

Pilot Randomized Controlled Trial to Reduce Readmission for Heart Failure Using Novel Tablet and Nurse Practitioner Education

Running Title: Heart Failure Education

Khadijah Breathett, MD, MS; Scott Maffett, MD; Randi E. Foraker, PhD; Rod Sturdivant, PhD; Kristina Moon, DO; Ayesha Hasan, MD; Veronica Franco, MD; Sakima Smith, MD, MPH; Brent C. Lampert, DO; Sitaramesh Emani, MD; Garrie Haas, MD; Rami Kahwash, MD; Ray E. Hershberger, MD; Philip F. Binkley, MD, MPH; Laura Helmkamp, MS; Kathryn Colborn, PhD; Pamela N. Peterson, MD, MSPH; Nancy Sweitzer, MD, PhD; William T. Abraham, MD

From the Division of Cardiovascular Medicine, Sarver Heart Center, University of Arizona, Tucson, AZ (K.B., N.S.); Division of Cardiovascular Medicine, Ohio State University Wexner Medical Center, Columbus, OH (S.M., A.H., V.F., S.S., B.C.L., S.E., G.H., R.K., R.E.H., P.F.B., W.T.A.); Institute for Informatics, Washington University in St. Louis School of Medicine, St. Louis, MO (R.E.F); Division of Biostatistics, Azusa Pacific University, Azusa, CA (R.S.); Division of Cardiology, University of Wisconsin, Madison, WI (K.M.); University of Colorado Adult and Child Consortium for Health Outcomes Research and Delivery Science, Aurora, CO, United States (L.H., K.C.); Division of Cardiology, University of Colorado and Denver Health Medical Center, Denver, CO (P.N.P.).

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Background: Heart failure education programs are not standardized. The best form of education is unclear. We evaluated whether addition of a novel tablet application to nurse practitioner (NP) education was superior to NP education alone in reducing 30-day readmission after heart failure hospitalization.

Methods: From 2/2015-3/2016, patients admitted to a quaternary academic center with primary diagnosis of heart failure were randomized to (1) treatment- NP education plus tablet application (interactive conditional logic program that flags patient questions to medical staff) or (2) control- NP education. The primary outcome was reduction in 30-day readmission rate. Secondary outcomes included satisfaction and education assessed via survey.

Results: Randomization included 60 patients to treatment and 66 to control. A total of 13 patients withdrew prior to intervention (treatment n=4, control n=1) or were lost to follow-up (treatment n=3, control n=5). The 30-day readmission rate trended lower for treatment compared to control, but results were not statistically significant [13.2% (7/53), 26.7% (16/60), respectively, p=0.08]. Similarly, satisfaction trended higher with treatment than control (p=0.08). Treatment patients rated explanations from their physicians higher than control (Always: 83.7%, 55.8%, respectively, p=0.01).

Conclusions: NP education plus tablet use was not associated with significantly lower 30-day readmission rates in comparison to NP alone, but a positive trend was seen. Patient satisfaction trended higher and heart failure explanations were better with NP education plus tablet. A larger study is needed to determine if NP education plus tablet reduces readmission rates following heart failure admission.

INTRODUCTION

Readmission rates after heart failure hospitalization remain above goal at over 20% within 30 days.¹ Heart failure is one of the leading causes of hospital readmission in the U.S.¹ Multiple strategies have been taken to reduce 30-day readmission rates.^{2,3} Heart failure education is perceived as a means of empowering patients to improve outcomes, such as hospital readmission.¹

The American College of Cardiology Foundation (ACCF) and American Heart Association recommend that heart failure education be provided prior to discharge from the hospital.¹ Heart failure education has been identified by the ACCF expert consensus as an answer to pivotal issues surrounding care in heart failure patients.⁴ However, the best method of providing heart failure education is unknown, and inpatient heart failure education is not standardized.²

Thus, the objective of this pilot study was to determine if nurse practitioner (NP) education and a novel tablet application, which employs individualized conditional logic and flags patient responses to medical staff, is better than NP education alone at reducing 30-day all-cause readmission rates. Secondly, we hypothesized that satisfaction and education would be improved with addition of the tablet application.

METHODS

Adult patients admitted with a primary diagnosis of heart failure were eligible for study enrollment. Exclusion criteria included: non-English speakers, observation status, end-stage heart failure, nursing facility residents, vision/hearing impaired, and dementia/delirium.

In this investigator-blinded study, patients were randomized 1:1 to inpatient (1) treatment with NP education plus novel tablet application or (2) control with NP education alone. NP education included one-on-one discussion of heart failure materials outlined in the center's heart failure patient education binder (heart failure overview, medications, lifestyle modification, and triggers for contacting a provider).

The tablet application was an interactive audio-visual conditional logic program, which provided individualized education and flagged patient questions to medical staff. The application had four specific foci for education: heart failure overview, nutrition plan, importance of medication adherence, and lifestyle modification (**Figure**).

The primary outcome was 30-day all-cause readmission rate, evaluated by chart review and follow-up phone calls. Secondary outcomes included discharge survey assessments of patient satisfaction and education. Survey questions were modified with permission from 2014 Hospital Consumer Assessment of Healthcare Providers and Systems, and responses used Likert scales.

After 3/31/2016, NP education was no longer available for treatment or control groups. As a secondary analysis, we compared results for (3) treatment with heart failure binder and novel tablet application versus (4) control with heart failure binder. For an effect size of 10%, 400 patients were needed to detect a reduction in readmission rates with a power of 0.8 and alpha of 0.05. Study enrollment was discontinued prior to reaching target due to scope of funds. Outcomes were compared using chi-squared analyses, t-tests, and Mann-Whitney U tests in SAS, version 9.4 (SAS Institute, Inc., Cary, North Carolina). This study obtained Institutional Review Board approval from the Ohio State University.

RESULTS

From 3/1/2015 – 3/31/2016, 126 patients were enrolled with 60 patients randomized to treatment and 66 to control. Among these patients, 4 treatment and 1 control patients withdrew before active treatment, and 3 treatment and 5 control patients were lost to follow-up. The final analysis included 53 treatment and 60 control patients.

At baseline, the average age was 60.6 years \pm 13.2. The majority of patients were men and had heart failure with reduced ejection fraction (**Table 1**). Baseline characteristics were similar between treatment and control with the exception of diabetes, which was more prevalent in the treatment group.

All-cause readmission rates at 30 days trended lower in patients with treatment compared to control [treatment 13.2% (7/53), control 26.7% (16/60), $p=0.08$], but was not significant. The survey response rate was 81.1% (43/53) among treatment and 71.7% (43/60) among control patients. Overall patient satisfaction scores trended towards higher satisfaction with treatment than control [treatment median 10.0 (interquartile range 7.5-10.0), control 8.3 (6.0-10.0), $p=0.08$ (**Table 2**)]. Patients particularly felt that providers offered better explanations of their care with treatment than control (Always nurses: treatment 86.0%, control 67.4%, $p=0.04$; Always physicians: treatment 83.7%, control 55.8%, $p=0.01$). Patients perceived better descriptions of medication side effects with treatment than control (Always: treatment 61.1%, control 26.7%, $p=0.01$). Trends towards improved understanding of patients' responsibilities and increased likelihood of changing patient plans/behavior were observed with treatment compared to control, but were not significant. Patients' perceptions of readmission likelihood trended lower in treatment versus control, but was not significant. Plans for medication adherence were high in both groups (Definitely yes: treatment 97.6%, control 100.0%, $p=0.49$).

In the secondary analysis, after NP education was no longer provided (4/1/2016 – 1/31/2017), an additional 34 patients were enrolled, 21 to treatment and 13 to control (withdrawal: treatment $n=2$, control $n=0$; loss to follow-up: treatment $n=4$, control $n=0$). Readmission rates trended higher with treatment of heart failure binder and tablet application compared to control of heart failure binder alone [60.0% (9/15) heart failure binder and tablet application, 38.5% (5/13) heart failure binder, $p=0.26$]. Overall 30-day readmission rates without NP education (50.0%, 14/28) were higher than rates with NP education (20.4%, 23/113) ($p=0.001$).

DISCUSSION

Compared to NP education alone, the combination of NP education and a conditional logic-based tablet application demonstrated trends towards reduction in 30-day all-cause readmission and improved patient satisfaction. The trend reversed when NP education was not provided to either group. This pilot study suggests that one-on-one heart failure education may reduce readmission rates after initial heart failure hospitalization, and the addition of novel tablet application may further reduce readmission rates.

Similar to this study, heart failure patient education has been effective at improving multiple outcomes.^{1,5} In a systematic review of 35 heart failure education studies, the majority demonstrated reduction in readmission after heart failure hospitalization and improvements in patient understanding of heart failure.⁵ Patient satisfaction was equivocal.⁵ However, as observed in registry data,² the format of heart failure education were highly variable, ranging from print handouts to audio/visual presentations.⁵

Rapid advances in technology have contributed to an abundance of computer applications designed to improve heart failure outcomes.⁶ Our results are supported by a recent meta-analysis which demonstrated reduced risk of heart failure hospitalizations with the usage of computer applications compared to education that excludes computer applications.⁶ Key components of these applications included personalized heart failure education, ability to communicate with health care providers, and telemonitoring.⁶ Compared to our study, these trials were missing results for the combination of one-on-one education and computer application.⁶

One-on-one heart failure education may be the appropriate standard of care upon which to expand heart failure education with computer technology. Although heart failure education methods are variable,² a unifying method was found in the systematic review of heart failure education, one-on-one patient education.⁵ In the review, educators' backgrounds varied from health care providers to trained lay persons.⁵ Similarly, an hour of inpatient heart failure education by a registered nurse was successful

in reducing readmissions.⁵ One-on-one heart failure education allows for direct patient communication, and computer applications provide opportunity for patient self-directed care and learning. The combination of one-on-one heart failure education with computer applications has the potential to further reduce readmission rates.

This study is subject to several limitations. First, it was underpowered. This was a single-center pilot study. The intervention will need evaluation in multiple centers to confirm positive trends and enhance external validity. Second, the latter end of the study had no NP education, and the intervention arm of tablet education combined with heart failure binder trended towards worse results than heart failure binder alone. This highlights the importance of one-on-one education with an NP.

CONCLUSIONS

Compared to NP education alone, NP education plus tablet application did not significantly reduce 30-day readmission rates, but did demonstrate a trend towards reduced readmissions and improved satisfaction. Education was improved with this combination. The absence of NP education resulted in higher readmission rates. These findings support the need for a larger multi-center study that compares provider-based education to the combination of one-on-one education and tablet application.

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FIGURE LEGEND

Figure. Tablet Application Screenshot Addressing Medication Adherence.

CLINICAL SIGNIFICANCE

- Heart failure education is not standardized, and clinical support for patient education is variable across hospital centers.
- The combination of novel tablet education and one-on-one nurse practitioner education may reduce hospital readmission rates and improve patient satisfaction and education.

TABLES

Table 1. Baseline Characteristics

	Treatment N=53	Control N=60	p- value
Men	73.6%	63.3%	0.24
Age, mean \pm SD	61.1 \pm 12.8	60.2 \pm 13.6	0.72
Race			0.82
African-American	20.8%	20.0%	
Caucasian	52.8%	48.3%	
Other	26.4%	31.7%	
LVEF, mean \pm SD	35% \pm 18	34% \pm 16	0.90
Comorbidities			
Anemia	48.1%	37.9%	0.28
Atherosclerosis	25.0%	18.3%	0.39
Atrial fibrillation/flutter	44.2%	43.3%	0.92
Cerebral vascular accident	5.8%	5.0%	>0.99
Chronic kidney disease	32.7%	43.3%	0.25
Chronic obstructive pulmonary disease	23.1%	30.0%	0.41
Depression	19.2%	28.3%	0.26
Diabetes mellitus	67.3%	45.0%	0.02
End stage renal disease	1.9%	0.0%	0.47
Hyperlipidemia	55.8%	56.7%	0.92
Hypertension	78.4%	83.3%	0.51
Obesity	57.7%	51.7%	0.52
Peripheral Vascular Disease	7.7%	1.7%	0.18
Tobacco ongoing	7.7%	18.6%	0.22
Insurance			0.85
Marketplace	28.0%	35.0%	
Medicare/Medicaid	66.0%	58.3%	
Private	4.0%	3.3%	
Self-pay	2.0%	3.3%	
Education			0.79
Less than high school	9.8%	16.7%	
High school	34.1%	31.0%	
College	56.1%	52.4%	
Annual Income			0.44
<\$10,000	26.3%	13.2%	
\$10-34,999	28.9%	42.1%	
\$35-59,999	18.4%	15.8%	
\geq \$60,000	26.3%	28.9%	

SD indicates standard deviation.

Table 2. Patient Survey Results

	Treatment N=43	Control N=43	p-value
Overall Patient Satisfaction Score, median (IQR)	10.0 (7.5-10.0)	8.3 (6.0-10.0)	0.08
Patient Satisfaction			
Nurses: Treat patient with respect	93.0%	93.0%	>0.99
Listen to patients	76.7%	74.4%	0.80
Provide good explanations	86.0%	67.4%	0.04*
Doctors: Treat patients with respect	95.3%	88.4%	0.43
Listen to patients	86.0%	72.1%	0.11
Provide good explanations	83.7%	55.8%	0.01*
New Medications: Anything new	78.6%	55.8%	0.03*
Provide reason before giving	86.1%	75.9%	0.29
Described side effects before giving	61.1%	26.7%	0.01*
Discuss adequacy of help needed before discharge	95.2%	87.5%	0.26
Symptoms to look for upon discharge were written	95.1%	81.6%	0.08
Would recommend this hospital to others	93.0%	85.7%	0.31
Staff considered patient preferences when determining pre-discharge needs	64.3%	57.5%	0.53
Patient Understanding			
Responsibility in managing health	82.9%	68.3%	0.12
Purpose of heart medications	83.3%	80.0%	0.70
Meaning of heart failure	78.6%	70.0%	0.37
When to call regarding symptom worsening	76.2%	70.0%	0.53
Type of foods to eat	71.4%	70.0%	0.89
Know patient weight	67.5%	56.4%	0.31
Patient Beliefs			
Readmission within 30 days is likely	9.5%	12.8%	0.73
Patient Plans			
Weigh self daily	78.6%	72.1%	0.49
Take medications regularly	97.6%	100.0%	0.49
Consume less than 2 grams of sodium daily	83.3%	79.1%	0.62
Exercise three times or more per week	69.0%	68.3%	0.94

Modified HCAPHS survey with permission. Higher score indicates increased satisfaction; IQR, interquartile range; *, p value <0.05. Other satisfaction questions are demonstrated as percentages for always, patient understanding and belief questions are demonstrated as highest values on Likert scale combining strongly agree and agree, and patient plans are demonstrated for highest value on Likert scale.



Focus:

1. Understanding Heart Failure
2. Nutrition Plan
3. **Importance of taking medications**
4. Lifestyle/Activities

This provides an example of the patient being asked about problems with taking medications. This question gauges whether or not the patient has shared difficulties with his/her healthcare providers. Patients may respond audibly or electronically.