

## TELEREHABILITATION FOR STROKE PATIENTS: AN OVERVIEW OF REVIEWS

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### **Abstract**

**Background:** The increasing number of survivors following stroke events are enlightening new needs to guarantee appropriate care and quality of life support at home. A potential application of telemedicine is to provide home care and rehabilitation. Within the framework of an EU FP7 project called Integrated Home Care (IHC Grant Agreement no: 222954) we performed an overview of reviews on the telefacilities for the homecare in stroke patients.

**Materials and methods:** A broad literature research was conducted in PUBMED, Web of Science® and The Cochrane Library databases. We included and graded all the reviews according to the following criteria: published in English in peer-reviewed journals, targeting stroke as adult patients (age>18yr.) and considering a homecare setting in the intervention.

**Results:** 6 reviews were included (i.e. 1 systematic review with meta-analysis and 5 non-systematic reviews). No conclusions can be stated on the effectiveness of telerehabilitation compared to other home treatments, due to the insufficient data available, nevertheless strong indications emerged for the inclusion of “all cause mortality” and “hospital admission” as primary outcomes. Besides “QoL”, “cost”, “adherence” and “patient acceptability”

should be included as secondary outcomes, for a complete evaluation of the tele-intervention. No adverse effects were reported in all the reviews, stating that tele-interventions appear to be safe as usual care at home.

Conclusion: Those indications should be considered as relevant in planning a telerehabilitation trial, in order to observe the expected effectiveness from a multidimensional point of view in the clinical, financial and social perspectives.

**Keywords:** telerehabilitation, stroke, homecare

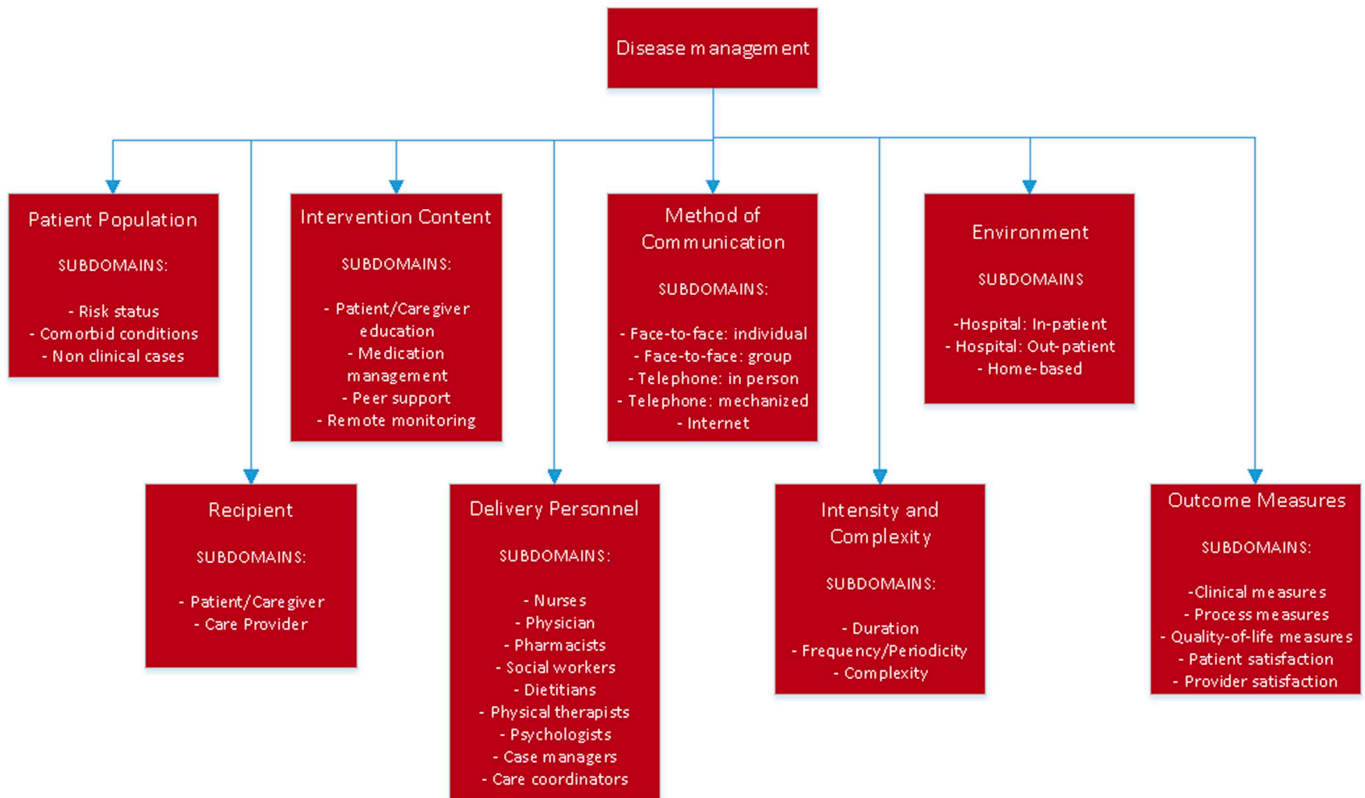
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## **Introduction**

The increasing number of survivors following an acute event like stroke and the consequent improvement in their life expectations are enlightening new needs to guarantee appropriate care and quality of life support at home.

The World Health Organisation (WHO) Europe Regional Office considers as a critical issue in Western-countries the fragmented delivery of health and social services.

Figure 1. Disease management taxonomy. This diagram appears courtesy of [Krumholz et al., 2006].



Disease management has shown great promise for the reorganization of chronic care and optimization of patient outcomes. Nevertheless, disease management programs are widely heterogeneous and lack a shared definition, which limits our ability to compare and evaluate different programs. To address this problem, the American Heart Association’s (AHA) Disease Management Taxonomy Writing Group [Krumholz et al., 2006] developed a system of classification (Figure 1) useful to categorize and compare disease management programs, as well as to identify specific factors associated with effectiveness.

Following the AHA taxonomy we can defined the telefacilities in homecare with a broader meaning like the “home-based remote monitoring and treatment of chronic patients delivered by healthcare professionals, through internet and communication technologies (ICT), with different intensity and complexity, in order to improve both objective and subjective outcomes”.

In recent years, the increasing availability of low costs ICT gave the opportunity to explore the effectiveness of technology solutions in providing health services within and outside the hospitals. This opportunity increased the interest for telemedicine in the rehabilitation - care field, thus the telerehabilitation and telecare are emerging as new branches of the telemedicine [Botsis & Hartvigsen, 2008].

Continuity across primary and secondary settings is mainly assured by integrated forms of care: telemedicine has been advocated as a possible technological, managerial and economic support for health service integration. A potential application of telemedicine is to exploit home care and rehabilitation of people impaired by neurological diseases such as stroke [Craig, McConville, Patterson & Wootton, 1999; Craig, Patterson, Russell & Wootton, 2000].

Telerehabilitation is defined as the remote delivery of rehabilitative services through internet and communication technology (ICT) [Rosen, 2004]. Telemonitoring (i. e. patient functioning assessment and clinical management), teletherapy, teleconsultation, telementoring and teleducation are potential services that can be provided to patients through professionals or caregivers.

A number of trials have been published to primarily test the feasibility of telerehabilitation and telemedicine homecare approaches, as well as to compare their effectiveness to standard home rehabilitation - care [Hermens et al., 2008; Hill, Theodoros, Russell & Ward, 2009; Piron et al., 2008; Piron et al., 2009; Schein, Schmeler, Holm, Saptono & Brienza, 2010].

A Cochrane review [Currell, Urquhart, Wainwright & Lewis, 2000] has already explored the effectiveness of the professional practice and health care outcomes in the use of telemedicine compared to face to face patient care. Nevertheless the authors couldn't perform a meta-analysis due to the high heterogeneity in the few studies included.

The authors concluded that using telecommunications technologies is feasible, but there is little evidence of clinical benefits, moreover no analysable data exist about the cost effectiveness of telemedicine systems,

with a consequent warning for the policymaker to recommend a broader use and investment in unevaluated technologies.

In order to understand the actual magnitude of telerehabilitation benefits and eventual harms when compared to standard home rehabilitation/care and to plan with meaningful outcomes a clinical pilot trial on tele-treatment at home in stroke survivors, we have summarized the body of evidence on the telerehabilitation approaches by means of an overview of reviews.

## **Methodology**

### **Search Strategy**

To include the major number of papers on telefacilities in integrated care for stroke patients, a broad search strategy, with no limits applied, was run in the databases: PUBMED, Web of Science® and The Cochrane Library. The following mesh terms were included in the string: “tele\*”, “telecare”, “telemedicine”, “homecare” and “stroke” combined with different Boolean operators.

### **Selection Criteria and Analysis**

The selected reviews were included according to the following criteria.

- language of publication was English;
- the targeted populations must include stroke patients;
- the patients enrolled in the study should be adult, namely with an age > 18 yrs;
- a home care setting considered in the interventions;
- full-text articles in peer-reviewed journals.

The reviews not addressing telemedicine in stroke patients and focused on caregivers or professionals, instead of patients directly, were excluded.

To grade the quality of evidences, the included reviews were rated (high, moderate or low) according to the following methodological criteria:

- HIGH: systematic review with meta-analysis;
- MODERATE: systematic review without meta-analysis;
- LOW: non-systematic review.

Descriptive data (author; year of publication; pathologies included; intervention; evidences) was extracted by all the reviews included. The findings were summarized into descriptive tables displaying the main data.

## Results

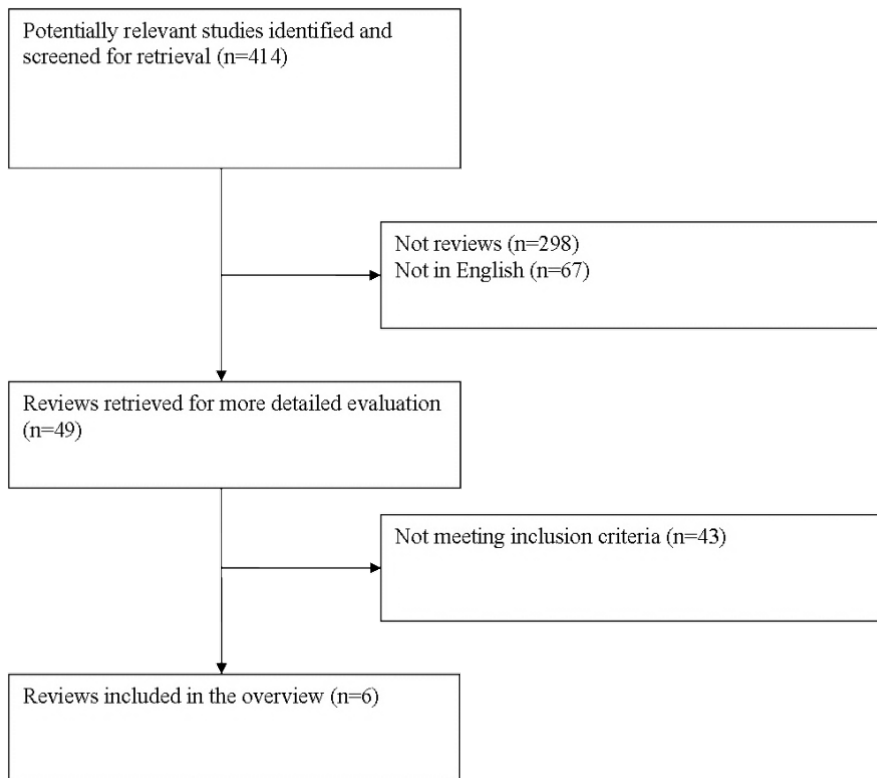
The literature search led to 414 potential relevant records in PUBMED (9,4%), Web of Science® (84.6%) and The Cochrane Library (6.0%) (Table 1).

Table 1. Bibliographic search strategy.

| Database             | Search strategy           | No of articles |
|----------------------|---------------------------|----------------|
| PUBMED               | tele* AND care AND stroke | 39             |
| Web of Science®      | tele* AND care AND stroke | 350            |
| The Cochrane Library | telecare                  | 5              |
| The Cochrane Library | homecare                  | 7              |
| The Cochrane Library | telemedicine              | 13             |

From the overall relevant studies we excluded all those not reporting a review and not published in English, resulting in 49 records whose abstract were screened following the selection criteria. In the end, 6 full-text reviews were included in the overview (Figure 2).

Figure 2. Flowchart of the review process according to the QUOROM PRISMA standard.



Within the records included, the publication year ranged from 2003 to 2006 and the sample was composed by: 1 systematic review with meta-analysis (16,7%), 5 non-systematic review (83,3%) and no systematic review without meta-analysis. With regard to the targeted populations, the only systematic review with meta-analysis compared different telemedicine approaches with usual care in stroke and HF patients, while all the 5 non-systematic reviews were targeted only to stroke patients.

### Interventions

Different kind of remotely controlled interventions at home were extracted from the analysis of reviews, confirming the outstanding heterogeneity in the available approaches to telecare for the management of stroke diseases after discharge.

It was possible to extract evidence on telerehabilitation interventions for stroke patients intended as:

- telephone follow-up (TFU),
- interaction with devices based on position/sensing technologies,
- remote control of devices based on position/sensing technologies
- remote control and interaction with virtual reality based devices.

Considering the heterogeneity in the different approaches to telerehabilitation interventions, it was not possible to plan a comparison of the results from different reviews.

## Summary of the Evidences

### High quality evidence

In HF and STROKE patients (Table 2):

Case management interventions providing also TFU were associated with the reduction in the overall mortality in HF patients, especially in high quality study (odds ratio = 0.68, 95% confidence interval 0.46 to 0.98, P=0.04), but it is unclear which are the effective components involved in the case management interventions. Moreover TFU in HF and STROKE patients showed clinically-equivalent results compared to control groups due to the low methodological quality of the studies specifically designed for this comparison. TFU couldn't be associated specifically with the reduced mortality in HF and STROKE patients.

Table 2. Summary of findings from systematic reviews with meta-analysis.

| Author         | Year | Pathology  | Intervention              | Evidence   |
|----------------|------|------------|---------------------------|--|
| Mistiaen, Poot | 2006 | HF; STROKE | Telephone follow-up (TFU) | <p>Low methodological quality of the included studies.</p> <p>No adverse effects reported.</p> <p>Clinically-equivalent results between TFU and control groups.</p> <p>Inconclusive evidence about the effects of TFU.</p> |



Low quality evidence

In STROKE patients (Table 3):

- The utilization of telemedicine is recommended to increase the delivery of evidence-based stroke treatments.
- There are still insufficient data about the use of telemedicine in stroke prevention, rehabilitation and post-stroke care.
- Telerehabilitation interventions using VR have been improving post-stroke patients outcomes, however few data are available at this time.
- Telemedicine might become a viable option in remote areas.
- Developing of a successful implementation of a home-based rehabilitation system is making technology reliable and blind to the user.
- Great potential is foreseen if the cost of the system is reduced.

Table 3. Summary of findings from non-systematic reviews.

| Author                       | Year | Pathology | Intervention   | Evidence  |
|------------------------------|------|-----------|--|---|
| Audebert, Schwamm            | 2009 | STROKE    | telemedicine   | Recommended to increase the delivery of evidence-based stroke treatments.<br>It can play a critical role, particularly in neurologically underserved areas.<br>Insufficient data in stroke prevention, rehabilitation and care. |
| Misra, Kalita, Mishra, Yadav | 2005 | STROKE    | telemedicine   | In remote area telemedicine may become a viable option  |
| Zheng, Black, Harris         | 2005 | STROKE    | Telerehabilitation position/sensing technologies based | Development of technologies reliable and invisible to the user.   |
| Holden                       | 2005 | STROKE    | Telerehabilitation Virtual Reality based               | Needs of reducing costs   |
| Burdea                       | 2003 | STROKE    | Telerehabilitation Virtual Reality based               | Telerehabilitation interventions using VR has been improving post-stroke patients<br>Lack of data is available at this time.  |

## **Conclusion**

The state of the evidence emerging from this overview should be considered in planning trials on tele-applications to provide rehabilitation services in homecare. Nevertheless it should be considered that the few indications emerging from the summarized data seem to be weak as based mainly on non-systematic reviews.

In stroke patients, it should be preferred an on-line interactive device (allowing also videoconference) than a store and forward device for providing the tele-intervention.

Primary outcomes like “overall mortality” and “hospital admission” should be included to prove the effectiveness of interventions; moreover secondary outcomes like “QoL, “cost”, “adherence” and “patient acceptability” should be taken into consideration to perform a complete analysis of the chosen telecare-approach.

The above indications should be considered as relevant in trials planning, in order to demonstrate from a multidimensional point of view the effectiveness of telerehabilitation in clinical, financial and social perspective. One of the main issue in dissemination of telerehabilitation mainly relies on the differences in recognizing, by policy maker, this service as a reimbursable one.

Regarding the systematic analysis of the literature, the methodology, in designing studies targeted to stroke population, should improve in order to obtain a more complete framework of the effectiveness of telemedicine as a useful intervention in the homecare of neurological conditions.

## **Acknowledgment**

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