Telerehabilitation should be considered a first rather than last option for appropriate candidates. The non-inferior or superior outcomes in the majority of domains, coupled with the considerable accessibility and cost advantages, make the case for universal application in stroke pathways.

Literature supports that a combination of in-person visits conducted monthly or quarterly and supplemented by 2-5 weekly telerehabilitation visits provides the best balance.

Telerehabilitation is demonstrated to be broadly effective, medical stability, intellectual capacity, availability of technology, and environment safety must be considered. Exclusion criteria must still be minimized, and accommodation and support must be provided to facilitate a maximum of accessibility rather than exclusion.

### 8.3 Limitations

There are a number of limitations that must be outlined. First, heterogeneity in intervention protocols, technology platforms, outcome measures, and follow-up times precludes direct comparisons and meta-analytic pooling. Second, recent large-scale uptake of telerehabilitation has provided shorter-term outcomes that are comparatively more well-researched than longer-term outcomes (>12 months). Third, publication bias for positive outcomes can inflate perceived effect size. Fourth, the trajectory of rapid technology development ensures that current evidence no longer reflects the entire profile of next-generation platforms and capabilities.

In addition, most of the studies were conducted in high-income countries with established health care systems and relatively high rates of technology penetration. Generalizability to low- and middle-income settings must be particularly considered. Finally, the COVID-19 pandemic created a unique circumstance that may have influenced both the uptake of telerehabilitation out of necessity and the comparisons with less-than-ideal usual care.

## 9. CONCLUSIONS

Telerehabilitation is a new post-stroke rehabilitation paradigm that is as clinically effective as conventional care but much more accessible, cost-reducing, and patient-satisfying. Summary evidence provided to establish:

1- Substantial cost was comfortably within acceptable ranges, indicating strong economic rationale.

2. Accessibility: Substantial enhancement in geographic access , temporal flexibility , and population reach .

3. Safety: Similar or decreased rates of adverse events (RR: 0.85) with appropriate protocols and patient inclusion/exclusion criteria being followed.
4. Patient Acceptance: High patient satisfaction and increased compliance vs. 64% for conventional home programs).
COVID-19 pandemic has demonstrated that telerehabilitation can rapidly scale up to deliver patients. The question is no longer if telerehabilitation is to be incorporated, but rather how best to optimize implementation so that there is equity in access, quality is guaranteed, and sustainable models are attained for patients and health systems globally.

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