

**Reorganization of work, systematic follow-up and information technology at CSSS du Grand Littoral:  
An analysis of the effects of a home telecare project**

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**Contextualization and mandate**

The management of chronic diseases is becoming an increasingly heavy burden on the healthcare systems of industrialized nations. In Canada, the incidence of several chronic illnesses has risen significantly over the past few years, in line with the aging population and its lifestyle habits (HCC 2007; CIHI 2006a, 2006b). Resources dedicated to these patients and their associated costs exert tremendous pressure on healthcare systems, which are struggling to meet the population's needs. The challenge becomes even more significant given the shortage of healthcare professionals, particularly outside major metropolitan areas (CIHI 2006b). These facts have stimulated research into new methodologies and processes in order to best take charge of patient groups suffering from chronic diseases. Among the solutions proposed, it is strongly recommended that systematic follow-up of patients take place, rather than spot treatment of severe problems (Bodenheimer *et al*, 2002a; Lewis & Dixon 2004; Epping-Jordan *et al*, 2004). In order to achieve this, new care procedures must be put into place; these must facilitate collaboration between the patient and a team of proactive caregivers whose activities are coordinated more tightly around the patient.

Information technology (IT) is considered a critical tool in facilitating the implementation of new models of chronic disease management (Young *et al*, 2007; Dorr *et al*, 2007; ISC 2007). More specifically, home telecare technologies (defined as using IT to monitor patients and deliver healthcare at their residence) would allow such facilitation. The CSSS du Grand Littoral has attempted to innovate in this area, as seen by its work reorganization project (2007-2009); this sought to improve the delivery of health services within its home care programme, specifically for patients suffering from chronic obstructive pulmonary diseases (COPD) (Morin *et al*, 2009).

This report presents the results of a study aiming to measure the effects associated with the home telecare services deployed by the CSSS du Grand Littoral within the framework of its work reorganization project. More specifically, the purpose of this study was to analyze the effects of telecare services with respect to patient satisfaction, quality of care, the relevance of specific interventions, the empowerment of patients to self-manage their disease, the use of these services, and the improvements in the condition of patients monitored through telecare.

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## Status of current knowledge

**Technological innovation.** Health Canada has defined home telecare technology as *the use of electronic information and communication technology networks for two-way transfer of information and data required for medical diagnosis, treatment, consultation, and/ or health maintenance between a patients' residence and a health care facility.*<sup>4</sup> More recently, we define this technology more loosely to include the entire spectrum of clinical information systems which may be used to improve both the organization and the coordination of home healthcare services, including systems used by healthcare practitioners to support their practice and the systematic follow-up of patients.

The main characteristic of these technologies is the elimination of spatial and temporal barriers which normally structure the organization of home care. More specifically, they offer communications methods which allow the rapid and opportune dissemination of a patient's clinical information as well as the medical expertise which the patient may require (Akesson *et al*, 2007; May *et al*, 2005; Wootton *et al*, 2006).

**Intervention type.** The type of intervention implemented by the CSSS du Grand Littoral is a device installed at the patient's residence, which can be used daily to obtain relevant information on his/her clinical condition (for example, monitoring vital signs, determining intensity of symptoms, etc). This data is transmitted in real time to a central data management and processing system. Thanks to a set of pre-programmed "smart" capabilities, should the patient's condition deteriorate or deviate from acceptable parameters, the system can set off a warning or offer decision-making assistance to both the patient and the clinical team. In addition, the team may directly access the patient's data, allowing it to react quickly and appropriately even at a distance. In theory, such a device should improve the systematic follow-up of a patient and facilitate the execution of well-defined care protocols based on the patient pathology. This type of telecare, which allows the transmission of clinical data directly from the patient's residence to healthcare facilities, is designed in part to encourage the patient to become involved in self-managing his or her clinical condition. In addition, it allows for systematic remote follow-up while encouraging the effective investment of professional resources which can intervene more often from a distance. A recent report prepared by Canada Health Infoway underlined the importance of implementing this type of telecare system in Canada (CHI 2007).

In this patient-centred model, improved clinical effects should be obtained due to the standardization and regularity of a systematic follow-up, which allows for rapid response by caregivers as soon as a problem is detected. This effectively minimizes the risks of a significantly serious deterioration in a patient's clinical condition. This technology strives to improve the systematic monitoring of chronic patients residing at home by standardizing all practices through an increased use of care protocols, while endeavouring to offer cost-effective solutions with regard to operating costs. As far as usage of healthcare services goes, studies have shown that a patient-centred model may reduce the number of home visits per patient as well as the number of hospitalizations (Paré *et al*. 2007).

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<sup>4</sup> <http://www.hc-sc.gc.ca/hcs-sss/pubs/ehealth-esante/1998-tele/index-eng.php>

### Home Telecare Services Concept

Type of home telecare	Patient-centred home telecare (self-management and remote follow-up)
<b>Primary device type</b>	PC or dedicated terminal installed in the patient's home and connected to a central device where clinical expertise is available.
<b>Who?</b> (Primary users)	Patients, caregivers, case managers.
<b>What?</b> (Type of data)	Patient self-management plan and remote follow-up, including vital signs, symptoms, measurement of health status, medication, lifestyle habits, compliance to treatment.
<b>Why?</b> (Primary objectives)	Facilitates patient involvement in self-management of illness; ensures systematic remote follow-up of patient's clinical status; reduces incidence of disease exacerbations; number of emergency room visits and hospitalizations are therefore reduced
<b>When?</b> (Frequency of use)	According to the patient's clinical needs.
<b>Where?</b>	From home, and remotely during systematic follow-up

**Effects of home telecare.** During a systematic review conducted recently, we synthesized a number of earlier studies which evaluated home telecare projects (also referred to as home telemonitoring) in the management of chronic diseases (Paré *et al*, 2007). This review allowed us to define the current state of knowledge on the nature and extent of the effects associated with this type of intervention, according to a systematic analysis of experimental and quasi-experimental studies undertaken with patients suffering from common chronic conditions such as pulmonary disease, diabetes, hypertension and heart failure. Globally, it appears that the effects of home telecare on a patient's clinical condition (e.g., early detection of symptoms, a reduction in blood pressure, a reduction in complications, etc.) were demonstrated in satisfactory fashion for these chronic pathologies, with the exception of heart failure and COPD. However, convincing results on the effects of home telecare on healthcare service usage (reduction in emergency visits, hospitalizations, and length of stay) are more consistent in studies concerning pulmonary and heart disease rather than those concerned with diabetes and hypertension (Jaana & Paré 2007; Jaana *et al*, 2006; Paré *et al*, 2007).

Research conducted within the MEDLINE database (PubMed interface), The Cochrane Library and the International Network of Agencies for Health Technology Assessment (INAHTA) database allowed us to identify five studies which had previously analyzed the clinical, behavioural, structural and/or economic effects of home telecare in patients afflicted with COPD. The results of each of these studies are summarized in the paragraphs below.

In a pilot project undertaken in the United Kingdom, Dale and colleagues (2003) remotely monitored 55 patients suffering from COPD over a period of three months. As a first step, patients were taught how to correctly handle various instruments (electronic spirometer and scale) and capture the clinical data into

the system. This training took place during the nurse's initial visit to the patient's residence. Clinical data was then transmitted to a telemonitoring centre via modem and the patient's telephone line. During the three-month period of the pilot project, 36 decompensations were noted. Of these, 29 (81%) were managed remotely from the patient's residence while the other seven required patient hospitalization. The study results indicate that the number of hospitalizations was 50% lower than had been initially expected for this patient cohort. Finally, an investigation at the end of the project found that patients considered the technology easy to use and the telemonitoring programme reassuring.

In the second study, Miaolo and colleagues (2003) followed a cohort of 23 Italian patients suffering from COPD. In the first phase of the study, patients agreed to be monitored for one year in the traditional way, consisting of face-to-face visits occurring once every three months. In the second phase, these same patients were monitored remotely at their homes for a 12-month period. Twice a week, these patients would take clinical measurements of their health status, which were then automatically transmitted to the hospital via a standard telephone line. Thus, it was possible to measure and compare the effects of telemonitoring at home. Hospitalization and acute episodes at home decreased respectively by 50% and 55% during the telemonitoring phase ( $p < 0.02$ ). Finally, 96% of patients stated they were satisfied with regard to the home telecare programme.

The third study took place in an ambulatory care centre within the Montreal, Canada area, which offers specialized pulmonary care to adults suffering from chronic pulmonary problems. From a technological standpoint, each patient received a web phone with integrated touch screen and modem. A personalized follow-up protocol, including monitoring of various parameters was pre-programmed into the device and was taught to the patient during a first meeting with the nurse. In order to determine the telemonitoring programme's attributable effects, a non-randomized clinical trial with a control group was held for six months (Paré *et al*, 2006). Twenty patients were assigned to the study group; ten were placed in the control group, which underwent traditional follow-ups including some home visits. Results indicate that the number of home visits made by the nurses was lower for the study group ( $p < 0.001$ ). Furthermore, an average of 0.11 hospitalizations for each telemonitored patient was observed, compared to 0.60 per patient within the control group ( $p < 0.05$ ) during that six-month period. Finally, in economic terms, the average per-patient cost of the home telemonitoring programme was \$6,750 lower than the traditional home care programme, a net savings of \$355 (or 12%) per patient.

For their part, Toledo and colleagues (2006) spent 12 months monitoring 157 Spanish COPD patients who were randomly assigned to either a control group ( $n=90$ ) or a study group ( $n=67$ ). The main objective of this study was to measure the effects of home telemonitoring on the number of hospitalizations, the number of repeat visits to the emergency room, and the mortality rate. The patients in the study group were given a 90-minute training session in order to learn how to transmit their biomedical parameters (peak flow rate, pulmonary function test, blood pressure) and their drug intake, and to participate in teleconsultation sessions (via videoconference) with a nurse. Patients in the study group also had access to a telephone call centre should the need arise. The results of the study, over the period of one year, revealed a greater reduction in the number of patients not readmitted to hospital among the study group patients than among the control group patients ( $p=0.04$ ). The same observation was made with regard to the number of patients readmitted only once during the twelve-month monitoring period ( $p=0.03$ ). The average delay before first hospitalization was longer for patients in the study group than for those in the control group. However, there was no significant difference recorded between the two groups in terms of the number of return visits to the emergency room, and their mortality rates.

The fifth study was performed by a group of researchers from the United Kingdom (Trappenburg *et al*, 2008). The primary objective of this non-randomized clinical trial was to determine the effects of a home telecare programme on a group of patients with moderate to severe COPD. Patients from four hospitals were assigned to the study group (n=59) while those from two other hospital centres were assigned to the control group (n=56). Study results indicate that the patients in the study group had fewer decompensations ( $p = 0.004$ ) and were readmitted to hospital less frequently ( $p = 0.02$ ) than those in the control group. However, no significant difference was recorded between the two groups in terms of perceived quality of life.

On the whole, the five studies described above indicate that a number of benefits can be expected from home telecare initiatives for patients suffering from COPD. One of the most significant advantages of this therapeutic approach revealed by these studies is the capacity to ensure a more frequent monitoring of the clinical condition of patients. Thus, patients at home may benefit from therapeutic plans that are better adapted to their current health status. Therefore, telemedicine offers potentially important benefits in terms of accessibility and an increased quality of care.

## **Methods**

**Research specifications.** In order to evaluate the effects associated with the home telecare programme implemented at the CSSS du Grand Littoral, a retrospective and prospective study with an equivalent control group was undertaken. This quasi-experimental specification allowed a comparison of the effects of telecare services (study group) with traditional home care services (control group); the analysis unit was in fact the patient. Patients in the study group were individually partnered with patients comprising the control group. This type of specification has the advantage of improving the quality of statistical analysis within the framework of a study with a control group, due to the individual matching of subjects to the study.

**Study population.** The selection of study subjects took place between March and December 2008. Patients in the study group were recruited from among those who were benefiting from the new intensive at-home monitoring programme. This initiative attempts to reach the most difficult patients; that is, those who experienced difficulty in complying with prescribed treatments and were more unstable from a clinical perspective. For the purposes of this study, we were able to gather information on twenty-three (23) patients who form the study group.

Subsequently, the matching process attempted to ensure that patients in the control group who are compared to those in the study group are as similar as possible. This would eliminate potential biases which may be detrimental to comparison between the study and control groups, and thus to a full appreciation of the effects of the new programme. The control group was formed from other patients registered in the regular home care services programme. Each patient in the control group was individually matched with a patient in the study group in order to form pairs which were as similar as possible. Appendix 1 presents the study times for each of the subjects under study. The matching criteria were: primary diagnosis of COPD, age, gender, and disease severity. Considering the small number of patients involved, two criteria – age and gender – were relaxed in certain cases in order to permit identification of control patients. In summary, we were able to benefit from a very good control group, from the standpoint of having a patient group who all suffer from the same condition, come from the same geographical region and were treated by the same clinical team. However, there was a

difference between the study group and the control group with regards to patient control of the condition. This difference evolves from a clinical decision to favour the choice of patients targeted for admission to the telecare service programme.

Therefore, the impact analysis was performed on a total population of 46 patients, divided into 23 pairs of individually matched patients.

**Definition of variables.** We based our research on studies done in the field of healthcare IT (Chaudhry *et al*, 2006) and more specifically on home telecare (Demeris *et al*, 2000; Finkelstein *et al*, 2006; Johnston *et al*, 2000), as well as our own previous work specifically examining the effects of telecare (Jaana *et al*, 2007; Jaana & Paré 2007; Paré *et al*, 2007). Thus, we developed a lengthy list of anticipated effects from home telecare (see table below). This study allowed for the analysis of several categories of effects: satisfaction, quality of services, relevance of services, patient empowerment with respect to their illness, usage of healthcare services, and finally, health outcomes. Except for the measurement of usage of healthcare services – which was primarily noted with the help of user data available within existing information systems – all variables were measured through structured questionnaires, which are valid measurement instruments which have been used for this type of study in the past (see the next section, and the accompanying table).

**Measurement instruments.** A number of instruments were used with patients within the framework of the present study:

- MOS SF12 (Medical Outcome Study Short Form-12 items; Gandek *et al*, 1998) – a measurement instrument of quality of life, it was used pre- and post-implementation for both the study and control groups;
- CSQ-9 items (Client Satisfaction Questionnaire with home care; Larsen and Attkisson, 1979) measured satisfaction with regard to home care services received. It was used post-implementation on both groups under investigation;
- In addition, for both groups, the effects of the programme and of taking charge of the disease were measured post. The self-empowerment (Hébert *et al*, 2008), self-sufficiency (Lorig *et al*, 1996) and treatment compliance (Morisky *et al*, 1986) instruments were adapted to the context of the study. This scale was composed of a total of nine items;
- Finally, study group patients responded to a questionnaire which measured their satisfaction levels with respect to the telecare technology systems (13 items). This instrument is based on the Delone and McLean (2003) Success Model, which measures the quality of a system and of its information.

### Potential effects associated with home telecare

Variables	Definitions and Measurement Instruments
<b>Patient characteristics (Control variables)</b>	<ul style="list-style-type: none"> <li>• Socio-demographic data (gender, age, civil status)<sup>1</sup></li> <li>• Severity of the disease (clinical opinion and objective clinical data)</li> <li>• Measurement of quality of life - Medical Outcome Study 12-item short form (SF-12)<sup>3-4</sup></li> </ul>
<b>Effects on patients</b>	
<p><u>Satisfaction</u></p> <p><u>Quality and relevance of care</u></p> <p><u>Empowerment to self-manage care</u></p> <p><u>Usage of healthcare services</u> Services received as home healthcare</p> <p>Services received outside of home healthcare</p>	<ul style="list-style-type: none"> <li>• Patient satisfaction with regard to the home care services received (CSQ Client Satisfaction Questionnaire; Larsen and Attkison, 1979)<sup>4</sup></li> <li>• Patient satisfaction with regard to telecare services (study group) (TSUQ-Telemedicine Satisfaction and usefulness questionnaire)<sup>4</sup></li> <li>• Perceived quality of received care</li> <li>• Perceived relevance of received care</li> <li>• Self-management of chronic disease (Lorig <i>et al</i>, 1996)<sup>4,5</sup></li> <li>• Self-empowerment of the patient (HCEQ-Healthcare empowerment questionnaire)<sup>4,5</sup></li> <li>• Treatment compliance (Self-reported measure of medication adherence; Morisky <i>et al</i>, 1986)<sup>4,5</sup></li> <li>• Benefits perceived by the caregiver (Tudiver <i>et al</i>, 2007)<sup>5,6</sup></li> <li>• Number and type of home care services received including planned telephone monitoring calls or urgent calls made by the patient<sup>2,6</sup></li> <li>• Work time spent by caregivers at the residence<sup>2,6</sup></li> <li>• Diversity of caregivers<sup>2,6</sup></li> <li>• Number of hospitalizations<sup>7</sup></li> <li>• Length of hospital stay<sup>1,7</sup></li> <li>• Number of visits to hospital emergency department<sup>1,6</sup></li> </ul>
<p><u>Health outcomes</u> Quality of life</p>	<ul style="list-style-type: none"> <li>• Medical Outcome Study 12-item short form (SF-12)<sup>3-4</sup></li> </ul>
<p><u>Data sources:</u></p> <ol style="list-style-type: none"> <li>1. Patient records.</li> <li>2. Clinical and administrative data, observation notes collected during home visits.</li> <li>3. Telecare device database.</li> <li>4. Questionnaire administered to patient (telephone survey).</li> <li>5. Questionnaire administered to home caregiver.</li> <li>6. Clinical and administrative information systems of the CSSS.</li> </ol>	

On the other hand, a 23-item instrument was administered to the respiratory therapists as well as the nurses responsible for monitoring the study group patients. Administered following a patient's release from the telecare programme, this questionnaire measured the levels of technology usage by the patient (1 item), and the effects on the quality of dispensed services (3 items) on patient empowerment with respect to his/her illness (12 items,) and on the service's perceived usefulness to the patient (7 items).

Finally, a questionnaire comprising 17 items was administered to caregivers located at the Info-Santé call centre and at partner hospitals at the end of the study period, in order to measure their levels of satisfaction with the home telecare technology and its benefits.

**Data sources.** As indicated in the table below, we obtained access to a number of different data sources, which allowed for triangulation of our results. Data was collected through a) structured questionnaires administered by telephone; b) patient records and personalized service plans used in the home care setting; c) administrative systems – both paper and electronic – used in the management of home care services; and d) for the study group, the database inputs generated by the software used for the telecare interventions. Identical data-collection strategies were used for both the study and control groups.

Data related to the usage of hospital and home care services was obtained from administrative and clinical information systems as well as through patient records. With respect to hospital services, the number of hospitalizations and the length of stay, as well as the number of visits to the regional hospital's emergency department, were collated for the pre/per and post periods. For the home care services, the data represents the number of visits by caregivers, the duration of each visit, and the number and duration of calls to patients (pre/per/post). It would have been equally interesting to analyze the usage of services in terms of the number of medical visits, but access to this data was difficult to obtain, given the number and geographical distribution of the region's medical clinics.

**Data analysis.** An analysis of the collected data was performed for the 23 pairs of patients forming the study and control groups. The statistical analyses that were performed were the chi-square and paired-t tests. The quality of life questionnaire was analyzed based on the scoring rules for the RAND 36-Item Health Survey (version 1). Thus, the items were rescored so that a higher score corresponded to a better health status. In addition, the various scales were recoded with scores ranging from 0 (unfavourable health status) to 100 (favourable health status). As proposed by the authors, the items were reclassified using two scales: a physical health scale (7 items) and an emotional health scale (5 items).

## **RESULTS AND DISCUSSION**

### **Characteristics of patients participating in the study**

The average length of the telecare follow-up period for the 23 patients in the study group was 146.7 days (standard deviation: 72.3 days). Two patients were monitored for over 11 months (340 and 358 days). If these two patients are removed from the calculation of the average telecare follow-up period, the average duration becomes 127.4 days (standard deviation: 35.5), which represents nearly **four months of remote monitoring**. Table 1 outlines patient characteristics of both groups under investigation. Statistical comparison of these two groups indicates that they were highly similar at the

start of the study, prior to introduction of the home telecare component. The sole statistically different characteristic is age, and this difference is slight, with a variation of less than two years. The three variables used to assess the initial gravity of the study patients' disease (severity of the disease, forced expired volume, and recourse to home oxygen therapy) do not present significant differences.

<b>Table 1 – Characteristics of patients participating in the study</b>			
	<b>Study Group (n = 23)</b>	<b>Control Group (n = 23)</b>	<b>Paired-t Test <i>p value</i></b>
<b>Gender</b>			
Female	10	10	ns
Male	13	13	
<b>Age</b>	<b>73.7 (9.55)</b>	<b>75.4 (9.70)</b>	<b>.02</b>
<b>Civil status</b>	(n = 20)	(n = 17)	---
Single	4	3	
Married	3	7	
Common-law spouse			
Widow(er)	13 0	2 5	
<b>Severity of the disease*</b>			ns
Mild	3	3	
Moderate	8	7	
Severe	12	13	
<b>Forced expired volume in seconds (FEV<sub>1</sub>)*</b>	(n = 21) 38.8 (13.4)	(n = 12) 46.6 (18.1)	(n = 11) 0.11
<b>Home oxygen therapy* (% of patients)</b>	(n = 22) 27.3 %	(n = 23) 13.0 %	ns
<b>Deaths during the period of study</b>	1	1	ns
* These variables were collected at the start of the study, prior to the start of the home telecare programme. The acronym "ns" signifies that the inter-group comparison is statistically insignificant.			

In addition, at the outset of the study, we assessed patient perception as to their own health states. To this end, we used a validated instrument to measure quality of life which examined two dimensions, one physical and the other psychological. Table 2 presents the scores reported by both patients groups in the study. On the whole, patients evaluated their health states rather negatively, particularly on the physical dimension (31.9 and 43.4 on a scale of 100). Evaluation of the psychological component reveals a more positive self-evaluation (56.3 and 58.5 on a scale of 100). A statistical comparison of both groups reveals that prior to the telecare intervention, a statistically significant difference ( $p=0.03$ ) did exist between the two groups. In fact, the patients in the study group perceived their state of physical health (31.9) more negatively than did the control group (43.4). In terms of perceptions regarding emotional health, they appear to be similar between both groups. This observed difference between the two groups is coherent with the information outlined previously with regard to the admissibility criteria

applied to the telecare services programme. Indeed, it was patients who experienced difficulty following the basic recommendations made by healthcare practitioners in a traditional monitoring programme who were selected on a priority basis to receive home telecare services. Their admission into the study group was designed to offer them a means – telecare services – to remedy this difficulty.

<b>Table 2 – Quality of life measurement, pre-trial</b>			
<b>Quality of life (SF12), pre (n = 22)</b>	<b>Study Group Average (standard deviation)</b>	<b>Control Group Average (standard deviation)</b>	<b>Paired-t Test <i>p value</i></b>
<b>State of physical health</b>	<b>31.9 (17.5)</b>	<b>43.4 (23.2)</b>	<b>0.03</b>
<b>State of emotional health</b>	56.3 (23.0)	58.5 (30.0)	0.78

### **Satisfaction with regard to services received, care quality and perceived usefulness**

Firstly, we wished to understand patient satisfaction with regard to the services they received. Table 3 presents the results of this evaluation for all services received within the home care programme by both patient groups under investigation. In the case of the study group, this data was collected when patients had ended their use of telecare services, whereas in the case of the control group, the data collection was based on an equivalent time period during which this group received traditional home care services.

<b>Table 3 – Satisfaction of study intervention and control group patients regarding the services received through a home care programme</b>			
	<b>Study Group Average (standard deviation) (n = 20)</b>	<b>Control Group Average (standard deviation) (n = 20)</b>	<b>Paired-t Test <i>p value</i></b>
Were the care and service you received of good quality?	4.6 (0.6)	4.6 (0.6)	1.00
Did you receive the kind of care and service that you wanted?	4.6 (0.6)	4.6 (0.5)	0.80
Did the care and service you received meet your needs?	4.8 (0.4)	4.6 (0.8)	0.23
If one of your friends had need of the same type of assistance, would you recommend that he/she use the same services that you did?	4.7 (0.5)	4.7 (0.6)	1.00
Are you satisfied with the quality of the assistance received?	4.5 (0.5)	4.3 (1.1)	0.51
Did the care and service you received help you to better deal with your situation?	4.1 (1.3)	4.4 (1.1)	0.50
Did the care you received help you to better follow treatment recommendations for your particular health condition?	4.2 (1.0)	4.5 (0.8)	0.25
Are you generally satisfied with the care and service you received?	4.7(0.5)	4.8 (0.6)	0.61
If you had future need of assistance, would you make use of the same care and service?	4.7(0.5)	4.7(0.6)	1.00
Note: Responses were measured using a Likert scale, which includes five levels varying from 'very dissatisfied' to 'very satisfied'.			

The data presented in Table 3 indicates that the degree of satisfaction with regard to home care services was extremely high. Indeed, average satisfaction scores obtained for the 9 dimensions all achieved a level greater than 4.0 on a scale of 5. These scores exceed 4.5 in most cases. We also note that there does not appear to be a significant difference between the study and control groups, as clearly seen in the last column of Table 3 (where none of the p values – indicating the margin of error – is lower than 0.10). It appears clear that patients belonging to both the study and control groups were therefore extremely satisfied with the entirety of the services they received through home care.

More specifically, we also wished to understand the degree of satisfaction with regard to the new telecare technology. To this end, we solicited input from patients as well as healthcare practitioners. We initially asked nurses and respiratory therapists offering home services to the patients in the study group to provide us with opinions as to the quality of care and usefulness of the new telecare technology. This data was collected at the time patients ended their use of telecare services.

<b>Table 4 – Effects perceived by nurses and respiratory therapists among patients using home telecare technology</b>	
<b>Study Group</b>	<b>Average (standard deviation) (n = 19-20)</b>
<b>Effects on level of quality of services dispensed</b>	
The technology facilitated contact between patient and nurses	8.0 (1.8)
The technology reduced delays in nursing intervention	8.7 (1.0)
The technology improved the quality of information provided to patients	7.4 (2.0)
The technology helped avoid a worsening of symptoms associated with the illness	8.1 (1.7)
The technology increased the quality of care received	7.3 (2.3)
<b>Effects in terms of usefulness for the patient</b>	
The technology answered a need	7.9 (2.0)
The technology was beneficial	8.1 (1.8)
The technology increased the satisfaction with the home care received	8.1 (2.1)
<b>Use</b>	
The patient used the telecare system as often as required	8.4 (1.4)
Note: Responses were measured using a Likert scale, which includes ten levels varying from 'completely disagree with' to 'completely agree with'.	

The results presented in Table 4 corroborate the positive evaluation received previously from patients in the study group (Table 3). Staff expressed a highly positive opinion. The scores obtained for the dimensions which measured the quality of telecare services were high, with results greater than 7 on a 10-level scale. We note that the quality of healthcare staff-patient contacts (8.0), the reduction of intervention delays (8.7), and a decrease in the severity of symptoms (8.1) obtained scores greater than 8 out of 10. In addition, scores measuring the usefulness of the new technology also reached high levels, similarly around 8 out of 10. Furthermore, we note that patients demonstrated very strong adherence to their telecare services, in the sense that the technology was very frequently used (8.4) as reported by healthcare staff.

<b>Table 5 – Satisfaction of study group patients regarding home telecare technology</b>	
<b>Quality of information provided by telecare system</b>	<b>Average (standard deviation) (n = 19 - 21)</b>
Information well presented	4.9 (0.4)
Easy to understand	4.6 (0.7)
Useful information	4.2 (1.4)
Confidence in the security and confidentiality of the data	4.4 (1.0)
<b>Use of telecare system</b>	
Ease of use	4.8 (0.4)
Ease of learning	4.4 (0.9)
Adequate functionality of the equipment	4.2 (0.8)
Frequency of use of system	4.9 (0.3)
<b>General satisfaction</b>	4.6 (0.8)
Note: Responses were measured using a Likert scale, which includes five levels varying from 'very dissatisfied' to 'very satisfied'.	

Finally, we assessed the levels of satisfaction expressed by the patients themselves with regard to the new telecare services. As can be seen through analysis of the results presented in Table 5, satisfaction levels surrounding the telecare technology proper were very positive. Patients judged both the characteristics of the new device as well as the information provided highly favourably. An average mark across all indicators is higher than 4 on a scale of 5 levels.

### The effects of telecare on patient empowerment with regard to their disease

Secondly, we wished to understand the effects of telecare on a patient's self-management of his/her disease. One of the principal objectives sought by the home telecare technology is to favour greater patient autonomy in terms of empowerment surrounding the disease. In order to assess this type of effect, we first compared perceptions within both patient groups. In the case of the study group, this data was collected when patients had ended their use of telecare services, whereas in the case of the control group, the data collection was based on an equivalent time period during which this group received traditional home care services.

<b>Table 6 – Effects perceived in the study and control groups with respect to empowering patients to take charge of their disease</b>			
<i>Over the last three months. ...</i>	Study Group Average (standard deviation) (n = 19-20)	Control Group (n = 19-20) Average (standard deviation)	Paired-t Test <i>p value</i>
Were you asked your opinion at the time your treatment plan was developed?	3.7 (1.4)	3.4 (1.3)	0.41
Were you involved in the decisions concerning your care and treatment?	4.2 (1.1)	3.7 (1.2)	0.20
Were you asked if you had had problems following the recommended treatment?	4.0 (1.0)	3.8 (1.4)	0.57
Did the instruction you received help you to have better control of your illness?	4.3 (1.1)	4.2 (1.2)	0.91
Are you confident of your ability to take care of yourself in a way that reduces your need to consult a physician?	3.7 (1.2)	4.0 (1.3)	0.51
Are you confident of your ability to do more than simply take your medications as a means of reducing the day-to-day symptoms of your illness?	<b>4.2 (0.8)</b>	<b>3.4 (1.4)</b>	<b>0.05</b>
Are you confident of your ability to determine when a change in your health status would require you to consult a physician or a nurse?	<b>4.6 (0.7)</b>	<b>3.7 (1.4)</b>	<b>0.03</b>
Do you always take your medications as prescribed by your physician?	4.8 (0.4)	4.8 (0.4)	1.00
When you feel better, do you stop taking your medications, whereas normally you would take them regularly?	2.1 (1.5)	1.7 (1.2)	0.42
Note: Responses were measured using a Likert scale, which includes five levels varying from 'completely disagree' to 'completely agree'.			

Table 6 presents the results of this evaluation for both groups of patients under investigation. Evaluation of the first three dimensions allows for measuring the impact of interventions within the services

offered, while the following dimensions measure their effects as perceived by the patients. On the whole, the results are encouraging. In most cases, scores were higher than 3.5 on a scale of 5 (note: scores for the final dimension of Table 6 which are lower than the midpoint must be interpreted positively, given the negative wording of the question).

A comparative analysis of the two patient groups demonstrates no difference with respect to the interventions performed by clinical staff on patients, whether in the study group or the control group. However, two of the dimensions which measure effect were different, specifically the patient’s ability to self-treat beyond medication (4.2 vs. 3.4;  $p = 0.05$ ) and the patient’s capacity to self-evaluate (4.6 vs. 3.7;  $p=0.03$ ). In both cases, a comparative analysis indicates that study group patients, which benefited from telecare services, developed a greater sense of empowerment with respect to their disease than did the control group. This result is even more significant than the difference between the two groups. Indeed, it is 0.8 in the first case (the difference between 4.2 and 3.4) and 0.9 in the second (the difference between 4.6 and 3.7) on a scale of 5 levels, representing a marked difference. Secondly, this result is highly significant given that the study group was initially more disadvantaged than the control group with respect to empowerment, given the criteria used for admissibility into the telecare services programme. These two results are therefore encouraging in terms of the efficiency that may be associated with telecare services.

Table 7 completes the evaluation of patient empowerment with respect to their disease, presenting the results of questions asked specifically of patients in the study group at the end of the period during which they benefited from the telecare services. We note that the new telecare technology offers a range of interesting benefits, notably with regard to psychological reassurance (4.2) and action steps to be taken during relapses (4.1). However, the new technology’s capacity to help patients follow the prescribed protocols in taking their medication correctly appears weak, with a score of 2.5, which is the mid-point of the scale. This result highlights a functionality which might easily be improved in the future. In fact, a more thorough analysis revealed that this type of functionality is already incorporated within the telecare technological solution; however, the clinical staff had elected not to use it, as it was insufficiently adapted to the specific cases of patients with COPD.

<b>Table 7 – Benefits perceived by patients using home telecare technology</b>	
<b>Benefits perceived through use of telecare system</b>	Average (standard deviation) (n = 19 - 21)
Helps me to more quickly detect signs and symptoms that would indicate a deterioration of my state of health	3.6 (1.3)
Helped me to know what measures to take when I am feeling less well	4.1 (1.3)
Helps me to take my medications as prescribed	2.5 (1.7)
Helps to reassure me	4.2 (1.2)
Note: Responses were measured using a Likert scale, which includes five levels varying from ‘completely disagree’ to ‘completely agree’.	

Finally, we completed this assessment of the effects of telecare services on patient empowerment by seeking the opinions of healthcare staff. Table 8 presents the perspectives of healthcare practitioners with regard to the improvements in the sense of empowerment they observed in patients from the study group once these patients had ended usage of the telecare technology. On the whole, these results corroborate the favourable opinions expressed by patients in terms of the benefits offered by

the telecare technology. The first three dimensions which assess improvements in patient knowledge were favourably rated by clinical staff, with scores varying between 7.3 and 8.2 on a scale of 10. In addition, three of the following dimensions which measured behavioural changes with regard to follow-ups and taking charge of the disease, were also positively evaluated, with scores ranging from 7.0 and 7.6. However, the dimension concerning patients' reassurance with respect to their condition was rated rather unfavourably (6.0) by healthcare staff. This result differs from the one observed within the patients themselves, who expressed a more positive opinion (4.2 on a scale of 5 – see Table 7). Finally, clinical staff also negatively rated the level of patient dependency they perceived the technology would create. This dimension effectively shows a high score of 8.3 on a scale of 10. We appear to be presented with a technology which offers both positive empowerment effects as well as negative dependency ones. We must also recognize that a difference of opinion exists between patients and clinical staff. Without attributing right or wrong - since each group offered assessments in accordance with their own specific criteria - it is useful to specify that the home telecare service programme management staff had anticipated the potential problem of creating a state of dependency on the technology. In order to remedy this situation, patients had been warned and made aware at the outset that the telecare services would be temporary. In actual fact, it appears that there were very few problems when these services were terminated.

<b>Table 8 – Effects perceived by nurses and respiratory therapists in patients using home telecare technology</b>	
Study Group	Average (standard deviation) (n = 19-20)
<b>Effects on patient self-management of his/her disease</b>	
The technology improved the patient's knowledge of the nature of his/her clinical condition	7.3 (2.1)
The technology improved knowledge of the symptoms being monitored	7.6 (1.8)
The technology improved knowledge of ways to better control his/her illness	8.2 (1.3)
The technology improved follow-up by the patient on the condition of his/her health	7.6 (1.6)
The technology improved control of his/her health condition	7.3 (1.9)
The technology increased his/her feelings of security regarding the state of his/her health	6.0 (1.9)
The technology increased self-empowerment with regard to his/her state of health	7.0 (1.8)
The technology created a dependence on such technology	8.3 (1.7)
Note: Responses were measured using a Likert scale, which includes ten levels varying from 'completely disagree' to 'completely agree'.	

### **The effects of telecare on home care service consumption**

Thirdly, we wished to measure the effects of telecare with respect to the usage of different types of healthcare services. On this issue, the objectives sought by a home telecare technology would normally include, on the one hand, reducing the intensity of professional resources who would offer healthcare services to a patient at his/her residence, and on the other hand, reducing the number of emergency visits and hospitalizations. In the case of the former, the very presence of the technology in the patient's home should decrease the intensity of the need for professionals to be present. For the latter, improved control of one's state of health brought about by the technology should serve to diminish the acute

phases of the disease, thereby reducing a patient's recourse to hospital care. In order to assess this type of effect, we initially analyzed the use of the home care programme's professional resources by both groups under investigation.

Table 9 presents the consumption of home care services in accordance with two types of intervention: home visits undertaken by respiratory technicians and nurses, and telephone calls made by these same professionals as well as by the Info-Santé call centre. Telephone calls from the call centre were separated into two categories: calls made by the call centre in response to an alarm triggered by the telecare system, and calls made by the patient himself/herself.

<b>Table 9 – Effects of telecare on the consumption of health services (raw data)</b>						
	<b>Study Group (n=23)</b>			<b>Control Group (n=22-23)</b>		
<b><u>Pre-telecare</u></b> (15 months) Visits/Telephone calls to the home	<b>Number of patients</b>	<b>Total number of visits</b>	<b>Combined duration of all visits (in minutes)</b>	<b>Number of patients</b>	<b>Total number of visits</b>	<b>Combined duration of all visits (in minutes)</b>
Visits from respiratory therapist	14	123	6380	15	147	7984
Visits from nurse	22	251	10301	22	235	8966
Telephone calls from respiratory therapist	4	5	200	1	1	15
Telephone calls from nurse	4	6	80	1	1	30
Telephone calls from Info-santé	1	1	-	0	0	-
Patient telephone calls to Info-santé	2	7	-	0	0	-
<b><u>During telecare</u></b> Visits/Telephone calls to the home						
Visits from respiratory therapist	15	63	3273	15	52	2710
Visits from nurse	18	81	3185	17	93	3366
Telephone calls from respiratory therapist	8	21	445	1	1	20
Telephone calls from nurse	9	15	225	3	7	90
Telephone calls from Info-santé	23	171	-	0	0	-
Patient telephone calls to Info-santé	12	40	-	0	0	-
<b><u>Post- telecare</u></b> (3 months) Visits/Telephone calls to the home	(n = 21-23)			(n = 20-22)		
Visits from respiratory therapist	13	25	1285	12	53	3160
Visits from nurse	14	34	1364	11	83	2818
Telephone calls from respiratory therapist	2	3	70	0	0	0
Telephone calls from nurse	1	1	15	0	0	0
Telephone calls from Info-santé	2	4	-	0	0	-
Patient telephone calls to Info-santé	2	2	-	0	0	-

Readers must exercise caution when comparing the observation periods (pre, per, post) in Table 9, since they relate to varying periods of time. Thus, the duration of the pre-telecare period is 15 months. The period during which telecare services were offered was personalized to each patient; and the post period is 3 months. In order to compare these periods, we have calculated service consumption averages on a monthly basis. These indices, presented in Table 10, allow us to make statistically valid

analyses in order to determine the effects of the telecare technology on consumption of healthcare services.

In reading Table 10, it is clear that telecare services had a considerable impact on resource usage with respect to the home care programme. Examination of the comparison before/after telecare care (see the last line in Table 10) reveals that the study group, composed of patients who had received telecare services, utilized more resources in the period following these services. These differences are statistically significant and demonstrate an increase in home visits by respiratory therapists (from 0.35 to 0.46 visits per month), in phone calls by respiratory therapists (from 0.01 to 0.14 calls per month), in phone calls by nurses (from 0.02 to 0.08 calls per month), in phone calls from the call centre (from 0.01 to 0.74 calls per month) and in phone calls from patients to the call centre (from 0.02 to 0.20 calls per month). Only the number of home visits by nurses remained stable in the two periods before/after.

<b>Table 10 – Impact of telecare on the usage of home healthcare services (monthly averages)</b>			
	<b>Study Group</b> Average/month	<b>Control Group</b> Average/month	Paired-t Test Study/ control
Visits/Telephone calls to the home			
	<b>Pre-telecare</b> (15 months) (n = 23)	<b>Pre-telecare</b> (15 months) (n = 22-23)	<b>p value</b>
Visits from respiratory therapist	.36 (.08)	.43 (.10)	.60
Visits from nurse	.73 (.12)	.68 (.14)	.80
Telephone calls from respiratory therapist	.01 (.01)	.01 (.01)	.16
Telephone calls from nurse	.02 (.01)	.01 (.01)	<b>.06</b>
Telephone calls from Info-santé	.01 (.01)	.01 (.01)	-
Patient telephone calls to Info-santé	.02 (.02)	0	.33
	<b>After telecare</b> (per and 3 mos post)	<b>After telecare</b> (per and 3 mos post)	<b>p value</b>
Visits from respiratory therapist	.46 (.08)	.65 (.19)	.36
Visits from nurse	.65 (.12)	1.10 (.38)	.32
Telephone calls from respiratory therapist	.14 (.05)	.01 (.01)	<b>.03</b>
Telephone calls from nurse	.08 (.02)	.04 (.03)	<b>.10</b>
Telephone calls from Info-santé	.74 (.09)	0	<b>.00</b>
Patient telephone calls to Info-santé	.20 (.08)	0	<b>.02</b>
	Paired-t Test <b>before/after *</b> <i>p value</i> (n = 21-23)	Paired-t Test <b>before/after *</b> <i>p value</i> (n = 21-23)	
Visits from respiratory therapist	<b>.08</b>	.18	
Visits from nurse	.81	.22	
Telephone calls from respiratory therapist	<b>.01</b>	.33	
Telephone calls from nurse	<b>.02</b>	.27	
Telephone calls from Info-santé	<b>.00</b>	16	
Patient telephone calls to Info-santé	<b>.04</b>	-	
* For a comparative analysis between the periods before and after telecare, the period 'After' is a total of the utilization indices <i>During telecare</i> and <i>Post-telecare</i> .			

Comparison between the study group and the control group reveals the same tendencies (see the fourth column in Table 10). While comparison of the two groups shows them to be very similar in their use of resources prior to the deployment of telecare, pronounced differences may be seen for the period subsequent to telecare. Indeed, only one statistical difference was evidenced between the two groups in the pre-period, which was the number of telephone calls made by nurses ( $p=0.06$ ). Furthermore, this difference was small; 0.02 calls per month within the study group and 0.01 calls per month within the control group. However, during the subsequent period, the differences between the two groups were numerous and far more significant. All four types of telephone calls were statistically different, and it is the study group which displayed the greatest use of these services.

<b>Table 11 – Effects of telecare on consumption of hospital services (raw data)</b>						
	Study group			Control group		
<b>Hospitalizations</b> (for respiratory condition)	Number of patients	Number of hospital stays	Total duration (days)	Number of patients	Number of hospital stays	Total duration (days)
<b>Pre (15 months)</b>	17	30	201	6	8	49
<b>Per</b>	6	7	143	5	8	55
<b>Post (3 months)*</b>	2	2	20	0	0	0
<b>Emergency Room Visits</b> (for respiratory condition)	Number of patients	Number of visits		Number of patients	Number of visits	
<b>Pre (15 months)</b>	16	46		8	12	
<b>Per</b>	7	11		2	3	
<b>Post (3 months)*</b>	3	5		2	4	

Subsequently, we wished to assess the impact of telecare services on the usage of hospital services. Table 11 presents this usage in two categories: hospitalizations and emergency visits. As in the previous case, readers are urged to interpret this data with caution, as the time periods varied according to the pre-, per and post-periods of observation. Therefore, we have recalculated these indices to obtain service consumption averages on a monthly basis. These indices are presented in Table 12.

The comparative analysis presented in Table 12 indicates that a statistically significant decrease in the number of hospitalizations within the study group occurred following the deployment of the telecare care technology (pre/post comparison;  $p = 0.040$ ). The average number of hospitalizations per month went from 0.09 before the institution of telecare care to an average of 0.05 following the deployment of telecare. However, no difference was noted with regard to emergency visits. Comparison of the study and control groups confirms the previous result. Indeed, it indicates that the two groups stayed similar with regard to their usage of hospital resources both before and after. Only two significant differences were noted ( $p=0.008$ ) between the two groups which pre-existed during the pre-period, relating to hospitalizations (0.09 and 0.02) and visits to the emergency department (0.05 and 0.03).

<b>Table 12 – Effects of telecare on consumption of hospital services (monthly averages)</b>					
	<b>Study group</b> Average/month		<b>Control group</b> Average/month		Paired-t Test Study/ control
<b>Hospitalizations</b> (for respiratory condition)	Number of patients	Average/month (standard deviation)	Number of patients	Average/month (standard deviation)	<i>P value</i>
<b>Pre-telecare</b>	23	.09 (.02)	22	.02 (.01)	.008
<b>Post-telecare*</b>	22	.05 (.02)	21	.03 (.02)	.645
Paired-t test before/after telecare*	22	<b>p = 0.040</b>	20	p = 0.802	
<b>Emergency room visits</b> (for respiratory condition)	Number of patients	Average/month (standard deviation)	Number of patients	Average/month (standard deviation)	<i>p value</i>
<b>Pre-telecare</b>	23	.13 (.03)	22	.04 (.01)	<b>.008</b>
<b>Post-telecare*</b>	22	.10 (.04)	21	.05 (.03)	.338
Paired-t Test before/after telecare*	22	p = 0.327	20	p = 0.713	

\* For a comparative analysis between the periods before and after telecare, the period 'After' is a total of the utilization indices During telecare and Post-telecare.

### The effects of telecare on patient quality of life

Next, we measured the effects of telecare care on patient state of health. To this end, we once again turned to an instrument measuring quality of life, which allowed for assessment of patient perceptions with regard to their health status. This measurement instrument was applied to both patient groups under investigation on two separate occasions: at the moment of recruitment into the study and at the end of the telecare services offering.

The results of this analysis indicate that there was no effect on the study group patients in this area. Indeed, Table 13 reveals that the comparison before/after deployment of telecare services (see the last line in Table 13) does not allow us to establish that patients in the study group perceived any improvement in their state of health. However, within the control group, it is possible to observe deterioration in health status as self-perceived by the patients. This deterioration is significant both from the physical health scale (p=0.03) as well as the emotional one (p=0.03).

Comparison between the study group and the control group reveals the same tendencies and does not indicate the presence of differences attributable to telecare care at home. While there was a significant

difference in the pre-period with respect to physical health, we do not observe a statistically significant difference between the study and control groups for the post-period.

<b>Table 13 – Effects of telecare on patient quality of life</b>			
<b>Quality of life (SF12)</b>	<b>Study Group Average (standard deviation) (n = 22)</b>	<b>Control Group Average (standard deviation) (n = 22)</b>	<b>Paired-t Test</b>
<b>Pre-telecare</b>			
<b>State of physical health</b>	32.1 (17.87)	44.9 (23.6)	0.03
<b>State of emotional health</b>	55.3 (22.96)	58.1 (30.7)	0.78
<b>Post-telecare</b>			
<b>State of physical health</b>	27.9 (14.82)	37.5 (19.5)	0.15
<b>State of emotional health</b>	54.5 (24.18)	45.5 (20.8)	0.16
<b>Comparison, pre-post telecare</b>	<b>Paired-t Test Before/After Telecare*</b>	<b>Paired-t Test Before/After Telecare*</b>	
	0.26	<b>0.03</b>	
<b>State of physical health</b>	0.89	<b>0.03</b>	
<b>State of emotional health</b>			

### **The effects perceived by partners in the home care programme**

Nine caregivers from the Info-Santé call centre responded to a questionnaire which sought to measure their opinions with respect to home telecare services. The caregivers' role within this call centre was to ensure continuity in the management of patients monitored through home telecare outside of the home care programme staff's regular work hours. As noted in Table 9, a high number of telephone calls was observed between the Info-Santé caregivers and the telecare programme patients.

Table 14 presents the degree of satisfaction of these caregivers with respect to usage of the telecare system, as well as their perceptions relative to its benefits. Overall, caregivers assigned fairly high marks to their use of the technology. Scores varied between 6.6 and 7.7 on a scale to 10. Among the comments offered spontaneously by the caregivers following this question, we note suggestions for modifications to the software designed to reduce the number of alerts the system automatically sends to the call centre, as well as to obtain a greater number of details concerning a patient's current clinical pathway. The caregivers' perceptions with regard to the effects of the telecare technology showed similar scores; these varied between 6.4 and 7.7.

The benefits of the telecare service programme which received the most positive evaluations surrounded the continuity of services (7.7) and the quality of the nurse-patient interactions (7.6). An analysis of comments offered spontaneously by respondents after this question corroborates the positive interpretation of these services in terms of their capacity to favour a more efficient use of the resources within the healthcare network. Finally, a majority of caregivers indicated they would recommend telecare services to a friend; this is an excellent indicator of their generally positive assessment of home telecare services.

Finally, we were able to gather the opinions of four caregivers working in two hospitals within the region. These caregivers were generally favourably inclined to the use of telecare services in order to foster greater patient autonomy in self-management of his/her illness. However, these caregivers were unable to provide a direct opinion on the technology since they had not tested it themselves.

<b>Table 14 – Perceptions of caregivers at Info-Santé call centres regarding home telecare technology</b>	
<b>Telecare technology allows for:</b>	<b>Average (standard deviation) (n = 9)</b>
Review the clinical condition of the patient	7.0 (1.4)
Uncover specific information concerning the patient	6.8 (0.9)
Monitor the patient’s clinical condition in real time	6.6 (1.9)
Write up observation notes	7.7 (1.2)
Put a pharmacological treatment plan into action	7.0 (0.7)
Consult or obtain information on the patient’s clinical condition during shift changes	7.2 (0.8)
Facilitate access to health network services for the patient	6.8 (1.4)
<b>Telecare technology has had a positive effect on:</b>	
Communication between nurses and service providers who work within the SCIAD framework	6.4 (0.9)
Time allotted to direct patient care	7.2 (1.6)
Delays in implementing care or treatment for patients	7.0 (1.3)
Quality of care given to patients	7.1 (1.3)
Continuity of care	7.7 (1.3)
The quality of the nurse-patient information	7.6 (1.5)
The accuracy of nursing interventions	7.4 (1.5)
Better patient empowerment in terms of self-management of one’s health condition	7.4 (1.0)
Better understanding of the illness on the part of the patient	7.4 (1.0)
Greater patient adherence to treatment	7.4 (1.0)
Note: Responses were measured with the use of the Likert scale, which features 10 levels varying from ‘Not at all’ to ‘Completely’.	

## Conclusion

This research sought to evaluate the impact of the use of home telecare technology on patients suffering from COPD. Thus, we conducted a quasi-experimental study based on a retrospective and prospective study with an equivalent control group constituted through the matching of patients within the study and control groups. The impact analysis was conducted on a total population of 46 patients divided into 23 pairs of individually matched patients. As summarized in Table 15, numerous types of effects were analyzed, and the results obtained are both encouraging and coherent with those seen in previous studies.

Firstly, the new telecare technology was well-received and accepted by patients as well as by clinical staff in the home care programme who had been experimenting with a new care model. As seen in

studies led by Dale *et al* (2003), Miaolo *et al* (2003) and Paré *et al* (2006), current results confirm generally positive levels of satisfaction expressed by patients towards the telecare technology. Healthcare practitioners also assessed the technology, both from the standpoint of its delivery of a higher quality of care as well as its intrinsic usefulness with respect to the systematic monitoring of patients. In particular, clinical staff praised the improvement in the quality of patient-clinical staff contacts, the reduction in treatment delays and the reduction in the gravity of symptoms. Furthermore, patients' adherence to using the technology was high.

Secondly, the current study is the first to analyze the effects of telecare on empowering patients to self-manage their disease. On the one hand, results indicate that patients within the study group developed a level of empowerment which was higher than that of the control group on two levels: a patient's ability to self-treat absent medication and the patient's ability to self-diagnose. However, evaluation allowed for the identification of one aspect which will require particular attention as this type of technology is further tested. Indeed, the ability of the telecare technology to contribute positively to adherence to treatment with respect to medication was not observed within the framework of this study.

Thirdly, with regard to its effects on the consumption of healthcare services, the use of telecare brought about a significant reduction in the number of hospitalizations seen within the study group. As indicated in Table 13, this encouraging result is consistent with previous studies which considered this type of effect within their analyses (e.g. Dale *et al* 2003; Miaolo *et al* 2003; Paré *et al* 2006; Toledo *et al* 2006; Trappenburg *et al* 2008). This significant reduction in the number of hospitalizations may be attributed to early detection of prodromal signs of decompensations which the telecare technology can offer. In addition, a decrease in the number of return visits to the emergency department following telecare was not revealed to be statistically significant for the study group.

Finally, it should be mentioned that the telecare programme implemented by the CSSS du Grand Littoral did not result in savings with respect to the usage of professional staff (nurses and respiratory therapists) in the home care programme. This result may be explained partially by the policies knowingly put into place for the duration of the telecare services testing period. In fact, it was decided at the outset that usual clinical practices would be continued, in order to ascertain that the new technology was operating adequately. Agreement has been reached on this issue and a revision of clinical practices is currently under way. Thus, at the time that data for this study was collected, no deliberate and systematic process had been undertaken to modify the frequency of visits generally prescribed for patients with COPD. We therefore noted that the number of nurse visits effectively remained stable while there was a slight increase in the number of visits by respiratory technicians. A further explanation regarding the absence of resource savings is directly related to the technology itself. A significant increase in the number of telephone calls made between professionals and patients was effectively observed. This increase in the amount of time required for patient management related to the warnings triggered by the telecare technology. There appear to be two solutions: revision of the care model to redesign the organization of care and the time dedicated to the patient – which had not been undertaken at the time this research was conducted – and analysis of the nature of the warnings triggered by the system, in order to verify whether their frequency might be lowered.

**Table 15 – Summary of effects seen in previous research and in current study**

Authors	Type of study	Size of group/groups	Observation type	Observation duration	Effects expected from telecare						
					Satisfaction among patients and caregivers	Greater patient empowerment	Decrease in number of decompensations	Improved quality of life perceived	Decrease in number of return visits to emergency room	Decrease in number of hospitalizations	Decrease in number of home visits
Dale <i>et al</i> (2003)	Cohort study	55	Prospective	3 months	Higher (patients)		81% were able to manage remotely			50% lower following intervention	
Miaolo <i>et al</i> (2003)	Cohort study	23	Retrospective and prospective	12 months pre, 12 months post	Higher (patients)		55% lower following intervention			50% lower following intervention	
Paré <i>et al</i> (2006)	Comparative, non-randomized trial	Study - 19 Control - 10	Prospective	6 months	Higher (patients)					Decrease significant	Decrease significant
De Toledo <i>et al</i> (2006)	Comparative, non-randomized trial	Study - 67 Control - 90	Prospective	12 months					No change following intervention	Decrease significant	
Trappenburg <i>et al</i> (2008)	Comparative, non-randomized trial	Study - 59 Control - 56	Prospective	6 months			Decrease significant			Decrease significant	
<b>Current study</b>		Study - 23 Control - 23	Retrospective and prospective	15 months pre, 4 months during, 3 months post	Higher (patients and staff)	Significant improvement		No effect observed	Decrease insignificant	Decrease significant	No change observed

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