Evidence Based Practice: Use of Telehealth to Reduce Rehospitalizations in the CHF Population

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Abstract

Aim: To evaluate if telehealth monitoring (TM) assists in reducing rehospitalization rates in the chronic heart failure (CHF) population when compared to usual care of visitation from homecare nurses by implementing an evidence-based practice (EBP) project. *Background*: Verbal or written education and two to three weekly homecare visits by nurses are insufficient methods to manage CHF. CDC (2012) reports one million CHF-related rehospitalizations occurred in both the years 2000 and 2010, signifying no improvement in the delivery of care. Another cost-effective method is required to care for this vulnerable patient population to decrease costs that total $34 billion and to improve quality of care. *Design*: After a PICOT question was developed, a critical appraisal of the evidence was conducted. Rosswurm and Larrabee (1999) EBP model was used as a guiding framework for the pilot study. At the end of the six months of the study, the data on the primary outcome - rehospitalization rates - were compared to the previous six-month time period when the usual care was provided. The secondary outcomes measured were mortality rate, length of stay in the hospital if re-admitted, and cost of care. The Donabedian Method was utilized to evaluate all aspects of care that contributed to the outcomes. *Results*: The pilot study supports the use of TM in the CHF patient population to reduce rehospitalizations. Intermediate outcomes: lower blood pressure, greater medication and diet adherence, improved mental, physical, and emotional well-being. *Conclusion/Implications*: TM, while a costly initial intervention, supports long-term benefits of cost savings and increased quality of life in the CHF population. The use of TM assists in identifying signs and symptoms of CHF exacerbation, thus resulting in earlier implementation of medical care and preventing rehospitalizations. TM promotes self-management of CHF, resulting in long-term lifestyle changes.

Evidence Based Practice: Use of Telehealth to Reduce Rehospitalizations in the CHF Population

Statement of the Problem

In United States (U.S), the population of patients diagnosed with chronic heart failure (CHF) is rapidly increasing with about 660,000 new cases diagnosed yearly. The debilitating disease affects 5.8 million people nationwide and 23 million people worldwide, and is the most common cause of rehospitalizations for patients 65 years of age and older (Centers for Disease Control and Prevention [CDC], 2010; American Heart Association [AHA], 2012). The data from the National Hospital Discharge Survey conducted by CDC (2012) reported that approximately one million rehospitalizations, an average of 24.7%, occurred in the patient population above the age of 65 years in the year 2000 and the year 2010, signifying no improvement in the quality of care delivered.

Recurrent hospitalizations are associated with increased healthcare costs, increased morbidity and mortality, and impaired quality of life (McGhee & Murphy, 2010). The disease mortality rate of CHF is 50% within five years of diagnosis, resulting in about 275,000 deaths a year (AHA, 2012). In order to reduce the yearly CHF healthcare costs of approximately $34 billion, Centers for Medicare and Medicaid Services (CMS) have recently adopted a plan supported by the Affordable Care Act that will reduce reimbursement to hospitals and home healthcare agencies with excessive readmission rates (CMS, 2012). With increasing accountability, hospitals and healthcare providers are seeking options to improve patient outcomes in this vulnerable population.

According to CDC (2012), half of the rehospitalizations caused by an underlying CHF diagnosis are avoidable if appropriate medical care is provided in a timely manner. This growing healthcare issue is identified in home healthcare environments, where the care provided by a nurse is often inadequate to prevent rehospitalizations. The home nursing visits scheduled 2-3 times a week to monitor for signs and symptoms of CHF disease exacerbation does not allow for early detection and treatment of disease risk factors (Weintraub et al., 2010; Gellis et al., 2012). Furthermore, evidence suggests that educating patients using verbal or written techniques are insufficient methods in managing disease processes (Wilson, 2003; Taylor-Clarke et al., 2012). The Institute of Medicine (IOM) (2012) proposes using an

emerging tool of telehealth telecommunications technology to care for high risk patients. Telehealth monitoring (TM) delivers safe, effective healthcare by providing remote surveillance of multiple patients by a healthcare professional (usually a nurse) using digital technology (Artinian et al., 2007; Marineau, 2007; IOM, 2012). TM is a cost-effective care model that focuses on *Healthy People 2020* goals of improving patient outcomes and access to care, and eliminating healthcare disparities (Reed, 2005; Lawton, 2010; AHA, 2012).

Clinical Problem using PICOT Format

New practices changes in clinical sites are required to address the high number of preventable rehospitalizations caused by CHF. Incorporating the use of TM at home, versus the usual care provided by visiting homecare nurses, in caring for patients diagnosed with CHF can have beneficial effects on rehospitalization rates. TM promotes patient self-management of disease process and results in lifelong lifestyle changes (McGhee & Murphy, 2010; Radhakrishnan & Jocelon, 2011; Gellis et al., 2012). Numerous randomized control trials research studies with CHF population have illustrated that TM assists in early identification of symptoms of disease exacerbation, thus resulting in earlier implementation of medical care and preventing the need for rehospitalizations (Artinian et al., 2007; Stone et al., 2010; Gellis et al., 2012).

PICOT Question

In patients diagnosed with CHF (P), how effective is the implementation of TM in the home (I) when compared to on-site visitations from home healthcare nurses (C) in the prevention of rehospitalizations (O) over a 6-month time period (T)?

Practice Change Team

For successful implementation of TM in homecare settings, an interdisciplinary planning team with specialized knowledge is required. The daily monitoring of the patient's vital signs and patient education will be performed by nurses (RN) who will be educated on the use of the TM equipment by a company representative of the Honeywell "HomMed" Health Monitoring System (HomMed Inc., 2011). The telehealth nurses will directly collaborate with the primary care physicians (PCP) or cardiologists to

closely case manage the care. In addition, a cardiologist or a nurse practitioner (NP), who specializes in CHF, will be the program directors/mentors. Other disciplines that are preferred for the practice change are physical therapy (PT), occupational therapy (OT), and nutritional services. If the patient requires rehabilitation services, home-based PT and OT can provide additional disease education (i.e. related activity) to the patient and/or family with every homecare visit. If the patient has other complex uncontrolled comorbidities (i.e. diabetes) or food allergies, a nutritionist or a dietician can assist with appropriate diet recommendations. The interdisciplinary team required for this practice change will consist of at least two RNs, a NP, a cardiologist, a PCP, a PT, an OT, a nutritionist or a dietician, and a company representative of HomMed, Inc.

In addition to an interdisciplinary team, key informants are also required in the fieldwork for the achievement of the program. Patients and family members are the best sources of assistance in providing individualized norms and perceptions of the program. Adequate education will be provided by nurses on the use of the TM system. Before initiating the home-based program, patients and families will be invited to share personal perceptions, interests of the program, and the likelihood of continuing the program for six months. Family members are of critical importance of the practice change and will be involved when educating patients on the disease process. If the patient lives in an assisted care facility, staff will be also educated on the CHF disease process and the TM device. Family members, facility staff, and telehealth nurses can reinforce healthy patient behaviors and discourage negative actions, thus preventing disease exacerbation.

Stakeholders, such as hospitals and health clinics, who will be affected by this practice change, can be involved in improving patient outcomes. To assist patients with transitioning care from hospital to home, social workers managing discharges of high risk CHF patients can refer these patients to the home healthcare agency instituting the TM services. Heart failure clinics and PCPs should also be aware of the implementation of the TM services as a practice change for other possible patient referrals. A collaborative approach is essential between the planning team members, between the planning team and

the key informants, and between the practice site and other stakeholder agencies to measure the effectiveness of TM in preventing rehospitalizations in the susceptible CHF population.

Synthesis of Relevant Data

Primary care nurses in various practice settings including home health nurses, special interest groups like the American Academy of Ambulatory Care Nurses, and government agencies including the United States Department of Agriculture and Institute of Medicine (IOM) are all proponents of the implementation of telehealth monitoring (TM). According to the IOM (2012), telehealth has developed in both the public and the private sectors. The federal government offers grant funding to encourage the peer-reviewed journals and professional societies to dedicate efforts in the field of telehealth. Due to the emerging need for TM, the private technology industry is striving to develop new user-friendly applications for telehealth (National Academy of Sciences, 2012).

After evaluating homecare nurses' feedback, it was suggested that due to the nature of the disease process, the chronic heart failure (CHF) population requires additional in-home monitoring to prevent recurrent hospitalizations. Most nurses state that the allotted 30-minute home care visit was insufficient to provide education and monitoring to this vulnerable patient population. The homecare nurses recommended a prevention strategy that would allow daily monitoring of the CHF patient for a longer duration of time (Greenberg & Cartwright, 2001). Implementing TM in homes will assist with closer monitoring of the patient and increased collaboration with medical practitioners to provide the necessary care to the patients. Additionally, the comparison data compiled by the Centers for Medicare and Medicaid Services (CMS), which consists of extracted information from the patient records (i.e.an OASIS Assessment), reveals consistent findings of lower overall rehospitalization rates in homecare agencies in Ohio that are currently utilizing TM (CMS, 2013).

Many special interest groups provide education and training to support the implementation of TM. For example, the Telehealth Nursing Special Interest Group, a subset of the American Telemedicine Association, serves as a resource and is involved with research, creating and refining practice guidelines, and advocating for the necessity of TM application in health care settings. Much of the research

conducted is supported and funded by government agencies such as the Agency for Healthcare Research and Quality (AHRQ) (American Telemedicine Association, 2008). Additionally, the American Academy of Ambulatory Care Nurses also supports the use of TM and encompasses elements of TM nursing into the Ambulatory Certification (American Academy of Ambulatory Nursing, 2013).

The IOM suggests that TM has positive implications for patient care, education, research, and public health (IOM, 1996). Other agencies supporting the use of TM include the Department of Defense, Department of Commerce, and CMS (Wakefield, 2012). The Health Resources and Services Administration (HRSA), an agency of the United States Department of Health and Human Services (US-HHS), encourages healthcare practitioners to extend the use of TM to populations that have poor access to health care services. Key functions of the agency include collaborating with state, federal, and private entities to fund research initiatives, synthesizing best TM practices, providing technical support, developing policies, and advocating for TM implementation (US-HHS, 2013). Three grants awarded by HRSA that encourage TM research are the Licensure Portability, Telehealth Network, and the Telehealth Resource Center. According to a HRSA representative, there are "twenty six federal agencies and offices that either have an interest or investment in telehealth technology" (Wakefield, 2012). Vested interest and support revolve around decreasing health care costs, cultivating access to minimize disparities, improving patient care outcomes, simplifying modalities, maximizing efficiency and quality, and increasing medication compliance. These are all potential TM contributions to the current and future state of health care (Wakefield, 2012).

Group Critique of Collective Evidence

Articles were obtained through Cochrane Library and CINAHL searches, and included the search terms (tele*) AND (congestive heart failure OR heart failure OR CHF).Dates included in the search ranged from 2007 to 2013. The English language was the only additional modifier utilized. The goal of the synthesis was to find the highest level of evidence to support the implementation of TM in the CHF population to decrease hospital admissions. Three systematic reviews and one randomized control trial

(RCT) were selected (see *Appendix A* for the appraisal forms, the evaluation tables, and the synthesis table of the studies).

After reviewing high level of evidence studies, results strongly support the implementation of TM to reduce rehospitalizations in the CHF patient population. Decreased rates of CHF-related admissions and decreased trends in mortality rates were the recurrent themes in all four of the studies. Additionally, two of the four studies reported decreased all-cause hospitalizations and bed days of care, thus favoring the implementation of TM (Klersy, De Silvestri, Gabutti, Regoli, & Auricchio, 2009; Polisena et al., 2010; Weintraub et al., 2010).

Polisena et al. (2010) supported the implementation of TM in the CHF population. Mortality rates (CI 95% [0.64(0.48-0.85)]), number of patients hospitalized (CI 95% [0.77(0.65-0.90)]), and emergency room visits (from one pre-post study, the mean values consisted of 0.17 versus 0.63) decreased. Additionally, the length of stay had a reduced trend (mean values from two observational studies were 1.21 versus 1.97 and 2.11 versus 3.93). The review by Polisena et al. (2010) also illustrated an increase in the prevalence of primary care clinic visits. Although the rationale is not explored in the review, numerous studies have indicated that daily monitoring of the patient leads to enhanced collaboration with the physician and increased office visits to identify and control early exacerbation of symptoms, thus preventing rehospitalizations (Aanesen, Lotherington, & Olsen, 2011; Lehmann, Mintz, & Giacini, 2006; Roher et al., 2010). The increased visits to the clinic are still considered measures of cost-effective care, reducing the average cost of one rehospitalization by over $23,000 (Wang, Zhang, Avala, Wall & Fang, 2010). TM also promotes self-management of disease processes and healthier behavioral choices, thus leading to increased participation in care. The TM patients, therefore, are more likely to comply with follow-up appointments with the primary care physicians or cardiologists (McGhee & Murphy, 2010; Radhakrishnan & Jocelon, 2011; Gellis et al., 2012).

Although not as many variables were assessed, Klersy et al. (2009) also supported the implementation of TM. RCTs that were studied favored the use of TM for CHF hospital admissions (CI 95% [0.72(0.64-0.81)]) and on all-cause hospital admissions (CI 95% [0.96 (0.90-1.03)]). Cohort studies

that were assessed favored the use of TM for all-causes of mortality (CI 95% [0.53 (0.29-0.96)]) and all-cause hospital admissions (CI 95% [0.52 (0.28-0.96)]). Additionally, these authors attempted to classify the various care approaches to the CHF population. Three different approaches were identified: 1) a usual care approach, which referred to in-person visits at the doctor's office, clinic, or at the emergency department without additional phone calls to and from the patient; 2) a phone monitoring approach including scheduled structured phone interaction with the health care professional (with or without home visits) and reporting of patient symptoms and/or physiological data; 3) a technology-assisted monitoring approach relying on the information communication technology (i.e. TM) to transfer physiological data. The second and third approaches significantly improved outcomes when compared to the first intervention (Klersy et al., 2009)

Clarke, Shah, & Sharma (2011) implemented a meta-analysis to evaluate the effectiveness of TM in the CHF population. Data on decreased mortality rates (CI 95% [0.77(0.61-0.97)]) and CHF-related hospital admissions (CI 95% [0.73(0.62-0.87)]) remained consistent with the other studies' findings and also favored the use of TM. Other variables studied were the number of all-cause hospital admissions, emergency department visits, and bed days of care. These findings illustrated no significant difference between the TM group and the control or usual care group, likely due to the relatively small sample sizes of some of the studies (Clarke et al., 2011).

Unlike the level one evidence systemic studies discussed, a level two RCT conducted by Weintraub et al. (2010) evaluated the impact of a TM intervention measuring body weight, blood pressure, heart rate, and subjective transmitted reports. The control group received disease management education from a nurse that directed the Specialized Primary and Networked Care in Heart Failure (SPAN-CHF) program, and the randomized intervention group received a nurse from SPAN-CHF in conjunction with TM. The 188 patients in the study were randomized to either the intervention or the control group (95 in the intervention group, 93 in the control group). Variables studied were consistent with the other studies and included the frequency of CHF-related hospitalizations, the incidences of all-cause hospitalization rates, and the rates of mortality. Increased compliance with heart failure medication

regime was also reported in the TM group. Educating the patients via TM on medications such as angiotensin-converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARB) resulted in 70% fewer rehospitalizations than patients who were not taking the medications (Weintraub et al., 2010). The study reported a lower rate of CHF-related hospital admissions and bed days of care as well as a decreased trend in mortality. However, the study reported an increase in the number of all-cause hospitalizations in the intervention group (Weintraub et al., 2010). This phenomena was not explored in detail, but may be attributed to the presence of pre-existing conditions not related to heart failure.

All four articles reviewed varied in terms of consideration of the control or "usual care" consortium. For example, control groups were assessed by a home care nurse, a physician, or a combination of both. Additionally, there was significant variance in the types of TM modalities that were employed. However, with recurrent similar findings from the high level and quality of studies reviewed, the strength of the evidence strongly supports the use of TM to decrease rehospitalizations in the vulnerable CHF population. It is important to note that TM encompasses an array of potential modalities, and the data suggests that the appropriate mode of TM delivery should be tailored to the patient's preferences and his/her health care needs and goals (Clarke et al., 2011).

Evidence-Based Practice Model

Efforts to change practice should be guided by conceptual models. The Model for Evidence-Based Practice Change (M-EBPC) is a revised version of the model by Rosswurm and Larrabee (1999), and contains six steps that focus on processes that improve outcomes (Rosswurm & Larrabee, 1999). This model has been employed for implementing change based on best practices by the American Stroke Association, intensive care units, and other settings (George & Tuite, 2008; Kavanagh, Connolly, & Cohen, 2006). The stages of this model are appropriate for the PICOT statement as the model is organized, easy to use, and allows for ongoing monitoring of completed projects (Melnyk & Fineout-Overholt, 2011; Rosswurm & Larrabee, 1999).

Step one of M-EBPC is identifying the problem, which is the prevalence of increased rates of rehospitalizations in the chronic heart failure (CHF) population. The implementation team then forms a

team composed of stakeholders, such as administrators, at least two registered nurses (RNs), a nurse practitioner (NP), a cardiologist, a primary care provider (PCP), a physical therapist (PT), an occupational therapist (OT), a nutritionist, and a company representative of HomeMed, Inc. for consultation regarding the Health Monitoring System (HomMed Inc., 2011). Internal data regarding the CHF population is collected, including emergency room (ER) visits, length of stay, costs of care, and the primary data of concern: rate of rehospitalizations. External data is gathered for benchmarking, and includes 30-day rehospitalization rates at or below the 80th percentile, which is considered optimal by the Centers for Medicare and Medicaid Services (CMS, 2013). After examining the data, recognition of the practice change is justified. The rehospitalization of CHF patients is then linked with the use of telemedicine technology to resolve the problem and to measure the outcomes. A PICOT is formulated to provide focus (Melnyk & Fineout-Overholt, 2011). The PICOT question under consideration of this project is: In patients with CHF (P), how effective is the implementation of TM in the home (I) compared to the visitation of home healthcare nurses (C) in the prevention of rehospitalizations (O) over a 6-month time period (T)?

Step two involves locating and identifying the types and sources of evidence, such as systemic reviews or meta-analysis (level 1 evidence) and randomized control trials (level 2evidence), installing a plan, and conducting a search. According to the M-EBPC, CHF care and TM evidence is then critically judged for strength in step three of the process. The feasibility, benefits, and risks of implementing a TM intervention are assessed. A final determination is made based on these factors, as well as on the quantity and strength of evidence to support the change (Melnyk & Fineout-Overholt, 2011; Rosswurm & Larrabee, 1999).

In step four, the proposed change is defined and resources identified. The TM intervention for the CHF population is initiated as a pilot change to determine possible adaptations needed before implementing the change into practice. After developing an evaluation plan, the baseline data and the outcome indicators regarding rehospitalizations are collected (Melnyk & Fineout-Overholt, 2011). Once the pilot study is implemented, the process is evaluated, outcomes are measured, and the

recommendations are developed. As part of step five in the process, data and verbal feedback from field users and participants are necessary for the adoption of, rejection, or adaptation of the new practice (Melnyk & Fineout-Overholt, 2011; Rosswurm & Larrabee, 1999).

Finally, the new practice is incorporated into the standard of care in step six. The outcomes are monitored and the results disseminated. After an approval from the stakeholders, HomeMed Inc. will provide an in-service education to all providers. Ongoing monitoring of the project is necessary for further refinements (Melnyk & Fineout-Overholt, 2011; Rosswurm & Larrabee, 1999).

Objectives of Change

The overall objective is to decrease rehospitalization rates by early identification and treatment of the signs and symptoms of a CHF exacerbation. This will be accomplished by improved self-management through education and the enhanced monitoring of TM. The telehealth nurse provides education and counseling in regards to salt and fluid restrictions, daily body weight measuring, medication compliance, smoking cessation, and symptoms that may indicate an exacerbation of CHF, such as swelling, frothy cough, orthopnea, or a general increase in shortness of breath (American Heart Association, 2013).

Support for Change

Homecare nurses report that homecare visitation time is insufficient to educate and monitor the vulnerable CHF population. TM provides a welcomed strategy for nurses to monitor CHF patients on a daily basis and for a longer time period, with the goal of keeping the patients out of the hospital (Greenberg & Cartwright, 2001). In fact, comparison data from the CMS reveals lower rehospitalization rates in Ohio homecare agencies that have implemented TM (CMS, 2013). With a CMS plan to reduce reimbursements for excessive readmission rates, the implementation of TM will also be supported by physicians, hospital administrators, and home care agencies. As integral domains for quality of life, *Healthy People 2020* (2010) goals are to assess patient reported outcomes, overall well-being, and participation measures that are influenced by physical, mental, and social functioning. Improved quality of life is suggested for CHF patients with TM who are able to remain at home in a stable condition with the family, and who are able to actively participate in self-care.

Resistance to Change

The implementation of TM contains upfront costs. These include system purchasing and increased staff hours for training and in-service hours. Cost recuperation and revenue gains may take a long time to realize, and can create resistance in moving forward (Health Resources and Services Administration [HRSA], 2013). Reimbursement for the services of TM is also a concern, as not all costs are reimbursed. Currently, Medicare only reimburses telehealth services in Health Professional Shortage Areas (HPSA) or in a county outside of a Metropolitan Statistical Area (MSA). Additionally, there is no standard payment scheme with TM for private payers or private insurance companies, and reimbursement varies state to state with Medicaid. As TM is becoming more widespread, utilized, and the benefits are realized, changes to reimbursement plans are projected. Eventually, Medicare will set the stage for payment to other parties (HRSA, 2013).

Special Considerations

Special considerations include access to the necessary technical support staff and training of the staff and patients to use the TM technology. Elderly patients may not be technology-savvy and may require repeated demonstrations of TM use. In order to implement the TM system, workflow changes are required and additional staff may be needed initially. Other considerations include examining the technical infrastructure requirements in order to implement TM. The facility broadband connection will be tested for adequate encryption methods to maintain confidentiality due to the increased demands of data transmission (HRSA, 2013).

Strategies to Gain Support

It is important to raise the awareness of the need for change by discussing baseline practice-based data. By sharing evidence, a discomfort with the status quo will create a readiness for change (Melnyk & Fineout-Overholt, 2011). In order to gain support from stakeholders, it is important to discuss the return on investment (ROI) when implementing TM for CHF. The FAST Adoption of Significant Technologies (FAST) group conducted a meta-analysis of three programs using TM for CHF. The results yielded a decrease in ER visits and rehospitalizations, reducing average annual costs from $11,549 to $3,263 per

person. In addition, hospital charges for CHF patients using TM over a six month period showed an 81% reduction, from $1,240,506 to $229,929 (National Health Policy Institute [NEHI], 2009). For every one dollar invested, a $2.10 benefit is realized. In addition to the financial perspective, 90% of patients approved the TM implementation, reported a greater confidence in managing their disease, and accounted to an increase in diet and medication compliance by using TM (NEHI, 2009).

Timetable

The telehealth intervention will be presented to the facility management on June 1, 2013. A formal document will be submitted on June 15th, and literature will be distributed thereafter. In-service education to the staff will take place during the first two weeks of July. July 15th marks the date for the pilot unit implementation, with the end date on January 15, 2014. Outcome measurements (rehospitalizations) will be monitored during this time. If positive outcomes are favored, facility adoption and implementation of the TM technology for CHF is projected January 31, 2014 *(*see *Appendix B, Figure 1*, for a Gantt chart/timeline*).*

Population/Setting/Recruitment

The TM intervention will be implemented in all patients' homes that are under the care of the homecare agency piloting the practice change, despite the age of the patients and the stage of CHF as classified by the New York Heart Association (NYHA). The recruitment criteria will include patients with a diagnosis of CHF (on or before July 15, 2013) with the intention to remain under the care of the agency for at least six months. Participants must have an access to a land-line phone, be English-speaking, and cognitively intact to be able to learn the use of the TM system. Participant exclusions would be cognitive or physical impairment that could hinder the ability to use the TM system. If the participant meets the inclusion criteria, an informed consent will be obtained and the participant will be recruited for the pilot study.

Intervention

The intervention will utilize the Honeywell "HomeMed" Health Monitoring System, which is a small tabletop in-home monitor (HomeMed, 2013). The participants are required to take blood pressure,

heart rate, oxygen saturation, and weight on a daily basis at the same pre-determined time. Using the monitor, patients are prompted to answer yes/no questions regarding the CHF process with a single key press. The data is collected within 5-10 minutes and sent via phone line to the health care agency, where telehealth nurses review the data and follow-up with a phone call for abnormal readings. The telehealth nurse provides education on the importance of body weight measurements, medication compliance, and dietary restrictions involving salt and fluids, as well as the symptoms of worsening CHF. The telehealth nurse is also able to collaborate with the patient's provider for obtaining new orders, and make a home visit if necessary. When analyzing the outcomes at the end of the pilot study, the data on rehospitalization rates will be compared to the previous six-month time period where the usual care (visitation of homecare nurses two to three times a week) was provided.

Evaluation

Outcome Definitions

The primary outcome that will be measured from the pilot study is the rehospitalization rates of the patients enrolled in the pilot study. The data will be collected by the registered nurses who are assigned to gather the TM data and from the electronic health records of the enrolled participants in the event they are readmitted for worsening condition. The secondary outcomes that will be collected, measured, and evaluated are emergency room visits, length of stay, and cost of the care provided.

Outcome Measurement

At the end of the six-month pilot study, the data collected from rehospitalizations will be compared with the baseline data. The baseline data will be rehospitalization rates obtained when the patients were receiving routine care. Routine care is defined as the care provided by homecare nurses two or three times a week. The empirical data will be tested for internal consistency by computing the Cronbach's alpha. The desirable alpha is greater than 0.80 (Polit & Beck, 2012). This evaluation will be reported in the final evaluation of the TM intervention study as an indicator of reliability.

Data Collection and Frequency

Data on rehospitalizations will be collected at the beginning of the intervention to gather a

baseline and at the end of the six month period to evaluate the changes. To assist in the data collection reliability and validity, the participants will utilize the same tools to gather the information. For example, the same telemedicine system (i.e. computer, weighing scale, blood pressure cuff, etc.) will be utilized for the same individual throughout the entire pilot study and for all participants enrolled in the study. Due to the error that may present utilizing biophysiological measures, it is important to consistently calibrate devices to decrease this risk (Polit & Beck, 2012). Additionally, the utilization of the test-retest method can assist with the inconsistencies that can be gathered from the incorrect reported health data. This is done by reviewing the patient record for possible data extremes to help ensure greater validity (Polit & Beck, 2012).

During the study, the TM trained nursing staff (two identified RNs) and the EBP team, consisting of four BSN prepared RNs will collect the data. The primary nurse researcher will be the main project coordinator to ensure the project direction and focus is maintained during the six months. The other nurse researchers will be tasked with data organization by creating a database. They will be responsible for updating the database with the incoming data received.

Donabedian Method

When the final data is collected, the Donabedian method will be utilized to assess the effects of the practice change. The Donabedian model was developed to assess quality in healthcare by examining the steps, structure, process and outcomes (Donabedian, 2005). This method will be utilized in outcome measurement for the proposed intervention. The empirical data will be evaluated for reliability and validity. The Donabedian method was chosen for evaluation of this practice change based on its focus on the entire process not just on outcomes (Donabedian, 2005). This method examines all variables, both positive and negative; and accounts for them when examining the final outcome. Additionally, it supports the Institute of Medicine (IOM) priority concern regarding CHF disease process by evaluating all aspects of care that may contribute to the outcomes of the CHF patient population (Institute of Medicine of the National Academies, 2013).

Monitoring Implementation of Practice Change

The implementation of TM in the patient population will require ongoing direction. In order to successfully implement the practice change, it is essential to follow the project time line to maintain focus. Each individual involved in the project will be updated on the specific roles, responsibilities, and deadlines. The nurse researchers will constantly reevaluate the need for further education related to the equipment provided to the patients. The research staff will be available on-site or by phone around the clock, seven days per week to troubleshoot any concerns that may arise during the study timeframe. Additionally, the technical services of Honeywell Inc. will be utilized to address any concerns with the "HomeMed" monitoring equipment.

Long Term Outcome Monitoring

Patients' consent will be obtained to allow the researchers to follow and monitor the patient for at least two years post-intervention to evaluate the long-term effectiveness of TM on rehospitalization rates. Reduced rehospitalization rates during the two-year period will be indicative of positive impacts of TM on self-management of the CHF disease process. The EBP team will also continue to dedicate time for ongoing re-evaluation yearly of TM intervention and rehospitalization rates. The primary focus of the team will be to identify the most common causes of rehospitalizations and to evaluate how TM can assist in reducing those occurrences. If necessary, more detailed yes/no prompted questions regarding a specific area of concern will be added for further assessment. For high-risk CHF patients, the TM can assist with enhanced monitoring by requiring patients to submit the data twice a day instead of daily. Additionally, other long-term outcomes can be measured such as the length of stay, ER visits, and total costs.

Several areas will be assessed in determining the success of the practice change. The EBP team will monitor rehospitalization rates, and compare them to baseline statistics. Additionally, feedback on the use of TM via questionnaires will be obtained from the patients and the nursing staff involved in the pilot study.

Human Subjects Concerns

With every human subject study, safety and privacy are the highest priority. Therefore, all involved researchers will complete the Collaborative Institutional Training Initiative (CITI) course. This

certification must be achieved before receiving approval to conduct research by the Institutional Review Board. Another human subject concern to consider is the possibility that the patient may experience harm from not receiving a hands-on assessment from a registered nurse. As telemedicine is a fairly new technology, the subtleties of the disease process must be thoroughly assessed to detect early exacerbations and to reduce the likelihood of harm or rehospitalization. To address this concern, future studies may include an intervention that consists of using TM in combination with receiving usual care.

Budget

Implementation of the evidence-based project (EBP) project will accompany expenses such as new materials and record keeping systems. The budget will be strategically constructed and the expenses will be deducted from the allocated monies of the EBP fund and the continuing education fund offered by the facility incorporating the practice change. Due to budget limitations, the pilot study will only enroll patients who have Medicare as the primary insurance. At this time, telehealth services are only reimbursed by Medicare Claims Administration (CMS, 2012). Approximately, 50 patients are estimated to be enrolled in the pilot study. The total anticipated cost of the project is $16,629 (see *Appendix C, Table 1* for a detailed budget).

Although the upfront costs are significant, the cost of the practice change is justified for two reasons. First, according to three meta-analysis studies, using telehealth monitoring (TM) in the CHF population results in a 81% reduction in hospital costs from $1,240,506 to $229,929 over a six month period; a savings of over two million dollars a year (National Health Policy Institute, 2009). Additionally, TM reduces the need for intensive home health or institutionalized services, such as a 24-hour monitoring at a nursing home. The Veterans Health Affairs (VHA) estimated costs of home health and nursing home services for chronic disease patients is approximately $13,121 and $77,745 per patient per year, respectively; compared to annual costs of only $1,600 per patient for using TM services (Chumbler, Haggstrom, & Saleem, 2011). TM is not only cost effective, but also aids in improving quality of care measures. In addition, well-conducted meta-analysis studies on CHF patients have suggested that the use of TM decreases mortality rates and health care disparities by increasing access to care, which are three

overarching goals of *Healthy People 2020* (2010) (Clarke et al., 2010; Klersy et al., 2009; Polisena et al., 2010).

Appendix A

Table 1 Levels/Types of Evidence

Article #	(Clarke et al., 2011)	(Klersy et al., 2009)	(Polisena et al., 2010)	(Weintraub et al., 2010)
Level I: ***Systematic review or meta-analysis***	**X**	**X**	**X**	
Level II: ***Randomized controlled trial***				**X**
Level III: ***Controlled trial without randomization***				
Level IV: ***Case-control or cohort study***				
Level V: ***Systematic review of qualitative or descriptive studies***				
Level VI: ***Qualitative or descriptive study (includes evidence implementation projects)***				
Level VII: ***Expert opinion or consensus***				

(Melnyk&Fineout-Overholt, 2011).

In patients diagnosed with CHF (P), how effective is the implementation of telehealth monitoring (TM) in the home (I) compared to the visitation of home healthcare nurses (C) in the prevention of rehospitalizations (O) over a 6-month time

Table 2 Synthesis Table

	(Clarke et al., 2011)	**(Klersy et al., 2009)**	**(Polisena et al., 2010)**	**(Weintraub et al., 2010)**
Number of Hospitalizations (CHF Related)	TM patients ↓	TM patients ↓	TM patients ↓	TM patients ↓
Number of Hospitalizations (All Causes)	No Significant Difference	TM patients ↓	TM patients ↓	TM patients ↑
Mortality Rate	TM patients ↓	TM patients ↓	TM patients ↓	TM patients (a lower trend)
Number of Patients Hospitalized	N/A	N/A	TM patients ↓	N/A
Number of Emergency Department Visits	No Significant Difference	N/A	TM patients ↓	N/A
Bed Days of Care	No Significant Difference	N/A	TM patients ↓	TM patients ↓
Number of Outpatient Visits	N/A	N/A	TM patients ↑	N/A
Quality of Life	N/A	N/A	Inconclusive	N/A
Additional Supportive Information	*No Significant Difference in medication adherence or cost *Some of the samples were small *Usual care definition varied	*Usual care definition varied	*Potential bias related to lack of randomization in a few studies *Some of the samples were small *Usual care definition varied	*Higher rates of non-CHF related hospitalizations may be attributed to other chronic conditions
Level	1	1	1	2
Sample	3480 patients	6258 patients in RCTs 2354 patients in cohort studies	3082 patients	188 patients
Study Design	Systematic Review	Systematic Review	Systematic Review	Prospective, randomized control trial

Table 3

Rapid Critical Appraisal of Systematic Reviews of Clinical Interventions/Treatments

Article:	**(Clarke et al., 2011)**

1. Are the results of the review valid?

a.)	Are the studies contained in the review randomized controlled trials?	**YES**	NO	UNKNOWN
b.)	Does the review include a detailed description of the search strategy to find all relevant studies?	**YES**	NO	UNKNOWN
c.)	Does the review describe how validity of the individual studies was assessed (e.g., methodological quality, including the use of random assignment to study groups and complete follow-up of the subjects)?	**YES**	NO	UNKNOWN
d.)	Were the results consistent across studies?	**YES**	NO	UNKNOWN
e.)	Were individual patient data or aggregate data used in the analysis?	**YES**	NO	UNKNOWN

2. What were the results?

a.)	How large is the intervention or treatment effect (OR, RR, effect size, level of significance)?	i. Favoring TM use on all-cause mortality: CI 95% [0.77 (0.61-0.97)] ii. Favoring TM use on all-cause hospital admissions: CI 95% [0.99 (0.88-1.11)] iii. Favoring of TM use on CHF hospital admissions: CI 95% [0.73 (0.62-0.87)] iv. Favoring control or non-TM use on all-cause emergency visits: CI 95% [1.04 (0.86-1.26)]
b.)	How precise is the intervention or treatment (CI)?	

3. Will the results assist me in caring for my patients?

a.)	Are my patients similar to the ones included in the review?	**YES**	NO	UNKNOWN
b.)	Is it feasible to implement the findings in my practice setting?	**YES**	NO	UNKNOWN
c.)	Were all clinically important outcomes considered, including risks and benefits of the treatment?	**YES**	NO	UNKNOWN
d.)	What is my clinical assessment of the patient and are there any contraindications or circumstances that would inhibit me from implementing the treatment?	YES	**NO**	UNKNOWN
e.)	What are my patient's and his or her family's preferences and values about the treatment that is under consideration?	**YES**	NO	UNKNOWN

(Melnyk&Fineout-Overholt, 2005)

Table 4

Rapid Critical Appraisal of Systematic Reviews of Clinical Interventions/Treatments

Article:	**(Klersy et al., 2009)**

1. Are the results of the review valid?

a.)	Are the studies contained in the review randomized controlled trials?	**YES**	NO	UNKNOWN
b.)	Does the review include a detailed description of the search strategy to find all relevant studies?	**YES**	NO	UNKNOWN
c.)	Does the review describe how validity of the individual studies was assessed (e.g., methodological quality, including the use of random assignment to study groups and complete follow-up of the subjects)?	**YES**	NO	UNKNOWN
d.)	Were the results consistent across studies?	**YES**	NO	UNKNOWN
e.)	Were individual patient data or aggregate data used in the analysis?	**YES**	NO	UNKNOWN

2. What were the results?

a.)	How large is the intervention or treatment effect (OR, RR, effect size, level of significance)?	i. RCTs 1. Favoring TM use on all-cause mortality: CI 95% [0.83 (0.73-0.95)] 2. Favoring TM use on all-cause hospital admissions: CI 95% [0.96 (0.90-1.03)] 3. Favoring of TM use on CHF hospital admissions: CI 95% [0.72 (0.64-0.81)] ii. Cohort Studies 1. Favoring TM use on all-cause mortality: CI 95% [0.53 (0.29-0.96)] 2. Favoring TM use on all-cause hospital admissions: CI 95% [0.52 (0.28-0.96)]
b.)	How precise is the intervention or treatment (CI)?	

3. Will the results assist me in caring for my patients?

a.)	Are my patients similar to the ones included in the review?	**YES**	NO	UNKNOWN
b.)	Is it feasible to implement the findings in my practice setting?	**YES**	NO	UNKNOWN
c.)	Were all clinically important outcomes considered, including risks and benefits of the treatment?	**YES**	NO	UNKNOWN
d.)	What is my clinical assessment of the patient and are there any contraindications or circumstances that would inhibit me from implementing the treatment?	YES	**NO**	UNKNOWN
e.)	What are my patient's and his or her family's preferences and values about the treatment that is under consideration?	**YES**	NO	UNKNOWN

(Melnyk&Fineout-Overholt, 2005)

Table 5

Rapid Critical Appraisal of Systematic Reviews of Clinical Interventions/Treatments

Article:	**(Polisena et al., 2010)**

1. Are the results of the review valid?

a.)	Are the studies contained in the review randomized controlled trials?	***YES**	NO	UNKNOWN
b.)	Does the review include a detailed description of the search strategy to find all relevant studies?	**YES**	NO	UNKNOWN
c.)	Does the review describe how validity of the individual studies was assessed (e.g., methodological quality, including the use of random assignment to study groups and complete follow-up of the subjects)?	**YES**	NO	UNKNOWN
d.)	Were the results consistent across studies?	**YES**	NO	UNKNOWN
e.)	Were individual patient data or aggregate data used in the analysis?	**YES**	NO	UNKNOWN

2. What were the results?

a.)	How large is the intervention or treatment effect (OR, RR, effect size, level of significance)?	I. Favoring TM use on all-cause mortality: CI 95% [0.64 (0.48-0.85)] II. Favoring TM use on all-cause number of patients hospitalized: CI 95% [0.77 (0.65-0.90)] III. Favoring TM use on all-cause hospital admissions 1. From 2 pre-post studies: 0.46 vs. 1.54, measures of variation not reported & 0.65 vs. 1.29, measures of variation not reported 2. From 1 RCT: 0.19 vs. 0.20, measures of variation not reported 3. From 1 observational study: 0.05 vs. 0.15, measures of variation not reported IV. Favoring control or non- TM use on all-cause hospital admission 1. From 1 RCT: 0.95 vs. 0.81, measures of variation not reported 2. From 1 observation study: 0.46 vs. 0.10, measures of variation not reported V. Favoring use of TM on number of ED visits 1. From 7 studies: lower mean number of ED visits (mean not reported) 2. From 1 pre-post study: 0.17 vs. 0.63, measures of variation not reported 3. From 1 RCT on CHF-related ED visits: 0.1 vs. 0.7, measures of variation not reported VI. Favoring TM use on number of bed days (LOS) 1. From 2 observational studies: 1.21 vs. 1.97 & 2.11 vs. 3.93 2. From 2 pre-post studies: 2.19 vs. 8.08 & 1.65 vs. 8.63 3. From 2 RCTs on CHF-related LOS: 0.46 vs. 0.97 & 2.69 vs. 3.75 4. From 1 pre-post study on CHF-related LOS: 5.87 vs. 13.75 VII. Favoring use of TM on number of outpatient visits: 1. From 2 observational studies found lower mean number of outpatient visits in TM group vs. usual care (mean values not reported)
b.)	How precise is the intervention or treatment (CI)?	

		VIII. Favoring control or non-TM use on number of outpatient visits: 1. From 2 RCTs reported greater number of outpatient and home care visits in TM group vs. usual care (mean values not reported) IX. Favoring TM use on QOL 1. From 13 studies: increased QOL X. Favoring control or non-TM use on QOL 1. From 7 studies: no significant differences

3. Will the results assist me in caring for my patients?

a.)	Are my patients similar to the ones included in the review?	**YES**	NO	UNKNOWN
b.)	Is it feasible to implement the findings in my practice setting?	**YES**	NO	UNKNOWN
c.)	Were all clinically important outcomes considered, including risks and benefits of the treatment?	YES	**NO**	UNKNOWN
d.)	What is my clinical assessment of the patient and are there any contraindications or circumstances that would inhibit me from implementing the treatment?	YES	**NO**	UNKNOWN
e.)	What are my patient's and his or her family's preferences and values about the treatment that is under consideration?	**YES**	NO	UNKNOWN

* With the exception of a few of the studies
(Melnyk&Fineout-Overholt, 2005)

Table 6

Rapid Critical Appraisal of Randomized Clinical Trials (RCTs)

Article:	(**Weintraub et al., 2010)**

1. Are the results of the study valid?

a.)	Were the subjects randomly assigned to the experimental and control groups?	**YES**	NO	UNKNOWN
b.)	Was random assignment concealed from the individuals who were first enrolling subjects into the study?	**YES**	NO	UNKNOWN
c.)	Were the subjects and providers blind to the study group?	**YES**	NO	UNKNOWN
d.)	Were reasons given to explain why subjects did not complete the study?	**YES**	NO	UNKNOWN
e.)	Were the follow- up assessments conducted long enough to fully study the effects of the intervention?	**YES**	NO	UNKNOWN
f.)	Were the subjects analyzed into the group to which they were randomly assigned?	**YES**	NO	UNKNOWN
g.)	Was the control group appropriate?	**YES**	NO	UNKNOWN
h.)	Were the instruments used to measure the outcomes valid and reliable?	**YES**	NO	UNKNOWN
i.)	Were the subjects in each of the groups similar on demographic and baseline clinical variables?	**YES**	NO	UNKNOWN

2. What are the results?

a.)	How large is the intervention or treatment effect?	i Favoring the use of TM on CHF related hospitalization: CHF patients had 50% less CHF related admissions in the intervention group compared to the control CI 95% [0.50 (0.25-0.99), p=0.05] Favoring the use of TM on HF inpatient days: Intervention group was CI 95%[4.73(0.19-117.3)] compared with CI 95%[11.86(0.36-396.0)] in the control group ii A trend of reduced mortality was seen in the intervention group [1.1%] when compared to the control group (4.3%) (p=.209) iii Favoring the use of TM on HF inpatient days: intervention group was CI 95% [4.73 (0.19-117.3)] compared with CI 95% [11.86 (0.36-396.0)] in the control group.
b.)	How precise is the intervention or treatment (CI)?	

3. Will the results assist me in caring for my patients?

a.)	Were all clinically important outcomes measured?	**YES**	NO	UNKNOWN
b.)	What are the risks and benefits of this treatment?	Benefits include decreased CHF related hospitalizations, decreased length of stay in the hospital, and reduced trend in mortality. Risks were not identified although there may be an adaptation period or learning curve for some patients depending on their comfort level		

		with technology. Detailed cost analysis needs to be explored further.		
c.)	Is the treatment feasible in my clinical setting?	**YES**	NO	UNKNOWN
d.)	What are my patients/family's values and expectations for the outcome that is trying to be prevented and the treatment itself?	Most patients understand that they have a chronic disease and desire interventions that will help to slow their disease progression, keep them from being cared for in the hospital, and increase their quality of life. An intervention such as TM, tailored toward to the patient's lifestyle, is promising for the future of heart failure.		

(Melnyk&Fineout-Overholt, 2005)

Table 7 Grid

Clarke, M., Shah, A., & Sharma, U. (2011). Systematic review of studies on telemonitoring of patients with congestive heart failure: a meta-analysis. *Journal of Telemedicine and Telecare*, *17*, 7-14.

Author/ **Conceptual Framework**	**Design/Method**	**Sample/Setting**	**Major Variables Studied**	**Measurement**	**Data Analysis**	**Findings**	**Appraisal: Worth to Practice**
(Clarke et al., 2011) None	Systematic ROL . To evaluate the effectiveness of TM on patients with CHF Databases searched include Medline, Cinhal, British Nursing Index, ACM, Scopus, Safari, HMIC, IEEE and Springerlink Search terms/key words included: congestive heart failure OR heart failure AND tele* OR remote patient monitoring OR homecare management Search was modified to find randomized control trials Dates queried include January 1969 and	13 publications used for meta-analysis out of 125 resulted articles from initial search Studies included 3480 patients. The follow-up period of the studies was 3–15 months 10 studies used physiological parameters such as body weight, heart rate, blood pressure and an electrocardiogram (ECG). In two of these studies, only daily body weight was transmitted but the patient also gave answers to simple questions regarding their HF symptoms,	IV1: Use of TM DV1: Number of CHF hospitalizations DV2: Number of all cause hospitalizations DV3: Mortality Rate DV4: Number of ED visits DV5: Bed Days	Mortality (10 studies) and hospital admission (6 studies) were the most common primary outcomes measured Secondary outcomes such as QOL, cost, adherence behavior and visits to other health providers were also measured in some studies 10 studies reported mortality as the primary outcome (5 of these reported significant	Meta-analysis was performed using the RevMan 5 statistical package (Review Manager Version 5) from the Cochrane library Cochrane's test was used for statistical heterogeneity Publication biases was assessed by means of funnel plots Variables were expressed as	Overall reduction in all-cause mortality (P ¼ 0.02) No overall reduction in all-cause hospital admission (P ¼ 0.84), although there was a reduction in CHF hospital admission (P ¼ 0.0004). No reduction in all-cause emergency admission (P ¼ 0.67) TM in conjunction with nurse home visiting and specialist unit support can be effective in the clinical	**Weaknesses:** Several studies were very small with a sample size of less than 50 patients The definition of care and usual care varied significantly which makes data more difficult to analyze Usual care in the control arm differed. For example, usual care varied from routine home visits being conducted by primary care doctors, with telephone

	October 2009, and searches were conducted between December 2008 and October 2009 TM defined as equipment being installed in the patient's home and requires some form of communication. In most studies, a telephone connection was used. In some studies broadband was used for the communication and this was also employed for a video link	such as ease of breathing. Data was transmitted to a remote center in which a health care professional was responsible for any needed follow-up Inclusion criteria included: studies that were randomized controlled trials that included an intervention and control arm; control arm had a clear definition of usual care; CHF population, trials had at least 50 patients Exclusion criteria included: studies that gave no specific description of the care provided to patients in the control arm; only telephone support was used for follow-up, that is, no TM equipment	of Care	reductions in mortality) and were large studies that had Funnel plots did not indicate bias, 6 studies reported all-cause hospital admissions as the primary outcome 7 studies provided the number of emergency visits as a secondary outcome 9 studies evaluated the effect of intervention on length of stay in hospital due to exacerbated CHF event and/or any cause hospitalization among the patients in studies	risk ratios (RR) with 95% CI	management of CHF patients and help to improve their QOL No significant difference in length of stay in hospital, medication adherence or cost Favoring TM use on all-cause mortality: CI 95% [0.77(0.61-0.97)] Favoring the TM use on all cause hospital admissions: CI 95% [0.99(0.88-1.11)] Favoring the TM use of CHF admissions: CI 95% [0.73(0.62-0.87)] Favoring control or non-TM use on all-cause ED visits: CI 95% [1.04 (0.86-1.26)]	support available by nurses during office hours or home visits with a specialty trained nurse nurses Intervention was not the same in all studies, with differences in the type of monitoring **Strengths:** MOTIVA system (M Clarke et al)was identified as the most advanced TM system as it collected vital sign readings and sent them trans-telephonically, and also displayed medication reminders, motivational messages, health-related surveys and educational messages via the

		was used; and patients that were not monitored at home					patient's TV screen **Conclusion:** Patients lived longer, with a reduced amount of time in hospital and an improved quality of life with TM modalities **Feasibility:** TM should be explored as data suggests beneficial outcomes for CHF patients

Klersy, C., De Silvestri, A., Gabutti, G., Regoli, F., &Auricchio, A. (2009, October 27). A meta-analysis of remote monitoring of heart failure patients. *Journal of the American College of Cardiology*, *54*(18), 1683-1694.

Author/ **Conceptual Framework**	**Design/Method**	**Sample/Setting**	**Major Variables Studied**	**Measurement**	**Data Analysis**	**Findings**	**Appraisal: Worth to Practice**
(Klersy et al., 2009) None	Systematic ROL Purpose: To assess the effect of remote patient monitoring (RPM) on the outcome of CHF patients Searched articles were from January 2000 and October 2008 Bibliographic search utilized The National Guideline Clearinghouse, PubMed, EMBASE, CINAHL, and the Cochrane Library Key words/search terms were "Heart Failure "AND "Telemedicine" OR ("heart failure" AND "remote patient monitoring" Modifiers included the inclusion of full-text articles in peer reviewed in which at least 2 treatment	253 abstracts were retrieved; however, 56 studies were excluded because they were duplicated 197 abstracts were resulted and reviewed; 20 of these were RCTs and the remainder were cohort studies 6,258 patients and 2,354 patients were included in RCTs and cohort studies	IV1: Use of TM DV1: Number of hospitalizations DV2: Number of all cause hospitalizations DV3: Mortality Rate	Data that was extracted included: type of study (multicenter or single center), total number of patients , number of arms/periods, mean duration of follow-up, age, sex, New York Heart Association functional class, and left ventricular ejection fraction of included patients For each arm, person-years of follow-up, and the modality of care were measured Other outcomes that were measured include death from any	Three different approaches of care were identified: 1) a usual care approach, which referred to in-person visits at the doctor's office, clinic, or at ED without additional phone calls to and from the patient; 2) phone monitoring approach including scheduled structured phone interaction with the health care professional (with or without home visits) and reporting of symptoms and/or physiological data; and 3) a technology-assisted monitoring approach relying on information	Median follow-up duration was 6 months for RCTs and 12 months for cohort studies. **RCTS:** Favoring the use of TM on all-cause mortality: CI 95% [0.83(0.73-0.95)] Favoring TM use on all cause hospital admissions: CI 95% [0.96 (0.90-1.03)] Favoring of TM use on CHF hospital admissions: CI 95%	**Weaknesses:** Significant variances in monitoring parameters and mode of monitoring Significant organizational and procedural variances as to how to organize the response of the health care professionals to data obtained from the RPM monitoring devices **Strengths:** Large number of meta-analyzed patients Statistical measurements are more advanced when in

	arms were evaluated, RCTs or observational cohort studies Articles could be written in English, Spanish, German, French, or Italian			cause, first hospitalization for any cause and first hospitalization for CHF The quality of the study was rated based on adherence to the CONSORT and STROBE statements and graded on a 0 to 10 visual analog scale	communication technology, with transfer of physiological data (Both 2 and 3 classified as RPM Frequency comparisons of the cumulative incidence of events (number of patients with events/total number of patients per arm) between the usual care approach and RPM strategies for measured outcomes The relative risk (RR) and 95% confidence interval (CI) for each outcome in each study were calculated. Study RRs were pooled according to the Mantel-Haenszel fixed effects method.	[0.72(0.64-0.81)] **Cohort Studies:** Favoring the use on all-cause mortality: CI 95% [0.53 (0.29-0.96)] Favoring TM use on all cause-hospital admissions: CI 95% [0.52 (0.28-0.96)]	comparison to some of the other ROL Data is conclusive in the support of home TM modalities **Conclusion:** Both RCTs and cohort studies showed that RPM was associated with a significantly lower number of deaths **Feasibility:** TM is reasonable to pursue, especially given that costs associated with hospitalizations and is decreased with implementation

					To account for differences among studies, DerSimonian and Laird random effect models were used Statistical heterogeneity was evaluated by the Cochran Q test and measured by the I2 statistic		

Polisena, J., Tran, K., Cimon, K., Hutton, B., McGill, S., Palmer, K., & Scott, R. E. (2010). Home telemonitoring for congestive heart failure: a systematic review and meta-analysis. *Journal of Telemedicine and Telecare*, *16*(2), 68-76.

Author/ **Conceptual Framework**	**Design/Method**	**Sample/Setting**	**Major Variables Studied**	**Measurement**	**Data** **Analysis**	**Findings**	**Appraisal: Worth to Practice**
(Polisena et al., 2010) None	Systematic review of literature (ROL) Purpose: To review studies that examine the clinical outcomes, patient quality of life (QOL) and the use of health-care services for home tele health monitoring (TM)compared with those of usual care Usual care included patients who had follow-up by a primary care physician or specialist	6236 total citations resulted. From these, 21 studies (3082 patients) were included in the review. Exclusion criterion included inappropriate study design, intervention, comparator, outcome and/or inappropriate patient population. Of the 21 studies, 11 RCT, 4 Pre-post studies, 6 Prospective Cohort Studies	IV1: Use of TM DV1:: Mortality DV2: QOL DV3: Bed days of care	Quality of the studies was assessed using a modified version of a tool developed by Hailey et al. Using the Quality Assessment, 3 of the 17 articles were classified as high quality, 4 were rated good quality, 4 were rated fair to good quality, 5 were	Random effects model was used to compute treatment efficacy to measure the average effect of the intervention across all studies Statistical analysis (STATA8.2) was used to analyze data 95% confidence intervals (CIs) were also calculated to show the reliability	Favoring TM use on all-cause mortality: CI 95% [0.64(0.48-0.85)] Favoring TM use on all-cause number of patients hospitalized: CI 95% [0.77(0.65-0.90)] Favoring TM use on all-	**Weaknesses:** Only 7 of the 21 articles that were examined were either good or high quality There were significant variances between the groups related to the number of emergency department visits Data showed that home TM was associated with

	after patient discharge from hospital Medline, Medline Daily Update, Medline In-Process and Other Non-Indexed Citations, BIOSIS Previews, EMBASE, CINAHL and PsycINFO, PubMed, the Cochrane Library, and the Centre for Reviews and Dissemination (CRD) include the databases searched Key words/search terms: [telehealth or telemedicine or telecare or telemonitor*] and [home* or in-home* or residen*] and [congestive heart failure or CHF].	17 of the 21 studies were focused on the purpose in comparing home TM with usual care (8 RCTs, 9 Observational) 4 of out of the 11 RCTs had 3 comparative indicators including home TM telephone support and usual care	DV4: Visits to the emergency department (ED) visits DV5: Visits to the primary care or specialist visits	rated poor to fair quality and 1 was rated poor quality 3 RCTs with 3 comparator arms were rated good quality and 1 was poor to fair quality QOL reported using various instruments such as the Minnesota Living With Heart Failure Questionnaire, SF-12,Health Survey, and Barnason Efficacy Expectation Scale-	of the summary estimate Count data such as the number of hospitalizations were summarized using rate ratios to measure the number of events per patient and to account for varying follow-up lengths Dichotomous data such as mortality status, hospitalizations or emergency department visits were summarized using risk ratios	cause hospital admissions *From 2 pre-post studies: 0.46 vs. 1.54, measures of variation not reported & 0.65 vs. 1.29, measures of variation not reported *From 1 RCT: 0.19 vs. 0.20, measures of variation not reported Favoring control or non-TM use on all-cause hospital	increased primary care visits but does not give cause of visits Instruments used to assess QOL, were extremely varied, more continuity may be beneficial for future studies Subjects in some of the observational studies were assigned to an intervention group by a physician instead of a randomized process which increases the risk of bias Variances among

	Articles searched were from 1998-2008 No language restrictions during search					admission *From 1 RCT: 0.95 vs. 0.81, measures of variation not reported * From 1 observation study: 0.46 vs. 0.10, measures of variation not reported Favoring the use of TM on number of ED visits: * From 7 studies: lower mean number of ED visits (mean not reported) * From 1 pre-	the types of TM systems was not discussed **Strengths:** Relationship was demonstrated between the use of TM and lower incidences of mortality and hospitalizations Clinical heterogeneity was present in the assessment of many outcomes of interest **Conclusion:** The evidence suggests that home TM may provide better clinical outcomes

						post study: 0.17 vs. 0.63, measures of variation not reported *From 1 RCT on CHF-related ED visits: 0.1 vs. 0.7, measure of variation not reported Favoring TM use on number of bed days (LOS) * From 2 observational studies: 1.21vs 1.97 & 2.11 vs3.93 *From 2 pre-post studies 2.19 vs. 8.08	for patients with CHF compared with usual care specifically with decreasing the number of hospitalizations and decreasing mortality rates in CHF patients **Feasibility:** TM is reasonable to pursue, especially given that costs associated with hospitalizations is decreased with implementation Types of TM need to be explored further

						& 1.65 vs. 8.63 *From 2 RCTs on CHF- related LOS: 0.46 vs. 0.97 & 2.69 vs. 3.75 * From 1 pre-post study on CHF related LOS: 5.87 vs. 13.75 Favoring use of TM on number of outpatient visits: *From 2 observational studies found lower mean number of outpatient visits in TM group vs. usual care	

						(mean values not reported) Favoring control or non- TM use on number of outpatient visits: *From 2 RCTs reported greater number of outpatient and home care visits in TM group vs. usual care (mean values not reported) Favoring TM use on QOL: *From 13 studies: increased	

						QOL Favoring control or non-TM use on QOL * From 7 studies: no significant differences	

Weintraub, A., Gregory, D., Patel, A. R., Levine, D., Venesy, D., Perry, K., Konstam, M. A. (2010). A multicenter randomized controlled evaluation of automated home monitoring and telephonic disease management in patients recently hospitalized for congestive heart failure: the SPAN-CHF II trial. *Journal of Cardiac Failure*, *16*(4), 285-292

Author/Conceptual Framework	**Design/Method**	**Sample/Setting**	**Major Variables Studied**	**Measurement**	**Data Analysis**	**Findings**
(Weintraub et al., 2010) None	Prospective, randomized control trial Purpose: Assess the impact if an automated home health monitoring (AHM) intervention Body weight, blood pressure, heart rate, & subjective reports transmitted by AHM Baseline data such as the presence of heart disease, diabetes, current ejection fraction, and prescribed heart failure medications, was gathered	Inclusion criteria included patients who has been hospitalized within the prior 2 weeks Exclusion criteria included a comorbidity other than CHF that was identified as the primary cause for decreased life expectancy or disability; acute myocardial infarction during the hospitalization or 30 days prior to admission; angina not responsive to medical treatment; invasive cardiac procedures such as open heart surgery or cardiac stenting while being hospitalized, 30 days prior to enrollment, or planned within 90 days after that start of the study; inability to independently stand to obtain weight; and absence of a working land line 188 patients randomized to either group (95 intervention group; 93 Control Group) Subjects were followed at 4 sites for at least 90 days	IV1: Use of AHM DV1: Number of CHF related hospitalizations DV2: All- cause hospitalization rates DV3: All- cause mortality rates	Compliance with heart failure medication was assessed Quality of Life was assessed using the Minnesota Living with Heart Failure Questionnaire	Descriptive statistics were used to describe baseline data between the two groups T-tests were used to compare continuous variables Chi-Square tests measured discrete variables Poisson regression equations used to compare the number of CHF hospitalizations between groups	Favoring the use of TM on CHF related hospitalization: CHF patients had 50% less CHF related admissions in the intervention group compared to the control CI 95%[0.50 (0.25-0.99), p=0.05] Favoring the use of control or non-TM on all-cause hospitalizat

	Randomized control group received the nurse directed Specialized Primary and Networked Care in Heart Failure (SPAN-CHF) program and the randomized intervention group received SPAN-CHF in conjunction with AHM Nurse managers collected data via telephone at Day 45 and 90 Cardiologist was blinded to intervention and control group	.				ions: There were approximately 24% higher for the intervention group CI 95% [0.92 (0.33-2.57)] when compared to the control group CI 95%[0.74 (0.29-1.89)] Favoring the use of TM on HF inpatient days: Intervention group was CI 95%[4.73(0.19-117.3)] compared with CI 95%[11.86(0.36-396.0)] in

						the control group A trend of reduced mortality was seen in the intervention group (1.1%) when compared to the control group (4.3%) (p=0.209). Favoring the use of TM on HF inpatient days: the intervention group was CI 95% [4.73 (0.19-117.3)] compared with CI 95% [11.86(0.36-396)] in

						the control group. Patients taking either an ACE inhibitor or angiotensin receptor blocker had 70% fewer rehospitalizations than patients who were not taking the medications CI 95% [0.29 (0.14-0.57), p<0.01]

Appendix B

Figure 1. Gantt Chart/Timeline 2013-2014.

Project Timeline

Implementation	June	July	August	September	October	November	December	January
Presentation to Management	June 1							
Formal Document Submitted	June 15							
Literature Distribution	June 15							
In-Service Education		1-14						
Pilot Unit Implementation		July 15, 2013: Pilot Start Date →						January 15, 2014: Pilot End Date
Facility Implementation								January 31, 2014: Facility Implementation
Evaluation		Ongoing From July 15, 2013 →						

Time

Appendix C

Table 1. Proposed Budget for Implementing Telehealth in Homecare Practice.

Category	Reason	Total Cost
Personnel	1. 4 RNs (researchers): Income paid from field staff budget = **$0** 2. 2 telehealth RNs: Care covered under Medicare reimbursement = **$0** 3. 1 NP from heart clinic (program mentor): Consulting fee $80/hr. x 10 hrs. = **$800** 4. 1 PT present during the initial project meeting to give feedback (3 hours): Covered under continuing education fund- **$0** 5. 1 OT present during the initial project meeting to give feedback (3 hours): Covered under continuing education fund - **$0** 6. 1 Dietician present during the initial project meeting to give feedback (3 hours): Covered under continuing education fund -**$0**	**$800**
New Materials	1. TM devices, cables, and equipment: $300 x 50 units: **$15,000** 2. Easy 1-2-3 instruction manual for TM: **$0** (included with TM device) 3. New practice change update with literature distribution to facility staff/patients: **$0** (included in the supplies budget of the agency)	**$15,000**
New Record Keeping Systems	1. Central surveillance station/computer: **$ 500** 2. 3 computers: **$0** (available on-site) 3. Statistical programs: SPSS 20 - **$79**	**$579**
Training	1. In-service education on use of TM to staff: **$0** (complimentary service provided by HomeMed Inc.) 2. Education on use of TM to patients/families by a RN (1 hour per patient): Care covered under Medicare reimbursement= **$0**	**$0**
Travel	One-way mileage reimbursement for RNs who make a homecare visit on an as-needed basis: 500 miles x $0.50 per mile = **$250**	**$250**
TOTAL		**$16, 629**

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