Maugeri Centre for Telehealth and Telecare: A real-life integrated experience in chronic patients

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Abstract
Management of chronic diseases in a progressively aging population is a major issue in western industrialized countries and telehealth is one way to ensure the continuity of care in chronic illness. We describe here our personal experience in a telehealth and telecare centre in Italy. Between January 2000 and December 2015, 1635 elderly patients (71% male) with one or more comorbidities have undergone a telehealth program tailored to their specific disease: chronic obstructive pulmonary disease (COPD)/chronic respiratory insufficiency; amyotrophic lateral sclerosis/neuromuscular diseases; chronic heart failure (CHF); post-stroke; and post-cardiac surgery patients discharged from hospital after an acute event. COPD and CHF represent the majority of patients treated (accounting for 80%). Interventions performed by the nurse tutor account for 39–82% of all activities in the five different programs. Specialist second opinion represents 12–27% of the health staff activities. Previously reported results show a reduction of the re-hospitalization rate and costs, and increase in quality of life and patient satisfaction with the service. A multidisciplinary telehealth and telecare integrated approach can provide efficient management for the growing number of complex patients.

Keywords
Chronic patient, home care, disease management, telemedicine, e-health

Introduction
Given the current demographic trend in western industrialized countries and consequent changing health profile of the general population, the greatest challenge that we face over the next 20 years is the management of chronic diseases in an aging population.1,2 At present, about 80% of ill health, disabilities and premature deaths are due to chronic diseases such as chronic obstructive pulmonary disease (COPD), chronic heart failure (CHF), stroke, and neurodegenerative diseases. The in-hospital mortality is high for chronic diseases, and readmissions in the year following an exacerbation occur in more than 50% of patients.3,4 Hospitalization costs account for more than 40% of the overall cost of chronic disease care (and for up to 60% for the most severe diseases).5 Despite new and more effective pharmacological and non-pharmacological treatments for chronic diseases, the prognosis still remains poor and hospitalizations are the major component of healthcare costs.6,7

By the year 2020, the costs for chronic diseases are anticipated to represent 70–80% of the health budget.8 Older adults in poor health are at risk of negative health outcomes and are the major consumers of health resources both in hospital and in the community. Given this socioeconomic trend, there is a heightened interest in delivering effective care to elderly and chronically ill patients at home.9 Innovative solutions such as e-health10 could meet this need.

Since experiences in the e-health field in Italy are limited, it is important to share real-life experiences in order to fill the knowledge gap and contribute to the promotion of best practices.

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practice. In this context, the Maugeri Centre for Telehealth and Telecare (MCTT) took the first steps in 1998 to develop a new physician-directed and nurse-managed model of integrated care based on remote telemonitoring and telephone support, to enable home care for patients with chronic disease and multi-morbidity. The aim of this paper is to describe our personal experience at the MCTT in providing continuity of care for patients with a chronic illness.

**Methods**

After hospital discharge at the MCTT, patients with a chronic illness are offered a multidisciplinary telehealth and telecare homecare program. The duration of the program varies depending on the diagnoses and specific clinical requirements. All programs have a common basic core but vary as to the specific interventions provided depending on which chronic disease is being treated: (i) COPD and chronic respiratory insufficiency (CRI); (ii) amyotrophic lateral sclerosis (ALS), (iii) CHF, (iv) post-stroke, or (v) post-cardiac surgery. Before their routine application in the MCTT, all programs underwent an experimental phase in accordance with the principles of good clinical practice and the Helsinki Declaration, and with the approval of the Central Ethics Committee of the Salvatore Maugeri Foundation in Pavia, Italy. As part of our routine procedure, all patients were asked to sign written informed consent before participating in the MCTT program.

The key element of the program is a structured physician-directed and nurse-managed telephone support and telemonitoring service provided to the patient in their home (see Figure 1). A trained and dedicated team, including specialists, nurses, and technical personnel, is involved in the e-health management. A nurse tutor (NT), available from 8:00 am to 4:00 pm weekdays, has the key role in the MCTT connecting all participants through a call centre. The overall intervention involves the following.

**Pre-discharge education sessions**

Patients receive several educational sessions before discharge from the NT regarding the disease, aimed to help

![Figure 1. Telecare management of chronic elderly patients through the MCTT program involving physician-directed and nurse-managed telephone support and telemonitoring of patients in their home. MCTT: Maugeri Centre for Telehealth and Telecare.](image-url)
them recognize early any signs and symptoms of deteriorating disease state and its co-morbidities. The booklet also informs patients about self-management using the ‘teach-back’ approach to ensure patient understanding. The sessions also include a demonstration of how to use the remote home telemonitoring equipment, if needed, and an explanation about why it is important for patients to monitor physiologic parameters.

**Telephone appointments with NT and specialist second opinion**

Patients are contacted weekly (according to the schedule) by the NT to reinforce the pre-discharge messages. During the call, the NT conducts a standardized interview enquiring about the patient’s general clinical condition, using assessment scales to detect if the patient’s signs and symptoms are worsening. The NT also counsels the patient on weight management and physical activity, smoking cessation, dietary changes, stress management and specific targets set. The NT enquires about the medications prescribed and checks whether therapy is taken regularly. If compliance is poor, the NT suggests strategies to improve the patient’s compliance. Patients can contact the NT at any time of the day through the call centre to report clinical problems, signs or symptoms or if they have any questions about the therapy. From these scheduled and unscheduled contacts, the NT relays relevant information to the clinical specialist (second opinion) who, based on the available information, can provide clinical feedback and, if necessary, modify the patient’s therapy.

**Electronic health record**

The NT has access, through personal authentication, to the patient’s medical history and medication records contained in the e-health record, available on a web platform. This platform handles all patients’ medical information and feeds the biological signals transmitted from the devices into the patient’s e-health record.

**Physical therapy support**

A specific program of physical exercise is prescribed at home, adapted to the patient’s particular needs and progress. The physiotherapist supervises the patient’s program through home visits, scheduled videoconferences and/or telephone appointments.

**Telemonitoring**

Depending on clinical requirements, patients are supplied with a series of sensorized devices (some wearable) including a blood pressure measuring device, one-lead electrocardiogram recorder, pulse oximeter, and weight measurement scales, that instantly transmit the signals to a server via a secure data connection.

**Videoconferencing**

Through videoconferencing, the physiotherapist can monitor each patient as they are performing their exercises and verify their improvement. The same system is used by the NT to deliver the educational program, check patients’ therapy and for counselling. All videoconference sessions are recorded and the operator can review the patient’s history through a ‘store and forward’ system.

A Telemedicine Service Centre (external to the hospital) provides technological support for telemonitoring activities with biomedical devices, and a database for the data collected; a call centre provides clinical and nursing support during the night and weekends through its health personnel, ensuring a 24 h/day service.

**Results**

Inclusion and exclusion criteria and the characteristics of the different services provided for the specific diseases as well as bibliographic references of the experimental studies carried out are summarized in Table 1. The MCTT is the result of a series of randomized and non-randomized experimental studies to verify the feasibility and efficacy of our approach. From January 2000 to December 2015, 1635 patients have been admitted to MCTT and evaluated. Table 2 shows the characteristics of these patients and the activities carried out by MCTT.

For COPD and CRI patients, we have demonstrated the feasibility of MCTT, its efficacy in reducing re-hospitalizations (−36%), acute exacerbations (−71%) and urgent calls to GP (−65%) and its cost-effectiveness (−33%) versus a control group. In the studies on ALS, we demonstrated the feasibility of the program, and the importance of following up these patients, helping them and their caregivers in the care, monitoring psychosocial status, being a source of information and accompanying them in the last days of their lives. Also in post-stroke patients, the MCTT program was shown to be feasible, enabling patients to continue rehabilitation at home after discharge from the hospital. For CHF patients, we demonstrated the feasibility of the program, its efficacy in reducing the rate of re-hospitalization (−44%) and of instability (−50%) and its cost-effectiveness (−24%) compared with a control group. For post-cardiac surgery patients, our studies demonstrated the feasibility of implementing a rehabilitation protocol in a home setting and its non-inferiority with respect to inpatient rehabilitation. An improvement in the quality of life (QoL) score was also observed (pre-post intervention), measured with different appropriate scales for COPD and CRI, post-stroke and CHF patients.

The overall evaluation of the programs showed a high and very high degree of patients’ and caregivers’ satisfaction, respectively. The results of these studies have led to the inclusion of our Telehealth programs for COPD, CHF and post-cardiac surgery patients as part of the healthcare services
Table 1. Key features of chronic conditions managed in the Maugeri Centre for Telehealth and Telecare.

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Main inclusion criteria</th>
<th>Main exclusion criteria</th>
<th>Services utilized</th>
<th>Funders</th>
<th>Duration of program</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>COPD/CRI</td>
<td>1. Patients in GOLD class III–IV and in the previous 12 months</td>
<td>1. Use of invasive mechanical ventilation,</td>
<td>Pulse oximeter device</td>
<td>Lombardy Region</td>
<td>6 to 12 months</td>
<td>11,12</td>
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<td></td>
<td>2. One hospitalization or two severe relapses for acute COPD, or</td>
<td>2. Illness with poor prognosis (&lt;12 months)</td>
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<td>3. Prescription ex novo of LTOT at home, or</td>
<td>3. Non-collaborative patients</td>
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<td>4. Start of non-invasive ventilation</td>
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<td>ALS</td>
<td>All patients with ALS – confirmed with El Escorial criteria – referred to the hospital</td>
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<td>Pulse oximeter device</td>
<td>Lombardy Region</td>
<td>Till death</td>
<td>13</td>
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<td></td>
<td>for rehabilitation</td>
<td></td>
<td></td>
<td>Patients Association</td>
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<tr>
<td>Post-stroke</td>
<td>1. Age &gt; 18 years</td>
<td>1. Presence of severe cognitive deficits and/or</td>
<td>A portable one-lead ECG device or BP measuring device</td>
<td>Health Ministry</td>
<td>3 months</td>
<td>14</td>
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<td>2. Stroke due to cerebral ischemia or haemorrhage</td>
<td>2. Absence of a caregiver who could provide informal care for the entire period of</td>
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<td>3. Functional deficit of the upper limb</td>
<td>home rehabilitation</td>
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<tr>
<td>CHF</td>
<td>1. Patients with CHF (NYHA classes II–IV)</td>
<td>1. Illness with poor prognosis (&lt;12 months)</td>
<td>A portable one-lead ECG device</td>
<td>Health Ministry</td>
<td>6 to 12 months</td>
<td>15,16</td>
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<td></td>
<td>2. LVSD with EF ↓40% or with LVDD and</td>
<td>2. Non-collaborative patients</td>
<td></td>
<td>Lombardy Region</td>
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<td></td>
<td>3. At least one episode of hospitalization for CHF within the previous 6 months</td>
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<td>Post-cardiac surgery</td>
<td>1. EuroSCORE between 0 and 5</td>
<td>1. Insulin-dependent diabetes or</td>
<td>A portable one-lead ECG device</td>
<td>Health Ministry</td>
<td>28 days</td>
<td>17</td>
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<td></td>
<td>2. No major complications after surgery</td>
<td>2. Overt CRI</td>
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<td>Lombardy Region</td>
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<td>3. Haemoglobin value ↑8.5 g/dl</td>
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<td>4. Availability of a caregiver at home</td>
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<td>CHF and COPD combined</td>
<td>1. COPD – GOLD classification (B, C and D class)</td>
<td>1. Physical activity limitations due to non-cardiac and/or pulmonary conditions</td>
<td>Pulse oximeter device</td>
<td>Health Ministry</td>
<td>4 months</td>
<td>21</td>
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<td></td>
<td>2. Systolic and/or diastolic heart Failure – NYHA class II, III and IV</td>
<td>2. Limited life expectancy</td>
<td>A portable one-lead ECG device</td>
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<td></td>
<td>3. At least one hospitalization or office visit due to CHF or COPD exacerbation in the</td>
<td>3. Severe cognitive impairments</td>
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<td>previous 12 months</td>
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(continued)
provided and reimbursed by the regional health system in Lombardy, Italy.\textsuperscript{19,20} For ALS patients, the main association of patients (AISLA, Italian Association Amyotrophic Lateral Sclerosis, www.aisla.it) decided to fund our activity.

As shown in Table 2, in the 16-year period of operation of the MCTT, the majority of interventions made were by the NT, accounting for 39–82\% of the time spent in the five different programs. The specialist’s second opinion mainly related to therapy modification or decision-making and accounted for 12–27\% of the interventions. Interventions by the physical therapist occurred only in rehabilitation programs.

After the first experimental period, we have continued to follow patients’ COPD and CHF with the aim to investigate the long-term effect of the program particularly on patients’ QoL. For ALS patients and their caregivers, the objective is to provide a continuum of palliative care at home until death, through an individualized structured holistic and rehabilitative program. For post-stroke patients, the objective is to maintain the benefits or slow down the loss of the benefits obtained during inpatient rehabilitation. In addition, considering that diseases like COPD and CHF can often coexist in the same patient due to common risk factors, we have extended our MCTT to these complex and frail patients, adding a specific physical rehabilitation protocol at home.\textsuperscript{21} Finally, we have initiated an MCTT program for older patients who have a high risk of falls.\textsuperscript{22}

### Discussion

Our experience demonstrates that a structured physician-directed, nurse-managed telephone support and telemonitoring program for chronic diseases has the potential to create synergism between hospital-based care and home care for the follow up of chronic patients in their daily life. The results obtained highlight the importance in chronic diseases management of a good organization supported by up-to-date technology.

Comparison of our experience with other reports in the literature is difficult because of differences in the type of health providers who managed the chronic patients and in the methods applied, leading to completely different results in terms of re-hospitalization, QoL, etc.\textsuperscript{23,24} Roccaforte et al.\textsuperscript{25} in a meta-analysis published in 2005, underlined that mortality and re-hospitalization rate were significantly reduced by a disease management program and that different approaches appeared to be equally effective; they concluded that the choice of specific program depended on the local health services characteristics, patient population and available resources. We decided to set up a long-term service focused on the nurse’s role as the key element of the intervention with information and communication technology used as a support to empower the patient to recognize signs and symptoms of instability early and to achieve optimal adherence to therapy.

Our experience is very similar to that of the DIAL study\textsuperscript{26} where collection of clinical information by the
nurse via phone produced good patient adherence and a significant reduction in hospitalizations for heart failure. On the contrary, many studies published use technology as the first step and the patient is contacted by the nurse only if the tele-monitored parameters are not normal. In this case, it is difficult to create a relationship between the nurse and patient to boost adherence to therapy and to incentivize patient self-empowerment and neither of these studies succeeded in reducing re-hospitalization.

The potential of the information and communication technology available in this field, ranging from basic to highly sophisticated tools, is enormous; nevertheless, so far, positive results such as in our experience (e.g. reduction in re-hospitalization rate, and increased satisfaction for patients and caregivers) have been obtained not simply through the use of telemonitoring alone, but through the integration of telemonitoring of biological signals with different health professional figures (e.g. nurse, physical therapist and specialist).

Standards for telemedicine require continuous monitoring regarding accuracy in technology, safety instructions and easy access for patients, and this should run parallel with the implementation of the system. As reported by Gund et al., the majority of healthcare professionals are positive about both current and future use of information and communication technology tools in healthcare and home follow up. However, difficulties with the implementation of new e-health tools have emerged, and two main reasons have been reported: the reluctance to change work routines, and the lack of interaction between primary care and hospitals.

Research on the empirical foundations of telemedicine interventions for chronic disease management shows that telemedicine changes the inputs of the traditional medical care process, encouraging patients to manage their own health. This could have a significant effect on outputs and it could be translated into a reduction in services utilization (hospital readmissions, length of hospital stay, etc.) and sometimes mortality.

The management of chronic diseases is such an important matter that, in March 2012, the European Commission set up a joint group of experts under the umbrella of the European Innovation Partnership (EIP) on Active and Healthy Aging (AHA) to support the development of a common European approach. Integrated care for chronic disease with telemonitoring is one of the pillars of the EIP program in Europe. There are many good examples in the field, even if they are mostly confined to the local level; our experience in this field has been integrated in the best practice report presented at the EIP meeting in 2013.

Conclusions

At present, the efficacy of a real-life program on continuity of care management has not been fully demonstrated. The current information and communication technology...
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