Use of Smartphone Applications in the Reduction of Hospital Readmissions of Heart Failure Patients in Short Term Acute Care Facilities

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Abstract

Prevention of unnecessary hospital readmission of patients diagnosed with congestive heart failure has become a concerning topic for many healthcare institutions. Several strategies and various programs have been implemented in hospitals across the U.S. to reduce the readmission rates, including outpatient focused strategies, and inpatient and transition care-focused strategies. This proposal describes how technology, specifically use of smart apps and wireless sensors, can be used to reduce hospital readmission rates, by delivering real-time data to dedicated heart failure management teams so early interventions can be taken to prevent costly, unnecessary hospital admissions.
Statement of the Problem

In the new era of Obama Care, reducing hospital readmission rates has become a national priority. Approximately 20% of Medicare beneficiaries are readmitted within 30 days of discharge and have been estimated to cost the American public over $17 billion annually (Kim, 2013). In response to these stipulations, many strategies and programs have been developed and tested to help hospitals reduce 30 day readmission rates.

There are more than 5 million Americans that have heart failure (HF), with 10 per 1,000 new cases reported each year after the age of 65 (Kim, 2013). According to the Centers for Disease Control and Prevention Statistics, congestive heart failure or CHF is the leading cause of death in the United States, killing over 280,000 people in 2006 alone. Approximately 670,000 people in the U.S. are diagnosed with CHF every year, the costs associated with this disease is approximately $29 billion in annual medical expenses. Readmission of patients with heart failure is common and approximately 50% of HF patients are re-hospitalized within 6 months of discharge (2013). Over 1 million people are admitted to an inpatient setting for HF and 27% of HF patients on Medicare are readmitted within 30 days (Hines, 2010). HF is the most frequent reason for re-hospitalization and reduction of these unnecessary admissions could lead to significant cost savings (2010).

The Patient Protection Affordable Care Act has created new incentives to reduce readmissions, and hospitals with high readmissions rates can lose approximately 3% of their Medicare reimbursement by 2015. The Centers for Medicare and Medicaid Services or CMS will decrease reimbursement and possibly add penalties for patients who require readmission for any cause within 30 days of initially being admitted for heart failure (Kim, 2013). As a result of the new stipulations enforced by the Affordable Care act, many institutions have been and are
continuing to seek ways to reduce their readmissions. Some strategies already being utilized include proper transitions home, multidisciplinary follow-up, home health, transitional care model, Care transitions, remote monitoring and palliative care programs (Hines, 2010). Another strategy is a complete paradigm shift where the view of readmission transforms from a biological, hospital-based event to a “sociobiological” process. This model helps to reconcile how both patient and provider/health system factors relate with one another through the post discharge environment. This increased stability in the post discharge environment can positively affect factors related to readmission (Hersh, 2013).

In order to successfully implement strategies and programs for this cohort, identifying those patients who are more likely to be readmitted within 30 days post discharge is crucial. According to Au et al, several models have been analyzed and compared that attempt to predict post-discharge readmission/ death risk in HF patients. The risk prediction models were reviewed including Charlson model, CMS-endorsed models and the LACE/LaCE index. The results were that LACE and LaCE demonstrated only moderate discrimination for predicting 30 day unplanned readmission or death, but were significantly better able to predict the composite of death or unplanned readmissions within 30 days of discharge (Au et al, 2012). Therefore the 4 component LACE (L – length of stay, A – acuity of admission, C- comorbidity of patient and E – ED utilization) and LACE+ which includes other variables such as age will be used as part of the study.

In this fast-paced, technologically savvy, wireless and computer centered world, incorporation of smartphone apps in healthcare is now common and widespread. According to an article in InformationWeek, “wireless health technologies, including pervasive sensors and wireless communications, can potentially help CHF patients through daily monitoring along with
guidance and feedback.” Patients can measure their weight, blood pressure, activity and other health related measurements by using wireless health applications whenever and wherever they need to. A wireless health system gives real-time and computer-based analysis, reducing the need for specialized visits which can prevent emergency situations and alerts caregivers when they must help patients. (Versel, 2011).

In another article, a developer for Futura mHealth, a Philadelphia-based joint venture from Futura Mobility and HE Healthcare Solutions, has created an app that has patients fill out an eight question survey daily and sends the information back to their provider who then assesses their likelihood of a COPD exacerbation. The developer says this app called SmartScope designed for COPD could potentially cut admissions by 40 percent and that this technology could be adapted for other conditions such as CHF and diabetes (Comstock, 2013).

In a large six-month clinical trial, patients with HF were equipped with a wireless sensor developed by CardioMEMS. Patients equipped with this wireless technology took medication instructions from physicians who monitored the sensor data and the control group relied on traditional indicators including blood pressure and weight. The HF patients utilizing wireless technology experienced 39% fewer hospitalizations than the control (Chu, 2011).

In the last few years, a new app called Pam+ which stands for patient advisory module, has been developed by researchers at the University of Southern California with St. Jude Medical (Singer, 2011). This app works with an external device that is placed over the heart and downloads data from a small implantable device located in the pulmonary artery. This information is then sent to a server at St. Jude, analyzed and returns information via the app with the latest readings and ongoing trends (2011). This data is shared with healthcare providers and other stakeholders. The hope is that patients can better manage their health and reduce
hospitalizations which are responsible for almost $40 million in health-care costs directly linked to heart failure (2011).

**Goals/Objectives**

The goals or objectives of this study include utilization of smart application(s) in the reduction of hospital readmission rates of Medicare recipient patients with CHF, to educate patients about the use of smartphone apps in managing CHF, and to increase perceived QOL for CHF patients using smartphone apps.

- The readmission rates of the experimental group will be 50% less than that of the control group.
- Experimental group members will score higher on their satisfaction surveys than the control group. Patients using the application along with standard protocol follow up care post discharge will report a greater sense of control in self-management and increased quality of life.
- Interval estimates for interventional arm will be lower than the average National Readmission rate set forth by CMS.

**Methods**

To implement this project, the design utilized will be a randomized clinical trial conducted at John Sealy Hospital, Cardiology Unit at the University of Texas Medical Branch in Galveston, TX. Patients whose diagnosis is CHF exacerbation will be screened for inclusion of the study. A control group and intervention group will be followed for a period of 30 days post discharge. A study by Arbaje et al supports that certain factors contribute to early hospital readmission. These include the following factors: being unmarried, living alone, lacking “self-
management” skills, and having an unmet activity of daily living and lower level of education. LACE index will also be utilized for inclusion and exclusion.

Variables significantly associated with readmission included lack of cardiology consult during admission, living status, point of entry of index admission, receiving Medicare, and having pulmonary hypertension (Hamner, 2005). Therefore, inclusion criteria are as follows:

- Medicare recipients (Medicare as primary insurance)
- Diagnosis of congestive heart failure
- Ages between 65yrs and 75 years
- Cognitively intact
- Currently admitted to hospital for CHF exacerbation as primary problem
- Education level – some college, high school graduate or below
- Ability to use smart phone application
- Living alone or single

Exclusion criteria include:

- TDCJ inmate, prisoner or
- Diagnosed with dementia or with limited cognitive abilities
- Major medical insurance as primary insurance
- 24/7 caregiver
- Age less than 65 years or greater than 75 years of age
- Patients discharged to LTAC facilities or hospice care

The control group will receive standard of care for discharge per CHF protocol. Intervention group will be given protocol plus classes, smartphone, and wi-fi access or dedicated data plan service through ATT. All members of the interventional arm will receive the Smart
Bandage, an adhesive patch containing an array of sensors that measure vital signs including blood pressure, oxygen saturations, heart rate and rhythm, weight changes, etc. The wireless transmitters in the bandage send readings to the smartphone app creating a “body-area network” that continuously monitors those patients at high risk for hospitalization (Versel, 2011). A dedicated CHF team will be assembled including a medical assistant, registered nurse, nurse practitioner, respiratory therapist and cardiologist to provide transitional and episodic care. The groups will be randomized. For 30 days following discharge, all patients in intervention group will “check-in” daily via smart phone application that will measure blood pressure, oxygen saturation, weight and subjective symptoms. Data will be analyzed and RNs will assess the likelihood of exacerbation. Cardiologist will be notified of potential readmission cases and RN and NP will visit the patients and per MD protocol will provide care in the home as predetermined by the heart failure team.

**Evaluation/Outcome Measures**

To evaluate the impact of this intervention, 3 measurements will be calculated. First, the percentage of control group readmissions will be measured and compared to the percentage of interventional group readmissions. Data for each individual patient in both arms will be analyzed from date of admission to 30 days post discharge. The hospital’s interval estimate will be computed and compared to the U.S. national 30-day readmission rate. If this estimate includes and/or overlaps with the national observed readmission rate, the hospital’s performance is considered the “No Different than U.S. National Rate” category. If it is below the national observed readmission rate, then the facility is considered performing “Better than U.S. National Rate.” If the entire interval estimate is above the national observed mortality or readmission rate, its performance is “Worse than U.S. National Rate.” (Hospital Compare).
Quality of Life will be measured using the MLHFQ (Minnesota Living With Heart Failure Questionnaire) which is designed to measure the effects of heart failure and its treatments on an individual’s quality of life. This measures the effects of symptoms, functional limitations, and psychological distress on an individual’s quality of life and consists of questions that assess the impact of frequent physical symptoms, the effects of heart failure on physical/social functions, and side effects of treatments, hospital stays, and costs of care. Both control and interventional groups will take the survey during hospitalization and 30 days post discharge and compared.

**Timeline**

The duration of this project will be 12 months. Projected timeline is as follows:

*Month 1–3*

- Recruitment of dedicated heart failure management team including: cardiologist, acute care nurse practitioner with over 2 years of experience in management of CHF, RN with certification in cardiology, respiratory therapist, medical assistant and computer specialist for data management support.
- Securing equipment and other services including smartphones, smart band aids, routers, office supplies, medical supplies.
- Training courses for medical staff related to use of smart app and software program.
- Recruitment of individuals dx with CHF that are eligible to participate in study.

*Month 4–6*

- Continued recruitment of patients for study.
- Continued collection of data from both control and experimental groups.
- Maintain regular appointments per protocol for both control and experimental groups.
- Bi-weekly checks on patients in experimental group.
Month 6-12

- Analysis of collected data.
- Continue with care per protocol for both groups.
- Administer satisfaction surveys and prepare outcomes presentation.

Budget – Start-up and Long term costs

In order to jump start the project, funding is needed for all phases of implementation of the healthcare intervention. The following is a table providing estimates of the costs of the different categories of components. These include hardware, software, man-hours or salaries, office and medical supplies and miscellaneous costs. AT&T cellular phone company has a contract with the University of Texas Medical Branch which should help to decrease costs of hardware. Office and medical supplies will be billed per patient.

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Amount ($)</th>
</tr>
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<tbody>
<tr>
<td>Android based Refurbished smartphones (8GB)</td>
<td>50 X $100</td>
<td>5,000</td>
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<tr>
<td>Vital stats smartphone application</td>
<td>50 (free app)</td>
<td>0</td>
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<tr>
<td>Data plan service – monthly X 6 mos</td>
<td>20 X $20</td>
<td>400</td>
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<tr>
<td>Man hours (staff including medical assistant, RN, NP, RT, data analyst, computer tech and MD)</td>
<td>7 X $1000</td>
<td>Regular pay per institution w/bonus incentives 18,000</td>
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<tr>
<td>Office supplies (pen, log book, assessment forms, etc)</td>
<td>n/a</td>
<td>500</td>
</tr>
<tr>
<td>Medical supplies</td>
<td>To be determined</td>
<td>10,000</td>
</tr>
<tr>
<td>(IV tubing, toilet hat, Foley catheters, prep trays, IV trays, surgical tape, scales, etc)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tablet computers refurbished</td>
<td>3X $300</td>
<td>900</td>
</tr>
<tr>
<td>Sensors (smart band aids)</td>
<td>20 X 500</td>
<td>10,000</td>
</tr>
<tr>
<td>Miscellaneous or unforeseen costs</td>
<td></td>
<td>500</td>
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<tr>
<td>START UP TOTAL</td>
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<td>Estimated Long-term costs</td>
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<tr>
<td>TOTAL COST (12 months)</td>
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<td>85,300</td>
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The total funding requested is $43K. Every effort will be made to reduce costs by hosting a campaign soliciting for donations and building partnerships with businesses with resources necessary to carry out the study.

**Summary**

Utilization of wireless technology via smartphone applications in the management of heart failure to reduce hospitalization readmissions is promising. The proposed intervention within a Care Transitions Intervention Model with remote real time monitoring has the potential to cut readmissions rate, actively engage patients in self-monitoring and increase quality of life by limiting unnecessary admissions. As with management of any chronic illness, this proposed intervention is one of many strategies available that should be used in the context of a multi-disciplinary approach.
References


