Telehome monitoring in patients with cardiac disease who are at high risk of readmission

A. Kirsten Woodend, RN, MSc, PhD,[a] Heather Sherrard, RN, BScN, MHA,[b] Margaret Fraser, RN,[b] Lynne Stuewe, RN, BScN,[a] Tim Cheung, PhD, MHA,[b] and Christine Struthers, RN, BScN, MScN[b]

Patients with chronic conditions are heavy users of the health care system. There are opportunities for significant savings and improvements to patient care if patients can be maintained in their homes. A randomized control trial tested the impact of 3 months of telehome monitoring on hospital readmission, quality of life, and functional status in patients with heart failure or angina. The intervention consisted of video conferencing and phone line transmission of weight, blood pressure, and electrocardiograms. Telehome monitoring significantly reduced the number of hospital readmissions and days spent in the hospital for patients with angina and improved quality of life and functional status in patients with heart failure or angina. Patients found the technology easy to use and expressed high levels of satisfaction. Telehealth technologies are a viable means of providing home monitoring to patients with heart disease at high risk of hospital readmission to improve their self-care abilities. (Heart Lung® 2008;37:36–45.)

Chronic illnesses such as cardiac disease will be the biggest operational and financial challenge facing the health care delivery system in the next decade. Approximately 1 in 100 of the general population and 1 in 10 of the elderly have heart failure (HF), and repeat admissions for HF are common.[1] Studies of HF report readmission rates as high as 47% within 3 months[2] and 54% within 6 months.[3,4] This represents a significant use of health care resources. The literature on hospital readmission rates for patients with angina is sparse compared with the HF literature. At the University of Ottawa Heart Institute, 6% of patients with a most responsible diagnosis of angina are readmitted within 30 days of hospital discharge. Patients with unstable angina are more likely than patients with a myocardial infarction to experience an unplanned readmission to a coronary care unit.[5]

Reductions in readmission rates among patients with HF have been demonstrated with both home-based programs and telehome monitoring.[6-10] The effects of multidisciplinary home-based interventions in the population with HF have also been shown to be sustained for periods of at least 18 months, resulting in both reduced hospital-based costs and mortality.[11] Although it is clear that multidisciplinary, home-based, non-telehealth interventions are effective in reducing readmissions and overall hospital costs in patients with heart disease and especially HF, these interventions can themselves be costly and are not accessible by all patients. Allen et al[12] determined that as many as 46% of home visits could be replaced by telenursing. Patients with heart diseases (HF, hypertension, and other forms of chronic ischemic heart disease) were among those for whom telenursing was considered most appropriate.

Telehome monitoring has been demonstrated to improve quality of care in patients with cardiac disease. Patients with coronary heart disease who participated in a 3-month transtelephonically monitored rehabilitation program had exercise and quality of life improvements comparable with patients who participated in on-site rehabilitation programs. Shah et al[13] demonstrated a reduction in both the number of hospitalizations and the length of hospitalization in 27 patients with HF who participated in a home-monitoring program. High levels of patient satisfaction with this approach to care have also been demonstrated.[14-16]

From the [a]University of Ottawa and [b]University of Ottawa Heart Institute, Ottawa, Ontario.

This study was funded by The Richard Ivey Foundation, The Change Foundation and an unrestricted educational grant from Merck-Frosst Canada.

Reprint requests: A. Kirsten Woodend, RN, MSc, PhD, Associate Professor, University of Ottawa, Faculty of Health Sciences, School of Nursing, 451 Smyth Road, Room 3052, Ottawa, ON, K1H 8M5.

0147-9563/$ – see front matter

doi:10.1016/j.hrtlng.2007.04.004

Early reports from studies in the United Kingdom,[17] Australia,[18] Canada (Edmonds et al, 1998),[19] and the United States[20,21] support the use of home monitoring as a means to improve triage and access to appropriate health care facilities. There are opportunities for significant savings to the health care system and improvements to patient care if patients can be carefully maintained in their homes through triage and home-monitoring programs.[13,14]

The objective of this study was to determine whether telehome monitoring of patients with cardiac disease at high risk of readmission would reduce hospital readmissions, improve functional status, and improve quality of life over usual care.

METHODS

This was a randomized controlled trial in which patients were randomly allocated to the study intervention (telehome monitoring) or usual care. Randomization was stratified by primary discharge diagnosis; an equal number of patients with HF and patients with angina were randomly allocated to receive home monitoring, and equal numbers were allocated to usual care. Patients were identified in the hospital and approached during their hospital admission for consent to participate in this study. Detailed information, including demographic data, medical history, results of laboratory and cardiac tests, and hospital course, was collected before discharge. The research was approved by the Human Research Ethics Board of the University of Ottawa Heart Institute.

Subjects

Patients were considered for admission to the study if they had symptomatic HF (New York Heart Association [NYHA] Class II or greater) or angina (Canadian Cardiovascular Society [CCS] Class I or greater scheduled to return for revascularization, or CCS Class II or greater angina being discharged on medical treatment). In addition, they had to be capable of reading and writing either English or French, live within 100 km (by road) of the University of Ottawa Heart Institute, and provide informed consent. Patients were excluded if they were being discharged from the hospital to another institution or long-term care facility.

Intervention

The intervention consisted of 3 months of video conferencing with a nurse, daily transmission of weight and blood pressure, and periodic transmission of 12-lead electrocardiogram. A technician visited the patient's home within 48 hours of discharge to set up the home-monitoring equipment and train the patient in its use. Video conferences were held at least weekly with each patient and included an assessment of the patient's progress and self-care education by the telehome-care nurse. Electronic records, including nurses' notes, were maintained for each patient. Conferences were more frequent in the first few weeks after discharge and tapered over the 3-month period. Video conferencing was done by standard telephone lines. Weigh scales and blood pressure and electrocardiogram machines were all electronic, and data were transmitted by telephone lines to a central station that held the electronic patient record at the Heart Institute.

Protocols were developed to guide both the frequency and the content of each patient contact. The educational content and timing of teaching for patients with HF and patients with angina were structured so that the content was covered within the first 8 weeks of monitoring. Patient knowledge and understanding were then reassessed, permitting a further 4 weeks to revisit content areas that were less well understood. Triage protocols were also developed to ensure that responses to clinical issues (eg, shortness of breath, chest pain) were consistent across the two study groups.

Patients in the control group received the usual care provided to patients with angina or HF discharged from the hospital. Per the intervention group, they were discharged to the care of their community physician or cardiologist. Some of these patients were referred to home care, as were eligible patients in the intervention group. All patients were given a 24-7 telephone number to access an advanced practice nurse with questions related to their care.

Outcome assessment

Outcome measures used to evaluate the effectiveness of the home monitoring included readmission, health care resource use, morbidity, and quality of life. These measures were selected because the typical concerns about these patient populations are the "revolving door" problem of readmissions and frequent visits to the emergency department and the impact of coping with a chronic illness on the quality of daily living. Data were collected at 1 month, 3 months, and 1 year postdischarge. Monitored patients were also asked how easy or difficult the equipment was to use and how satisfied they were with their care.

Readmissions and health care resource use. Health care resource use, in addition to readmissions, included days in hospital (broken down into intensive care and ward care days), emergency department visits without admission, physician (specialist and generalist) visits, and home care services. Data were based on patient self-report at 1, 3, and 12 months.

Symptoms and functional status. Morbidity was assessed using disease specific measures of functional status. The Minnesota Living with Heart Failure (LiHFe) questionnaire (Rector et al, 1987)[22] was used for patients with HF, and the Seattle Angina Questionnaire (SAQ) (Spertus et al[23]) was used for patients with angina. Both of these measures were available in English and French.

The Minnesota LiHFe questionnaire is a self-administered, 21-item scale with a 6-point response format ranging from 0 to 5. It consists of a total score and scores for physical and emotional dimensions; higher scores indicate poorer levels of functioning. The LiHFe has been validated in a number of populations with HF (Rector et al, 1992)[24] and has been shown to be valid, reliable, and responsive (Rector et al, 1993).[25] The LiHFe also has high internal consistency when used in 638 patients with HF; Cronbach's alphas for the total, physical, and emotional subscales are .91, .91, and .85 respectively.[26]

The SAQ is a disease-specific, self-administered functional status measure composed of 19 questions that take less than 5 minutes to complete. Higher scores on the SAQ indicate better levels of functioning. It quantifies five domains related to coronary artery disease: physical limitations, anginal stability, anginal frequency, treatment satisfaction, and disease perception. All of the scales of the SAQ are significantly correlated with the CCS classification of angina.[27] Each of these five domains has been validated independently[28] and shown to be both reliable and responsive to clinical changes.[23,27] The internal consistency reliability of the SAQ ranges from moderate to good (.66 for treatment satisfaction to .89 for physical limitations).[27]

Quality of life. The Medical Outcomes Study Short Form 36 (SF-36)[29] was used to assess quality of life at baseline and 1, 3, and 12 months. The SF-36 is a 36-item, self-administered generic measure of quality of life with eight subscales: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health. The subscales are not combined to form a global measure of quality of life. This measure has been extensively used and validated in both well and chronically ill populations, including patients with HF.[30,31] The internal consistency reliability (Cronbach's alpha) of the eight subscales ranges from .73 to .95, with most greater than .80. Test–retest reliabilities for 2-week to 6-month intervals for the subscales range from .60 to .90.

Analysis

The number of patients we planned to enroll in this study was fixed by the number of systems available (n = 20). Assuming that each patient would use the equipment for 3 months, we planned to enroll 160 patients (80 with chronic heart failure, 80 with angina) in the intervention arm of the trial. Assuming the analysis is done within each diagnostic group (results are not pooled), and assuming that the family-wise alpha is maintained at .05, this would have yielded 80% power to detect a clinically significant decrease in admissions.

All analyses were conducted on an intention-to-treat basis. The demographic and health characteristics of the home-monitoring and usual-care groups were compared, within diagnostic categories, using chi-square and *t* tests. All analyses comparing the outcomes of the home-monitoring and usual-care groups were done within the diagnostic categories (HF and angina). Repeated-measures analyses of variance (between and within) were conducted to assess differences between treatment groups, over time, and in functional status and quality of life.

RESULTS

A total of 249 patients (121 with HF and 128 with angina) were enrolled and randomized to receive 3 months of telehome care after discharge or usual postdischarge care. The mean age of patients with HF and patients with angina was 66 years, and approximately three-quarters of the patients were male (Table I). Patients with HF who were randomized to receive telehome care were significantly less likely to have Class 3 or higher angina than those randomized to usual care. Patients with angina randomized to receive telehome care were significantly more likely to have HF than those randomized to usual care. Otherwise, the intervention and control groups were similar. Nine patients with HF and three patients with angina died during the study period; nine patients in the telehome care arm of the study and six patients in the usual care arm (not significant) were lost to follow-up at 1 year.

Table I
Profile of enrolled patients

	Heart failure		Angina	
	Telehome	Usual care	Telehome	Usual care
N	62	59	62	66
Age, y	67 ± 13	66 ± 11	66 ± 12	65 ± 10
Sex (% male)	74%	70%	77%	79%
Previous CABG	37%	34%	34%	24%
Previous MI	60%	53%	53%	53%
Angina (yes)	57%	68%	100%	100%
CCS class (3+)	*7%	22%	55%	58%
Heart failure	100%	100%	*24%	6%
NYHA class (3+)	66%	58%	0%	0%

CABG, Coronary artery bypass graft; *MI,* myocardial infarction; *CCS,* Canadian Cardiovascular Society; *NYHA,* New York Heart Association.
*Statistically significant differences between telehome and usual care groups.

Hospital readmissions

Three months. For the patients with angina there was a 51% reduction in the number of admissions per patient with angina receiving telehome monitoring compared with those receiving usual care ($P = .02$). There was also a 61% reduction in the number of days spent in the hospital ($P = .04$) (Table II). There was no significant difference between patients with HF receiving telehome monitoring or usual care in the number of readmissions to hospital. Telehome-monitored patients with HF spent 28% fewer days in the hospital than usual care patients with HF within the first 3 months of discharge, but this difference was not statistically significant.

One year. Telehome-monitored patients with angina had significantly fewer hospital admissions at 1 year than patients receiving usual care ($P = .02$); hospital admission rates were reduced by 45%. The number of days spent in the hospital during that first year did not differ significantly between the two groups of patients with angina. Telehome-monitored patients with angina spent 62% fewer days in hospital in the first postdischarge year, but one patient spent 228 days in hospital after surgery, skewing the results. When this outlier was removed, telehome-monitored patients with angina spent 21% fewer days in the hospital than usual care patients, and this difference remained nonsignificant. There were no differences between the proportions of patients with HF in the telehome group and the usual care group who were readmitted to the hospital within the first year of discharge or in the number of days they spent in the hospital in the first year postdischarge.

Other health care resource use

Within the first year, 56% of all the patients with HF had made at least one visit to the emergency department compared with 35% of patients with angina. Patients with angina who received telehome monitoring made an average of .15 trips to the emergency department in the first 3 months compared with .35 trips for patients receiving usual care ($t = 2.012$, $P = .037$). Telehome-monitored patients with angina also made fewer visits during the first year (.31/patient) compared with usual care patients (.83/patient) ($t = 2.63$, $P = .012$). There were no significant differences between randomized groups in the number of emergency department visits made in the first month, 3 months, or 1 year after hospital discharge (study enrollment) for all patients combined or for patients with HF.

Health professional visits

There were no differences between the intervention and usual care groups in the numbers of visits made to cardiologists in each time period, nor were there any differences between the groups in the number of visits made to general practitioners. When all physician visits (general practitioner and

Table II
Hospital readmissions and days in hospital

	Intervention	Control	% diff	*P*
Readmissions (No. per patient)				
Combined				
3 mo	.40	.59	32.57%	.048
1 y	.75	.96	22.65%	NS
Angina				
3 mo	.34	.69	50.76%	.016
1 y	.55	1.00	44.64%	.02
Heart failure				
3 mo	.46	.49	5.48%	NS
1 y	.96	.92	−4.17%	NS
Days in hospital				
Combined				
3 mo	2.11	3.93	46.42%	.038
1 y	5.00	7.52	33.55%	NS
Angina				
3 mo	1.58	4.10	61.57%	.038
1 y*	3.18	8.26	61.54%	NS
Heart failure				
3 mo	2.69	3.75	28.48%	NS
1 y	7.13	6.71	−6.21%	NS
*With outlier (228 d removed):				
Angina*				
1 y	3.1786	4.0385	21.29%	NS

NS, Not significant.

all specialists) were combined, there were no significant differences between the invention and usual care groups in the total number of visits made to any physician during any of the follow-up periods. Patients with HF made significantly more visits to their family physicians within the first month, first 3 months, and first year than patients with angina. Patients with HF made more visits to their cardiologist than patients in the angina group.

Home care visits

There were no differences between the intervention and usual care groups in the numbers of home visits or homemaking services provided for either patients with HF or patients with angina. More patients with HF than patients with angina received home visits in each follow-up period. At 12 months, 22% of patients with HF compared with 7% of patients with angina had received home visits ($P = .003$). Home visits included visits for either nursing or home-making. When home-making is looked at separately, there is no difference in services received between patients with angina and HF patients at one month, but HF patients were more likely than angina patients to receive home-making services at 3 months (12% vs. 3%, $P = .008$) and at 12 months (13% vs. 4%, $P = .02$) postdischarge.

Functional status

Minnesota living with heart failure. Patients in both the intervention and control groups showed significant improvement in overall LiHFe scores in the year after hospital discharge (repeated-measures analysis of variance, $f_{3,49} = 12.59$, $P < .001$). There were also significant improvements in the both the physical ($f_{3,49} = 10.19$, $P < .001$) and emotional subscales ($f_{3,49} = 9.69$, $P < .001$) of the LiHFe over time (Fig 1). There were no differences between the intervention and control groups at 1 month postdischarge in overall LiHFe score ($P = .18$) or in the physical ($P = .063$) or emotional subscales ($P = .60$) of the LiHFe when controlling for LiHFe scores at baseline. Patients randomized to receive telehome care had significantly better func-

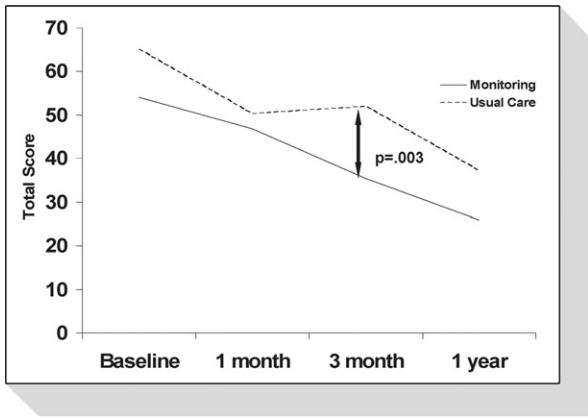

Fig 1 Minnesota LiHFe scores over time.

tional status on both the overall score ($P = .003$) and the physical subscale ($P = .001$) of the LiHFe at 3 months than patients receiving usual care. There was no significant difference between randomized groups in the emotional subscale at 3 months. At 1 year postdischarge, the differences between randomized groups on the LiHFe and on its two subscales were not significant after controlling for baseline differences.

Seattle angina questionnaire. Patients with angina receiving telehome care did not differ from usual care patients in anginal stability, anginal frequency, or disease perception at any time during study follow-up. Patients receiving telehome care consistently reported higher levels of treatment satisfaction than those receiving usual care and had a better exertional capacity at 1 year (Table III). Baseline differences in scores were controlled for in all analyses.

Patients with angina experienced significant improvements over the first year after discharge in all five subscales of the SAQ. The change in exertional capacity was greatest between the 3-month and 1-year follow-up periods (effect size [ES] = .41). The greatest improvement in anginal stability occurred between discharge and 1 month (ES = .40), and the greatest improvements in anginal frequency (ES = .40) and disease perception (ES = .33) occurred between 1 and 3 months postdischarge (Table III).

Quality of life

Quality of life was better in telehome-monitored patients with HF than in usual care patients on five of the eight SF-36 subscales at 3 months. This is the time period at which most significant differences in quality of life between the two groups were detected (Table IV). There were significant differences in three of the subscales at 1 month and in only one subscale at 1 year after discharge. The magnitude of the absolute differences in quality of life between the intervention and control groups ranged from 4% to 15%. The only subscale on which telehome-monitored patients had significantly better quality of life at all three points in time was the vitality subscale, which reflects the subject's energy level and fatigue. Patients with HF in both randomized groups demonstrated significant improvements in quality of life over time in all of the SF-36 subscales.

Patients with angina in both intervention and control groups demonstrated significant improvements in quality of life over time in all of the SF-36 subscales. General health was better in telehome than usual care patients at 1 and 3 months postdischarge. At 1 year, the following subscales demonstrated higher quality of life in telehome than usual care patients: (1) physical functioning ($P = .04$), (2) bodily pain ($P = .03$), and social functioning ($P = .04$).

When data for both patients with HF and patients with angina were combined, patients receiving telehome care had significantly better quality of life than usual care patients on most of the SF-36 subscales at all three follow-up periods (Table V). Quality of life scores improved over time in both intervention and usual care patients.

Ease of use and satisfaction

Overall, patients found the equipment was easy to use; the most difficult was the 12-lead electrocardiogram. This latter required that the patient attach three electrodes to specific areas on his/her torso, attach wire leads from the electrode to a small box (~3 × 3 × 5 inches), and hold this over three areas on their chest while pressing a button for a specific amount of time. Patients with arthritic hands found that pressing the button while holding the equipment, especially in the position under the left arm, was difficult. Patients also reported some difficulty with the c-phone (video-conferencing equipment), although this was most often related to difficulties in obtaining good signals over the telephone lines. There was a slight trend for older patients than younger patients to report more difficulty using the equipment.

Satisfaction was calculated as a sum of scores on 10 questions related to satisfaction with various aspects of telehome monitoring, and scores could range from 0 (very low satisfaction) to 100 (very high satisfaction). The mean scores for all patients combined at 1, 2, and 3 months of monitoring were 92,

Table III
Seattle angina questionnaire scores

Subscale	Randomized group	Baseline	1 mo	3 mo	1 y	Time*
Exertional capacity	Telehome monitoring	57.64	51.36	58.26	73.21	$F_{3,78} = 11.63$
	Usual care	50.69	51.00	56.312	62.56	$P < .001$
Anginal stability	Telehome monitoring	43.42	61.06	68.00	66.67	$F_{3,66} = 15.87$
	Usual care	45.83	57.86	70.83	71.94	$P < .001$
Anginal frequency	Telehome monitoring	48.62	48.68	61.70	72.29	$F_{3,77} = 15.17$
	Usual care	55.44	53.33	65.90	78.00	$P < .001$
Treatment satisfaction	Telehome monitoring	86.49	90.45	86.28	90.19	$F_{3,77} = 5.45$
	Usual care	76.56	85.96	85.80	87.71	$P = .002$
Disease perception score	Telehome monitoring	47.70	53.27	61.86	74.57	$F_{3,74} = 20.64$
	Usual care	44.85	50.66	59.48	68.06	$P < .001$

Significant differences between the intervention and usual care groups, controlling for scores at baseline, are underlined.
*F and *P* values for repeated-measures analysis of variance.

Table IV
Significant *P* values (*t* tests) for differences between groups on short form-36 subscales controlling for baseline scores (patients with heart failure)

Subscale	1 mo	3 mo	1 y
Physical functioning		.044	
Role physical		.025	
Role emotional			
Bodily pain		.022	
Vitality	.030	.003	.019
Mental health	.038	.006	
Social functioning			
General health	.044		

Table V
Significant *P* values (*t* tests) for differences between groups on short form-36 subscales (all patients combined)

Subscale	1 mo	3 mo	1 y
Physical functioning	.050	.012	.008
Role physical			.050
Role emotional			
Bodily pain	.022	.017	.009
Vitality	.024	.007	.015
Mental health	.025	.014	
Social functioning		.032	.023
General health	.005	.007	

92, and 97, respectively. Patients with HF and patients with angina did not differ in their overall ratings of ease of use or satisfaction with telehome care.

Monitored patients were also given the opportunity to complete open-ended questions about what they liked and disliked about telehome care. When asked what they liked, a random selection of patients made the following comments: "It took away a lot of my worries and gave me confidence that I would have answers to my questions." "The clarification of the medication prescribed by doctors. Discussing my personal medical problems with the nurses and receiving their advice for my situation gave me assurances for improving my health in the future." "It helped me to feel more at ease after leaving the hospital; it also eased my husband. There is someone close at hand to answer any questions and offer advice." "I understand better how to take care of my health." When asked what, if anything, bothered them about being monitored at home, most patients said "nothing." The few other comments made included the following: "I initially wondered if there would be a cost. Also, I wasn't sure as to whether it would tie me down." "The commitment to scheduling certain times and dates for the video conference." "At first I was a little concerned about remembering the procedure, especially the ECG." "Only poor quality of video. . . regular phone would have been fine."

DISCUSSION

Telehealth technologies are a viable means of providing home monitoring to patients with heart disease at high risk of hospital readmission, improving quality of life and functional status, and reducing hospital readmission in this population.

Health resource use

Telehome monitoring significantly reduced the number of hospital readmissions, visits to the emergency department, and days spent in hospital for patients with angina. Contrary to expectations, a similar impact on hospital readmissions for patients with HF was not detected. Although this finding is similar to DeBusk et al's,[32] it differs from the findings of a number of studies in this population, many of which included smaller numbers of patients.[13,20,33-35] A couple of these studies included only patients with "severe heart failure"[35] or NYHA Class III/IV HF.[33] In the study by Benatar et al,[33] in which telehome care was compared with standard home visiting, telehome care significantly reduced hospital readmissions and lengths of stay in 216 patients with NYHA Class III/IV HF. Cordisco et al,[35] in a nonrandomized study, found decreased emergency department visits and hospitalizations in 50 telehome-monitored patients compared with controls. A large randomized controlled trial (n = 1518) of a telephone-based intervention for patients with HF detected a significant 25% difference between intervention and control patients in HF admissions;[36] we looked at all-cause admissions in the present study and were not able to distinguish between admission related to HF and admission related to other causes. When our study data were analyzed, including only patients with Class III/IV HF, there were still no differences between the intervention and the usual care groups in either the numbers of hospital admissions or days spent in the hospital at 3 months or 1 year. We might expect that patients with more severe HF would spend more time in the hospital, but NYHA classification was not associated with either the number of readmissions or days in the hospital at any time period. The differences in hospital readmission rates between the HF intervention and control groups were small (5%); the number of patients with HF in the study yielded 80% power to find a 60% difference in admission rates.

Similar studies have not been undertaken in patients with angina, although Noel et al[37] trialed telehome monitoring in elderly patients with various chronic diseases, including heart disease, and they found a significant decrease at 6 months in the numbers of bed-days of care and the number of urgent visits to clinics or emergency departments.

Functional status and quality of life

Although the quality of life and functional status of all study participants improved over time, patients who were telehome monitored for 3 months after discharge experienced greater improvements in both functional status and quality of life that those who were not. Telehome-monitored patients with angina had greater improvements in exertional capacity at 1 year and greater improvements in physical functioning, bodily pain, and social functioning. Because there are no published studies of the impact of telehome monitoring in patients with angina, comparisons cannot be made. Although both Noel et al[37] and Chumbler et al[38] studied mixed groups of patients, including those with heart disease, neither measured quality of life. Both did include measures of functional status; there were no differences between randomized groups in Noel and colleagues'[37] study, and intervention patients had better functional status than control patients in the latter study.[38]

Five studies of telehome monitoring in patients with HF have included measure of quality of life and or functional status.[33,39-42] Two were small pilot studies with insufficient power to detect differences,[41,42] and one study included 90 patients with no differences between telehome-monitored and usual care patients in functional status, depression, or health-related quality of life.[39] Barnason et al[40] found differences, using the same equipment as in the LaFramboise study[39] (Health Buddy), in the SF-36 subscales for physical, general health, mental, and vitality at 3 months. Although Benatar et al[33] found no difference between telehome-monitored and standard home care patients in Minnesota Li-HFe scores after 12 months of follow-up, they did detect significant improvements in hospital anxiety and depression scale scores.

Telehome-monitored patients with HF had greater improvements in functional status than usual care patients at 3 months, but differences were not sustained at 1 year. The greatest differences between the two groups in quality of life improvements also occurred at 3 months, although the difference in the vitality subscale was sustained at 1 year. This finding is contrary to that of Stewart et al,[11] who suggested that the effects of multidisciplinary home-based interventions could be sustained for periods up to 18 months. Naylor et al[43] followed patients with HF

receiving transitional care and found differences in quality of life between intervention and usual care patients at 3 months; as in our study, these differences were not sustained at 1 year.

Although the intent of the study under discussion was to study the effect of telehome monitoring on outcomes, a great deal of the teaching that was done by the telehome care nurse focused on improving the patients' self-care abilities. Unfortunately, no measures of self-care ability or self-efficacy were included in the study. A number of the studies of telehome monitoring have also included measures of self efficacy,[33] confidence in ability to manage care,[39,41] and treatment adherence [16,40-42] with variable findings.

Ease of use and satisfaction

Patients found the technology easy to use and expressed high levels of satisfaction with this approach to care. Only patients in the telehome-monitored group were asked to complete patient satisfaction measures, so comparisons between the groups cannot be made. The SAQ does include a patient treatment satisfaction subscale. Patients with angina who received telehome care were significantly more satisfied with the treatment of their angina at all three follow-up periods than were those receiving usual care.

Despite concerns that this older patient population would find the telehome equipment difficult to use and learn, the majority reported little trouble. These findings are similar to those of Finkelstein et al[44] and somewhat better than in other studies of telehome-care. Agrell et al[45] studied patients' perceptions of home care using structured interviews. All patients were either very satisfied (67%) or somewhat satisfied (33%) with services they had received, with 93% saying they were willing to receive home telecare services in the future. Patients perceived that the presence of telehome-care equipment in the home implied 24-hour-a-day access to a nurse. Chae et al[46] found that 72% of elderly patients receiving telehome care were satisfied, with patients in their own homes (82%) being more satisfied than patients in nursing homes (50%).

LIMITATIONS

The major limitation to this study was that health care resource use data (readmission, days in hospital, physician visits) were based on patient recall. Patients in this study could reside within 100 road-kilometers and were admitted to many different hospitals. It was not feasible to contact each of these hospitals. Readmission data can be obtained at the provincial level, but we did not have the patients' prior consent, as would be required, nor did the study budget permit this. Finally, the study was not designed to determine what aspect(s) of the telehome monitoring influenced outcomes. Jerant et al,[34] for instance, concluded that having access to video conferencing was not better than using the telephone, although both of these were better than usual care. Problems were frequently encountered in videoconferencing, and study nurses had to use telephone interviews instead on many occasions. Use of telephones only would save money and time, but the study design did not permit us to investigate this.

Telehealth technologies are a viable means of providing home monitoring to patients with heart disease at high risk of hospital readmission to improve their functional status and quality of life, and to reduce hospital readmissions and emergency department visits. Although the impact on quality of life in all patients and readmissions of patients with angina has been demonstrated, it is also important to demonstrate that use of this technology is cost-effective. A cost-effectiveness analysis of telehome monitoring using data collected in this study is presently in progress.

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