Tele-assistance in pulmonary diseases: current status and open issues

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Summary

Tele-assistance represents a fundamental medical application of advanced technologies. Evidence suggests that this technology when applied to monitoring and treatment may provide specific benefits to patients with respiratory diseases and their relatives. Economic advantages for healthcare systems, though potentially high, are still poorly investigated.

KEY WORDS: telemonitoring; telerehabilitation; telehealth; telemedicine; ICT; pulmonary rehabilitation; respiratory diseases.

Background

In recent years an increased interest emerged to explore the effectiveness of advanced technologies for management of chronic respiratory diseases (1, 2). These interventions may be described as "telehealthcare", a more comprehensive term that, regardless the specific professional delivering the intervention, includes technologies described so far under various terms such as "telehealth", "telemedicine", "telecare" and "telenursing" (3). Telehealth interventions may include:

1. Video or telephone links with healthcare professionals in real time or using store and forward technologies (4, 5)
2. Systems of care using internet-based telecommunication with healthcare professionals (6, 7)
3. Systems of care using both wired and wireless telemetry for telemonitoring of spirometry, respiratory rate, blood pressure and oxygen saturations involving feedback to the patient, which has been processed or authorised by a healthcare professional (8-11).

Chronic Obstructive Pulmonary Disease (COPD)

The most common service provided by telehealth in individuals with chronic obstructive pulmonary disease (COPD) consists of routine data transmission between the patient's home and a healthcare professional located in the hospital. Heart rate and physical activity monitoring were recently included as part of these systems of care following the growing interest in modifying patients lifestyle (12). Telehealth has also been successfully used to promote quality of chronic respiratory disease management in primary care, by providing educational resources and a remote expert support to general practitioners. A recent meta-analysis including ten randomised controlled studies of telephone and/or video-conference follow-up program concluded that telehealthcare in COPD may have a possible impact on patients quality of life and emergency department and hospital admissions but not in one-year survival (2).

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Quality of care and cost savings may result from different potential mechanisms, including (13):

- patient and caregiver education and counselling for prevention and early detection of COPD;
- improved treatment adherence;
- teleconsulting services as substitution of hospital visits;
- remote collection of patient data;
- early detection and symptom management of disease exacerbation;
- reduction of unscheduled/unnecessary visits to the physician and emergency services;
- prevention and reduction of hospitalisations.

Telehealth applications for transmission of clinical and physiologic data (telemonitoring) have been used for the management and follow-up of several chronic respiratory diseases, such as asthma, COPD, and pulmonary transplantation. A systematic review of the literature reporting effects of home telemonitoring for patients with respiratory conditions concluded that this approach re-

sulted in early identification of worsening in patient conditions and symptom control. Nevertheless, the evidence of the size of clinical effects resulted still inadequate (14). A recent study showed that telemonitoring of COPD patients may reduce mean hospital admission rate, nevertheless larger studies are needed to confirm the effectiveness of telemonitoring programmes in reducing healthcare costs (15).

Pulmonary rehabilitation

Telerehabilitation has the potential to deliver pulmonary rehabilitation (PR) programmes in case of limited access to specialised centres. Only few studies evaluated the application of telehealth to PR. In detail, the technical feasibility of transmitting real-time pulse oximetry data was successfully investigated during remote training session performed with a mobile videoconferencing system developed for speech and neuro-motor rehabilitation (16).

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In another study stable, moderate to severe COPD patients completing an outpatient PR program were randomly assigned to receive standard care or telemonitoring in order to evaluate if telemonitoring after PR impacted health care use. Telehealth group showed fewer primary care contacts for respiratory issues, but there were no differences between the groups in emergency room visits, hospital admissions, days in hospital or contacts to the specialist COPD community nurse team (17).

The feasibility of home PR programmes delivered by an internet-enabled prototype technical platform has been also evaluated. The system consisted of the patient's TV screen connected to a dedicated, remote controlled computer, and a stand-alone videoconferencing system. Self-management education included group education and exercising, individual consultations, educational videos and a digital health diary. The small group of enrolled COPD patients reported a good acceptance of the six-week home trial (18). In a recent controlled Canadian study, the efficacy of an outpatient PR program delivered via Telehealth technology was compared with PR delivered through a standard outpatient, hospital-based program. Enrolled patients were assessed by teleconferencing for their suitability for PR, and they attended PR twice a week for eight weeks within their local community. Exercise sessions included teleconferencing education sessions and were performed in groups of two to six, supervised by a local health care professional (19). Using a non-randomised parallel group, non-inferiority experimental design, the authors demonstrated that the two programs resulted in similar improvements in quality of life and functional capacity. The effects of Telehealth in addition to standard support and treatment in terms of incremental cost per quality adjusted life year (QALY), are controversial and should be evaluated in large-scale studies (15, 20, 21).

Telehealth may represent an option for patients living in isolated areas or unable to access transportation to hospital or outpatient programs (22).

Chronic respiratory failure

Cost-effectiveness of a tele-assistance program in reducing exacerbations and healthcare resources utilisation was investigated in a large randomized study including chronic respiratory patients requiring oxygen or mechanical ventilation. Compared with controls, patients receiving a 1-year teleassistance programme experienced significantly fewer hospitalisations, urgent general practitioner calls and acute exacerbations. Among COPD patients a reduced hospital and emergency room admissions, urgent general practitioner calls or exacerbations were also reported. After deduction of TA costs, the average overall cost for each patient was 33% less than that for usual care (9).

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Mechanically ventilated patients in ICU

Some studies were carried out in intensive care units (ICU). A reduction in hospital costs, as assessed by shorter hospital stays, and patient mortality were reported when a telehealth service was operating (23-25). Improvement in patient experience was reported when tele-ICU is part of the care team (26). A systematic review and meta-analysis on telemedicine ICU coverage concluded that Tele-ICU coverage is associated with lower ICU but not in-hospital mortality and length of stay (27).

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Home mechanical ventilation

Recent technical progress has allowed an increased transition from the hospital to the patient's home environment, also in patients needing prolonged mechanical ventilation (28). Home mechanical ventilators have been equipped with remote monitoring tools, in order to improve physicians supervision on the delivered treatment and adapt settings to the patient's need and comfort (29). In patients with moderate to severe obstructive sleep apnea, using a web-based telemedicine system at the initiation of treatment an improvement in CPAP treatment adherence was reported (30).

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Neuromuscular patients

The feasibility of a home PR guided by telemonitoring for neuromuscular patients with impaired cough capacity has been verified in a recent italian pilot study (31). Home chest physiotherapy was prescribed according to respiratory signs and symptoms registered and daily transmitted to a remote control center. An apparent reduction of hospitalisations and emergency room admissions for respiratory complications was reported in the first year of the follow-up compared to the year prior to the enrollment (31).

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Only few studies were addressed to investigate effectiveness and results of telemedicine monitoring in neuromuscular patients which were ventilated in their own home (28-30, 32-34). A reduction in health care resources utilisation was reported in a small controlled study in ALS patients undergoing home noninvasive mechanical ventilation with a modem device connected to the ventilator that was used to send ventilator and compliance data, but also for introducing changes in the ventilator setting (34).

Conclusions

Current literature provides encouraging initial evidence of benefits of telerehabilitation and telemonitoring for rerspiratory diseases. Nevertheless more studies can contribute to strengthen such finding and identify specific insights on their cost-effectiveness ratio. The application of available technology on remote treatment and monitoring of respiratory diseases has already demonstrated high potential impact on societal, economic, clinical issues. Regulatory issues (legal, insurance, reimbursement) have to be soon addressed in order to transfer these important findings to clinical practice as well.

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