



#### EXECUTIVE SUMMARY

Congestive heart failure (CHF) constitutes a serious and growing socioeconomic and health burden among the elderly, their caregivers, and the health systems that serve them. Management of CHF is associated with a reduced quality of life for the patients and their caregivers and with increased health care utilization, as evidenced in high hospital readmission rates. Telemedicine is being integrated into traditional primary care-home care management to identify patients at risk for early readmission and to enhance quality of care.

The Technology Assessment Program (TAP) conducted this brief systematic review on behalf of the Director of Research at the Columbia VAMC in South Carolina. This report restricted its focus to remote physiologic monitoring, or "telemonitoring," systems that measure patients' physiologic status in the home and transmit the data to a remote site for analysis and interpretation, as the client indicated this technology was of greatest interest to him. The technology incorporates peripheral devices for monitoring vital signs, pulse oximetry, and weight measurement.

TAP's systematic review of the peer-reviewed published literature found that evidence of the effectiveness of telemonitoring in patients with CHF was limited to a few small, short term pilot projects comparing various nurse case management interventions with and without telemonitoring, aimed primarily at reducing hospital admission and improving functional status. Current evidence shows the feasibility of telemonitoring and its potential for clinical and economic benefit, but limitations in study design prevent being able to draw definitive conclusions of effectiveness.

Other literature reviews of telemedicine or multi-disciplinary strategies for managing chronic diseases were identified in this report. They reinforced that optimal strategies for managing these patients using multidisciplinary approaches to care had not been firmly established, and the extent to which care management processes would need to be reengineered to support telemedicine applications across various settings was unknown. They further supported the need to consider both monetary and non-monetary effects, such as

satisfaction, on the user (patient, family, and provider) as well as on the payer.

Responses from an e-mail survey to Veteran Integrated Service Network (VISN) Clinical Managers showed that interest in telemonitoring as part of strategies for managing these patients is in its early stages of use and/or evaluation and is growing. Several sites expressed interest in integrating telemonitoring into VA Intranet systems to maximize efficiency and to augment evaluation of the care management process.

Evidence in this review supported the need for rigorous randomized clinical trials to address the relative cost-effectiveness of telemedicine strategies in the continuum of care of patients with CHF. This review uncovered several initiatives currently underway for identifying and developing continued quality improvement in the care and health outcomes of these patients. Among them, Veterans Health Administration (VHA) is poised to make significant contributions through its health services research and evaluation components in clinical care.

#### BACKGROUND

On August 22, 2000 Dr. William Hrushesky, Director of Research at the Columbia VAMC in South Carolina, asked the TAP for assistance in answering the following question:

*"Do telephone management protocols for patients with chronic congestive heart failure diminish hospitalizations and emergency urgent care visits for congestive heart failure, improve patient satisfaction, and enhance patient quality of life?"*

Through subsequent conversation, the client indicated that the purpose of his question was to determine if randomized clinical trials or other high quality studies exist to address the effectiveness of remote physiologic monitoring for managing patients with congestive heart failure, or if it should be studied. An interim response was sent to the client on November 21, 2000. This report is the final version and includes additional information on related activities throughout VHA.

CHF is one of the most common discharge diagnoses among the elderly and particularly among the increasingly aging veteran population (CDC 1998; DVA Annual Report 1997). In these patients, high hospital readmission rates within a few weeks or months of discharge are burdensome for health care systems and the patients they serve. VHA researchers have suggested that ensuring inpatient readiness for hospital discharge and targeting multidisciplinary interventions at patients who are at risk for hospital readmission may reduce hospital readmissions, improve functional status, and potentially lower medical costs (Ashton 1995).

Telemedicine, or medicine at a distance, in its many forms can be thought of as a new way of using information and communications technology to deliver health care services to patients who are at a physical distance from their provider. Ohinmaa and colleagues (1999) emphasized the role of telemedicine as “a part of the wider process of care or chain of care, rather than a single technology.”

For managing CHF, telemedicine is being used to identify patients at risk for early readmission and to enhance traditional primary care-home care strategies. According to Kinsella and Warner (1998), telemedicine applications for these patients can include follow-up, screening, reminders, after-hours access, and counseling by telephone. They can use an array of peripheral devices such as vital sign monitoring equipment, weight scales, pulse oximetry, and stethoscopes, as well as systems for menu planning, compliance reminders, educational resources, and program critical pathways.

Remote physiologic monitoring, or “telemonitoring,” systems measure patients’ physiologic status in the home; the data are then transmitted to a remote site for analysis and interpretation. Care management strategies can employ patient- or caregiver-initiated data recording and transmission, automated collection and transmission to a full-scale telemedicine workstation, or a combination.

Conversations with the Chief Consultant of the VHA Telemedicine Strategic Healthcare Group confirmed that for patients with CHF, primary care-home care strategies using physiologic telemonitoring devices can be quite varied and are often employed in combination with other interventions. The literature suggests that objective data acquired by telemonitoring may help improve symptom control, patient compliance, and quality of life, thereby decreasing emergency room visits, hospital readmissions, and their associated costs.

Studies of outcomes management and quality improvement strategies in caring for patients with CHF include a variety of interventions, expertise, settings, and perspectives. ***This report restricted its focus to telemonitoring interventions that incorporated peripheral***

***devices for monitoring vital signs, pulse oximetry, or weight measurement in the home setting, as the client indicated that these areas were of particular interest to him.***

## METHODS

For this report, TAP confined its evaluation to the peer-reviewed, published literature. TAP used a systematic approach to assess the literature, which approaches the process of literature review as a scientific endeavor. A systematic literature review uses explicit, reproducible methods to minimize potential biases in addressing a focused question (Mulrow 1997). In contrast, a traditional narrative review relies on implicit methods and may be susceptible to bias in the selection, analysis, and synthesis of studies. TAP designed methods for this report to elicit the most current and relevant data to answer the client’s question within a few weeks of the request.

On September 21, 2000 TAP conducted a comprehensive search covering a variety of databases (MEDLINE®, HealthSTAR®, EMBASE®, Current Contents®, and The Cochrane Library 2000) from the years 1995 to the present using a variety of terms indicating telephone, telemetry, telemonitoring, remote monitoring, telemedicine; congestive heart failure or heart diseases; terms for quality of life, patient satisfaction, emergency or urgent care; and terms for systematic review, technology assessment, meta-analysis, randomized trials, controlled trials etc.

A single reviewer reviewed abstracts retrieved from these databases and selected articles for inclusion in this report using the following criteria:

- Study subjects are adults;
- Control group or historic reference sample is present;
- Disease of interest is congestive/chronic heart failure;
- Intervention of interest is any physiologic telemonitoring system, as previously defined, which is used to capture vital signs, pulse oximetry, or weight measurement;
- Stated outcomes are hospital readmission rate, emergency room visits, patient satisfaction, quality of life, or health care cost or charges;
- Setting is in the home;
- English language articles or abstract available;
- Studies present original data or are systematic reviews of the literature covering the intervention and disease of interest.

End references of initially retrieved articles were reviewed manually, and articles were selected which met the inclusion criteria or provided background to the report. To avoid double counting articles of studies on the same study population for the same purpose by the same investigators,

TAP included only the most recent or the most comprehensive article from that study group in the review.

### Other information sources

To obtain additional citations or information on policies and practices regarding physiologic telemonitoring in patients with CHF, TAP posted the request on September 21, 2000 to electronic mail exchanges maintained for the International Network of Agencies for Health Technology Assessment (INAHTA) and evidence-based medicine communities.

On December 12, 2000 TAP canvassed each VISN Clinical Manager via e-mail for ongoing or proposed activities involving physiologic telemonitoring within their

network. On December 20, 2000 TAP searched the VA Research and Development website [vaww.va.gov/resdev] for relevant information.

### Critical appraisal

For guidance, TAP applied the framework used by Ohinmaa and colleagues (1999) in a systematic review on telemedicine they produced for INAHTA (see table 1). These authors used a well-established framework by Jovell and Navarro-Rubio (1995) to appraise the strength of the evidence that links use of physiologic telemonitoring interventions with the observed outcomes. Each level was further refined based on how well bias and confounding factors were controlled in the design and conduct of a study.

**Table 1. Levels of Evidence Scale**

Level	Strength of Evidence	Study Design
I	Good	Meta-analysis of randomized controlled trials (RCT)
II	Good	Large sample RCTs
III	Good	Small sample RCTs
IV	Good	Non-randomized controlled prospective trials (concurrent controls, multicenter)
V	Fair	Non-randomized controlled prospective trials (historic controls, single site)
VI	Fair	Cohort studies
VII	Fair	Case control studies
VIII	Poor	Non-controlled clinical series Descriptive studies, surveillance of disease, surveys, registers, data bases, prevalence studies
IX	Poor	Expert committees, consensus conferences, anecdotes or case reports

Source: Jovell AJ, Navarro-Rubio MD (1995).

## RESULTS

TAP electronic and manual searches yielded 155 citations. Six articles (3.9%) met the inclusion criteria, of which three (Balas 1997; Philbin 1999; Ohinmaa 1999) were systematic reviews and three (Cordisco 1999; de Lusignan 1999; Heidenreich 1999) provided original data from clinical studies. Queries to electronic exchanges and to the VISNs uncovered one additional original study (Noel 2000) and two systematic reviews (Taylor 2000 and AHRQ 2001), which were published after TAP conducted its literature search in September, that met criteria for inclusion in the review.

The four studies providing original data are presented in table 2. Evidence from these studies comprised two single site non-randomized controlled trials and two small RCTs. They evaluated nurse care management with and without

physiologic telemonitoring in various forms along with patient education materials, home visitation, teleconsulting, and other mechanisms aimed primarily at reducing hospital admission and improving functional status. At face value, short term results suggested a reduction in resource use and an increased functional level with telemonitoring, and patients tended to be satisfied with telemonitoring devices and their care.

Two of these studies involved investigators at VA facilities. It is uncertain how many veterans Heidenreich and colleagues (1999) included in their study, but Noel and Vogel (2000) included only veterans (n = 20) in their randomized controlled pilot study. This pilot study laid the foundation for a two-year study, funded under the VHA New Initiative Program, of veterans with CHF, chronic obstructive pulmonary disease, and/or diabetes mellitus (n = 200) using Panasonic's Telecare unit in the

home setting. Outcome measures will include quality of life, functional status, total costs of care, and patients' understanding of their disease and participation in treatment (see also VISN 1 response in table 3).

TAP identified five systematic reviews either completed or underway. One assessment reviewed a range of telemedicine applications (Ohinmaa 1999); the others addressed aspects of telemedicine or multidisciplinary programs for managing Medicare patients (AHRQ 2001), patients with chronic illnesses (Balas 1997) or, more specifically, CHF (Philbin 1999; Taylor 2000). Each review highlighted the methodological limitations in the published literature. They further noted that optimal strategies for managing these patients using multidisciplinary approaches to care were unknown, and they supported the need for rigorous RCTs to address the relative cost-effectiveness of available strategies.

Philbin (1999) pointed out that multidisciplinary programs for CHF of intermediate or long duration typically emphasize compliance with recommended treatment options, repetitious patient education, and careful surveillance to improve functional status and reduce hospital admissions and their associated costs. He summarized key features of the existing literature that may also be applied to this review:

- It seems reasonable to conclude that most patients with chronic CHF are candidates for multidisciplinary management programs.
- Characteristics of patients enrolled in these programs were broad and varied and included individuals likely to be encountered in typical practice.
- Studies were typically too small for subgroup analyses needed to identify patients who were more likely to respond to the intervention. Evidence does not exist for a "niche technology" appropriate only for highly selected patients.
- There is a positive trend in the downward direction and magnitude of the change in hospital admission rates resulting from shifting care from the hospital to the home setting. Improved clinical status, as demonstrated by improvement in functional status, quality of life, and patient satisfaction measures during or following the various interventions, appears to support this trend.
- That said, rigorous study is deficient in identifying the mechanisms for improved clinical status.
- Evidence of the economic impact of these programs is less compelling. Cost or charge data, if reported at all, were often not reported as total health care costs, underreported costs of the intervention, or extrapolated actual or likely savings by using reduction in hospitalizations to estimate cost savings without accounting for other costs associated with patient care.

(Note: TAP's review identified only one study (Heidenreich 1999) that reported cost data.)

AHRQ (2001) investigators recommended that telemedicine research should give priority to diseases with a high burden of illness and to barriers to access to care. They encouraged systematic observation of the effect of telemedicine through patient registries, RCTs that assess patient outcomes and costs related to entire episodes of care, and more rigorous journalistic standards for published telemedicine research. They stressed the need for basic research to refine target populations for telemedicine services and associated interventions, develop standardized tools to measure effectiveness and harm, and assess the effect of different methods of delivery and payment.

Ohinmaa and colleagues (1999), who have since updated their review of telemedicine through the spring of 2000 (personal communication), further noted the uncertain extent to which care management processes would need to be reengineered to support telemedicine applications across various settings. They stressed consideration of both monetary and non-monetary effects, such as satisfaction, on the user (patient, family, and provider) as well as on the payer in determining optimal strategies of care.

In the United Kingdom, Taylor and colleagues (2000) are undertaking a systematic review to assess the effectiveness of inpatient, outpatient, or community-based interventions or packages of care in preventing death or hospital readmission in patients admitted to secondary care with a diagnosis of heart failure. Their review excludes interventions that are not primarily educational in focus as well as prescription or administration of pharmaceuticals. Secondary outcome measures will include hospital bed days, health-related quality of life, and cost.

#### Other findings

VHA has been actively involved in using or evaluating physiologic telemonitoring devices in these patients. Of the 22 VISNs queried, 17 (77%) responded to the survey, and nine of these reported using or planning to use these devices in a routine or evaluative capacity (see table 3).

Responses show that interest in telemonitoring equipment in patients with CHF is in its early stages of use or evaluation, and that integration of telemonitoring into VA Intranet systems is an important consideration for efficient use of these devices and for evaluating the impact of telemonitoring on clinical care processes and outcomes.

From electronic mail exchanges, TAP uncovered two additional VA facilities involved in evaluating telehealth strategies for managing patients with CHF:

- The VA Palo Alto Healthcare System participated in a feasibility study of the Alere DayLink monitoring system (not peer reviewed and not included) (Alere 2000).
- Veteran patients of the South Texas Veterans Health Care System are eligible to participate in a 27-month RCT entitled “A Demonstration Project to Evaluate an Integrated System of Disease Management Among a Population of Veterans, Military and Medicaid Patients in South Texas.” It is funded by the Department of Defense and led by Dr. Gregory Freeman at the University of Texas Health Science Center in San Antonio. Interventions consist of intensive in-home education and surveillance by nurse case managers with or without in-home pulse oximetry, activity monitoring using an Actigraph watch, and cardiac output via impedance measurement. Endpoints include change in emergency room visits, death, and patient satisfaction (UTHSC 2000).

## CONCLUSION/DISCUSSION

The burden of caring for patients with chronic diseases on caregivers and health systems, such as VHA, is driving the need to optimize outcomes management and quality improvement strategies for these patients. Telemedicine is not new to health care, since electronic media have been used to transmit health care information for several years. However, technical innovations in telemedicine coupled with the need to optimize finite health care resources are important motivating factors for using telemedicine to change the delivery of patient care.

Physiologic telemonitoring is quickly evolving and is being marketed as a way to contain costs and improve functional status and quality of life. Results from this short report and other reviews assessing the broader scope of telemedicine confirm that optimal strategies for managing patients with chronic diseases like CHF in the community setting have not been established. In the broader scheme of multiple management strategies, the relative value of telemonitoring must be considered in the context of other telemedicine alternatives and of non-telemedicine care systems.

To that end, the reviews identified in this report provide general considerations and frameworks for assessing telemedicine that may be useful in designing cost-effectiveness studies. Likewise, Noel and Vogel (2000) offer useful insights into study design and conduct learned from their pilot study in the context of delivering VA patient care. This study may assist other VA researchers and practitioners in designing longitudinal studies to explain the influence of telemonitoring, as part of models

of delivery and coordination of care, on objective and subjective outcome measures.

VHA research has made notable contributions to outcomes research in managing chronic disease and continues to explore ways to provide veterans with the most cost-effective care. VHA’s Quality Enhancement Research Initiative (QUERI), led by the Health Services Research and Development Service, is designed to translate research discoveries and innovations into better patient care and systems improvements (Anonymous 2001). CHF QUERI was developed to create measurable, rapid, and sustainable improvements in the quality of care and health outcomes of veterans with CHF [[www.va.gov/resdev/queri.htm](http://www.va.gov/resdev/queri.htm) or [www.va.gov/resdev/queri.htm](http://www.va.gov/resdev/queri.htm)]. These research efforts, coupled with ongoing evaluation activities in clinical care identified in this report, put VHA in a principal position to make significant contributions to the quality of care and health outcomes of patients with CHF.

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**Table 2. Controlled Clinical Trials of Physiologic Telemonitoring for Patients with Congestive Heart Failure**

Author, pub. year	Level of evidence	Subjects	Intervention/Features	Outcome measures	Results/Conclusions
Cordisco 1999	V  (Non-RCT, single site)	<p><b>Sampling strategy</b> Patients with severe CHF seen from Jan 1997-Jan 1998 at a university-based heart failure program with either recent admission for CHF or patients with chronic volume overload</p> <p><b>Study group n=30</b></p> <ul style="list-style-type: none"> <li>• Coronary artery disease (13)</li> <li>• Dilated cardiomyopathy (17)</li> </ul> <p><b>Comparison group n=51</b></p> <ul style="list-style-type: none"> <li>• Refused telemonitoring (13)</li> <li>• Non-English speaking (3)</li> <li>• Awaiting cardiac transplant (35)</li> </ul>	<p>DayLink Monitor® (Alere®, San Francisco, CA) with electronic scale connected to central station via phone line</p> <p>Control group weighed themselves daily with regular scale, instructed to call clinic for weight gain &gt; 5 lbs.</p> <p><b>Observation period</b> Unclear but approximately 1 year for some analyses</p>	<ul style="list-style-type: none"> <li>• ER visits</li> <li>• Hospitalizations</li> <li>• Deaths</li> <li>• Transplants</li> </ul>	<ul style="list-style-type: none"> <li>• Study group had fewer ER visits than the control group: 1 (3%) v. 11 (22%) (p&lt;.05)</li> <li>• 36 subjects (71%) of the control group required no or one hospitalization v. 13 (43%) of the study group (p&lt;.05)</li> <li>• No statistically significant difference in the number of multiple hospitalizations, deaths, or transplants between groups, but downward trends in the number of multiple hospitalizations and delays in the time to hospitalization or ER visits were observed</li> </ul> <p><b>Authors' notes</b></p> <ul style="list-style-type: none"> <li>• Limitations in study design (nonrandomized, open-labeled use of device, likelihood of more noncompliant patients in the control group, high severity of illness in both groups, and no cost analysis) limit findings</li> <li>• Randomized multicenter studies are needed to answer the effect of telemonitoring on hospitalizations and related cost savings</li> </ul>
de Lusignan 1999	III  (small sample RCT)	<p><b>Sampling strategy</b></p> <ul style="list-style-type: none"> <li>• 20 patients from a group physician practice in UK randomized to study or control group</li> <li>• Mean age=75.1 years</li> <li>• NYHA Class I to IV, mean 1.75</li> </ul> <p><b>Study group n=10</b></p> <p><b>Control group n=10</b></p>	<ul style="list-style-type: none"> <li>• Hewlett-Packard Heart Link program connected to electronic weight scales for daily weight measurement</li> <li>• BP measured twice daily and stored manually in computer by patient</li> <li>• Weekly teleconsultation</li> </ul> <p>Control group had baseline visit and assessment by nurse at home at six-week intervals</p> <p><b>Observation period</b> 3 months</p>	<ul style="list-style-type: none"> <li>• BP</li> <li>• Weight</li> <li>• QOL measures</li> </ul>	<p><b>Data as presented by authors</b></p> <p>Telemedicine group (over first 60 days)</p> <ul style="list-style-type: none"> <li>• 9 of 10 showed reduced systolic BP</li> <li>• 7 of 10 showed reduced weight</li> </ul> <p>Control group (over first 60 days)</p> <ul style="list-style-type: none"> <li>• Improvement in average systolic BP from 190, mean (120-200) to 146, mean (130-160)</li> <li>• No change in diastolic, pulse, or weight</li> </ul> <p><b>Other findings</b></p> <ul style="list-style-type: none"> <li>• QOL improved in study group over 90 days, whereas QOL in the control group appeared to worsen</li> <li>• Telemedicine equipment acceptable to patients</li> <li>• Authors noted technical difficulties such as no uniform standard of television connection for teleconsulting equipment and the amount of wiring needed to connect phone to television</li> </ul>
Heidenreich 1999	V  (Non-RCT, single site)	<p><b>Sampling strategy</b></p> <ul style="list-style-type: none"> <li>• Patients treated by primarily primary care physicians in northern California.</li> <li>• Identified using claims data from April 1994--Oct 1995</li> </ul>	<ul style="list-style-type: none"> <li>• LifeMasters® Supported SelfCare<sup>SM</sup>, Inc. included patient education, daily self-monitoring with digital scale, automated blood pressure cuff used at home, toll free number</li> </ul>	<ul style="list-style-type: none"> <li>• Claims</li> <li>• Hospitalizations</li> <li>• Hospital days</li> </ul>	<p><b>Total claims in 1996</b></p> <ul style="list-style-type: none"> <li>• Program (\$7,400 ± \$11,700) v. Control (\$18,800 ± \$34,000) (p =.04)</li> <li>• Admissions/yr and Hospital days/yr not statistically significant between two groups</li> </ul> <p><b>Change in total claims from 1995 to 1996</b></p> <ul style="list-style-type: none"> <li>• Program (decreased from \$8,500 ± \$13,000 to \$7,400 ± \$11,400, p</li> </ul>

Author, pub. year	Level of evidence	Subjects	Intervention/Features	Outcome measures	Results/Conclusions
		and with physician and patient consent  <b>Study group n=68</b> <ul style="list-style-type: none"> <li>mean age 73 ± 13 years</li> <li>NYHA Class II-III</li> </ul> <b>Control group n=86</b> <ul style="list-style-type: none"> <li>matched based on medical claims and sex</li> </ul>	used to dial into computerized voice answering system; physician notification of abnormal measurements  <b>Observation period</b> 11 days to 10.9 months		not reported) <ul style="list-style-type: none"> <li>Control (increased from \$9,200 ± &amp;15,000 to \$18,800 ± \$34,000, p &lt; .05)</li> <li>Subgroup analysis found cost savings among men and patients older than 75 years (p not reported)</li> </ul> <b>Other findings</b> <ul style="list-style-type: none"> <li>Older age, female gender, diabetes, high serum creatinine levels and low serum sodium levels were independent predictors of an increase in claims from baseline (p &lt; .05)</li> <li>Little change in QOL scores in program group from baseline to 3-month follow-up</li> <li>High satisfaction scores and compliance with daily vital sign and symptom entry (85% of the time) among program participants</li> </ul>
Noel and Vogel 2000	III  (small sample RCT)	<b>Sampling strategy</b> 20 veterans (10 cases, 9 controls, one death) seen in VA Connecticut Healthcare System with: <ul style="list-style-type: none"> <li>high resource use for six months preceding study and:</li> <li>three or more chronic and complex conditions including CHF, COPD or diabetes</li> <li>3 or &gt; hospitalizations and/or 6 or &gt; ER visits</li> <li>active usual home healthcare services</li> <li>frequency of resource use ranged 130 times per month</li> </ul>	Intervention = nurse case management + 24-hour telemonitoring using HANC*  Control = nurse case management only  HANC unit (Caremonitor Corp.) over POTS (plain old telephone lines) has 2-way voice and visual display between patient and monitoring station; collects vital signs, pulse oximetry, lung sounds, EKG; activates medication reminders.  <b>Observation period</b> 6 months  *Note: unit no longer in use	Objective and subjective QOL measures: <ul style="list-style-type: none"> <li>Functional level</li> <li>Cognitive assessment</li> <li>Self-rated health status</li> <li>Satisfaction with care</li> </ul> Homecare costs based on \$88/visit preferred rate, additional costs incurred during visit and hospital transport costs  Hospital and ER costs 6 months prior, and 3 and 6 months during intervention	<b>Mean costs at baseline, during intervention (3 months) and at 6 months</b> Control (n=9): \$11,176 v. \$8,360 v. \$9,504 Study (n=10): \$10,912 v. \$7,744 v. \$8,712 <ul style="list-style-type: none"> <li>Differences not statistically significant, no p values reported</li> </ul> <b>Quality of life measures</b> <ul style="list-style-type: none"> <li>Cognitive status (p=0.0672)</li> <li>Functional level (p=0.4667), although intervention group showed trend toward improvement</li> <li>Satisfaction with care (p=0.2489)</li> <li>Self-rated health status (p=0.2089)</li> <li>Variances for each QOL scale were similar</li> <li>During telemonitoring, cognitive status, functional level, and self-rated health status improved, but no statistically significant differences between two groups</li> </ul> <b>Other findings</b> <ul style="list-style-type: none"> <li>HANC unit presented barriers: bulky, difficult to fit into home, costly to transport, cumbersome to store when not used.</li> <li>Third party monitoring presented problems: increased risk of misinterpretation, delays in forwarding data, inability to integrate physiologic data directly into hospital's Intranet, and compromised efficiency of nurse case managers</li> <li>No relationship between telemonitoring, nurse case management and satisfaction with care</li> <li>Patient acquiescence may explain absence of a relationship between subjective results of satisfaction with care and self-rated health status and objective results for cognitive status, functional level, and resource use</li> <li>Hospital's Firm system model also influenced QOL outcomes and resource use costs</li> <li>Objective measures may be more reliable for determining QOL outcomes</li> </ul>

Author, pub. year	Level of evidence	Subjects	Intervention/Features	Outcome measures	Results/Conclusions
					<p><b>Comments</b></p> <ul style="list-style-type: none"> <li>Factors contributing to lack of statistical significance: small and underpowered sample size, short observation period, high-risk and high cost subjects not representative of other homebound patients enrolled at the hospital, potential differences across study groups with respect to demographics and complex co-morbidities, costs added in maintaining the usual number of home healthcare services throughout study</li> </ul>

BP, blood pressure  
 CHF, congestive heart failure  
 COPD, chronic obstructive pulmonary disease  
 ER, emergency room  
 NYHA, New York Heart Association heart failure classification  
 QOL, quality of life

**Table 3. Survey Results of Physiologic Telemonitoring Activities Across Veteran Integrated Service Networks (VISN)**

VISN	Responses
1	<p>West Haven: VA Connecticut Healthcare System has a 2-year research study underway of veterans (N = 200) with CHF, COPD, and/or diabetes using Panasonic's Telecare unit in the home setting to collect physiologic data, monitor physical status, and provide patient education. Outcomes are transmitted directly to VA Intranet (VistA) for interpretation and analysis by healthcare providers and are used to send advice and instructions to telemonitored patients. Research funded by VHA New Initiative Program.</p> <p>Noel, H. C., &amp; Vogel, D. C. (2000, October). Resource costs and quality of life outcomes for homebound elderly using telemedicine integrated with nurse case management. <i>Care Management</i> 2000; 6(5): 22-31. Reports results of a telemonitoring pilot study of veterans with CHF (using a telemonitoring unit no longer in use (see table 2).</p>
2	Albany: has piloted a telemedicine system developed by Global Teledex to do realtime audio, video, telestethoscopy, and vital sign monitoring (blood pressure, pulse, oximetry and weight) in an adult home where 6-12 veterans reside.
6	Richmond: actively working with Agilent (Hewlett Packard) to get their wireless home monitoring system integrated with CPRS for home monitoring of CHF patients.
8	Lake City Division: The Rural Home Care Project uses audio-video equipment to monitor patients with heart failure on a weekly basis. Also uses Health Buddy by Health Hero to follow some less severe CHF patients. The Buddy is an in-home messaging device that asks the patient a series of questions including weight, B/P, and blood glucose, and trends these variables, and assigns a risk-management level to help flag potential problems. Team accesses Health Buddy data online. Evaluation component uses SF 36V and patient satisfaction questionnaires, health clinic and insurance data, as well as utilization review and cost data. Data are input in an Intranet database managed and independently analyzed at the Baltimore VAMC. Currently exploring ways to incorporate an evaluation process directly into Health Buddy questions and other telemonitoring systems for CHF patients. Using both of these technologies has prevented ER visits and hospitalizations and has made patients feel more secure at home.
	Fort Myers VA Outpatient Clinic: The Telehealth Project is utilizing the same equipment and targeting the same diagnoses as the Lake City Project and uses same evaluation component.
12	Westside VA: Dr. Avitall has developed and is currently using his own system for monitoring patients at home with chronic illnesses including CHF. He works out of the Univ. of Chicago but has used his system on veterans at the Westside VA. His web site is <a href="http://www.uic.edu/~gcastro">www.uic.edu/~gcastro</a> and he has an abstract entitled "A Prospective Randomized Study of Home Care Delivery Methods for Chronic Heart Failure" (did not meet inclusion criteria for review) <a href="http://srd.yahoo.com/goo/bondmass/2/*http://www.ispub.com/journals/IJANP/Vol3N2/chf.htm">http://srd.yahoo.com/goo/bondmass/2/*http://www.ispub.com/journals/IJANP/Vol3N2/chf.htm</a>
	Madison: Interested in having a telemonitoring system for CHF management. Has looked at a service from Minneapolis monitored by a nurse manager that provides an electronic weight scale with built-in message transmission capability to communicate with the patients when they weigh themselves. Several issues were raised during the demonstration: inability to monitor blood pressure and heart rate /ECG which the company said would be forth coming in their next phase of development; inability to integrate data with CPRS to which company said they would work with us locally to achieve it. Successful employment requires start -up funding, a CHF nurse, and universal integration with the CPRS at some level beyond the local system, which may require additional discussion between the vendor and the CPRS service.
13	Minneapolis: HCC had applied for a grant to study the use of home health equipment for patients with specific indications, CHF being one. Grant was not approved.
14	Omaha: Alere system used on a few veterans with severe heart failure
	Iowa City: Study underway to test telephone and in home video for CHF patients
15	Developing a research protocol using Agilent technology
17	Austin: Project proposed using the Agilent system in conjunction with a CHF clinic. The evaluation parameter will be a pre-post comparison of the number of hospital days per year for patients followed via telemedicine monitoring and a comparison to other CHF patients in the same NY Classes who are not enrolled in the clinic.

CHF, congestive heart failure  
COPD, chronic obstructive pulmonary disease  
CPRS, computerized patient record system

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