

Readmissions

Improve Cardiac Health And Prevent Avoidable Readmissions Heart Failure:

There's An App For That!



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ABSTRACT

OBJECTIVE: To evaluate the effectiveness of mobile phone technology (app) to engage patients in managing heart failure (HF) and reduce all-cause 30-day readmissions in a community hospital population.

RESEARCH DESIGN: The study used a convenience sample of patients who: 1) had a hospital stay during the study time frame (August 2013 through April 2014) at AtlantiCare Regional Medical Center (ARMC); 2) had a primary or secondary diagnosis of HF when hospitalized at ARMC; 3) had a smart device (phone, tablet) and received education about the free WOW ME 2000mg™ HF app and downloaded the app with assistance from a staff nurse or cardiovascular nurse prior to discharge; and 4) received follow-up phone calls (post-discharge) from cardiovascular resource nurse at day 3, 14 and 31. Medicare Fee-for-Service (FFS) claims and process measures were analyzed.

SETTING: A regional community hospital – AtlantiCare – Atlantic City Campus and Mainland Campus

RESULTS: A total of 19 HF patients (8 Medicare FFS beneficiaries and 11 non-Medicare) in the Atlantic and Cape May counties of New Jersey Community were recruited. Eighteen patients answered post discharge phone calls. Among the patients that used the HF app, 90% found it useful on day 3, 88.9% on day 14 and 66.7% on day 31 after discharge. The most widely used options on the app were tracking daily weight (100%), evaluating symptoms/follow-up (64.3%) and tracking sodium/fluid (60.7%). No significant difference was found on readmission, observation stay, ED visit, and physician office follow-up for the study group and the comparison group.

CONCLUSIONS: The project demonstrated the potential for effective use of mobile phone technology to engage patients in management of HF diagnoses. However, patient factors resulted in a small sample size making it difficult to draw conclusions on the effectiveness of the app in reducing hospital readmissions. Further study with a larger study population is needed. At this time, older adults might not be good candidates in using smart phone apps to manage their HF diagnosis. Overall, this study adds to the body of knowledge about smartphone usage to manage and improve health outcomes among an older population. Future studies of healthcare smartphone apps should be focused on an age group that is more likely to be smartphone users to get the most comprehensive feedback on usability related to health outcomes.

INTRODUCTION

Background and Significance

Patients have access to more health care information today than ever, yet patients' involvement in their own care remains low. Studies have shown that more patient involvement leads to better outcomes and satisfaction. Patients must be educated, active participants in their care. They should understand their day-to-day decisions affect their health in ways physicians cannot always prevent or control. This is especially important for patients with serious chronic illnesses, because they usually receive care from multiple providers in multiple settings, which can lead to mixed messages and misunderstandings. Heart failure (HF) patients in particular can have a hard time avoiding re-hospitalizations. The education patients

need to care for themselves often differs from provider to provider, leaving the patient confused and overwhelmed. Success in reducing HF readmissions has been shown through the provision of coaching services, such as care transitions coaching and transitional care nurses. However, long-term self-management of the condition requires constant patient education reinforcement as well as reminders about the importance of monitoring daily weight, medication, food and fluid intake.

In addition to traditional coaching and education interventions, advances in mobile technology have led to the development of mobile apps for chronic disease management aimed at reducing prevent-

able hospital admissions and emergency rooms visits. Some of these apps have shown promising results in reducing emergency visits^{1,2} and improving weight and blood pressure readings.^{2,3}

According to an unpublished study from the Mayo Clinic,² patients who used the assigned cardiac app or reported online had 40% fewer readmissions to either the hospital or an emergency room within 90 days, were nine pounds lighter and about 8mmHg lower on average blood pressure. There was a dose-response² between the use of the intervention and secondary measures of cardiovascular disease that were examined. Hospitals and health systems have
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“If the app signals a two pound gain in one day, an alert advises the patient to call the healthcare provider or the heart failure resource center.”

developed apps as a convenient, cost-effective, and customer-focused communication tool to help patients manage chronic conditions. The diversity and increasing number of health related apps has raised questions regarding their effectiveness.⁴

Physician stakeholders from the Atlantic-Cape Community Coalition wanted to engage patients in self-care. Asking the patient to be compliant had not been effective in changing patient behavior or achieving better outcomes. To address this issue, AtlantiCare Regional Medical Center (ARMC) developed an app to help HF patients/caregivers/families manage their own care. The application was approved by Apple's App Store in December 2012 and Android's Marketplace in July 2013.

Built around AtlantiCare's WOW ME 2000mg™ printed patient education materials, the app provides allows patients to electronically track and monitor, and take actions needed, to evaluate/manage their condition each day. WOW ME 2000mg™ stands for: **W**eigh yourself daily, **O**utput/intake monitoring, **W**alk and be active, **M**edication adherence, **E**valuation of symptoms/follow-up and 2000 mg of sodium/ml of fluid. This tool incorporates all six elements of self-management care as recommended by the Joint Commission and Centers for Medicare and Medicaid Services. For two years, WOW ME 2000mg™ has been helping patients better care for themselves and prevent avoidable re-hospitalizations. This app would make the WOW ME 2000mg™ program more accessible, by reinforcing the HF daily self-man-

agement tasks that are taught in the hospital and in community settings. The app has the ability to be customized with patient's baseline information and daily goals. The app also monitors patients' daily progress with its tracker functions for daily weights, medication, sodium and fluid consumption and activity. The patient logs his or her fluids or enters the amount of sodium on the label of food consumed. The app calculates and maintains a running tally throughout the day.

When the patient gets within 20% of his or her daily limit, a warning band alerts the patient that he or she is near the daily allotment of fluid and/or sodium. The app also tracks a patient's weight for a week and signals a trend of increasing weight. If the app signals a gain of five pounds or more in a week, an alert advises the patient to call his or her health care provider. If the app signals a two pound gain in one day, an alert advises the patient to call the healthcare provider or the heart failure resource center. This app was designed to be user-friendly with minimum data entry required. The app tracks a patient's symptoms, which is critical. Most HF patients don't recognize their symptoms until it's too late and they have to go to the ED. The app focuses on bringing awareness to symptoms that are worsening, and when to contact to the provider.

Healthcare Quality Strategies, Inc. (HQSI), the federally-designated quality improvement organization (QIO) for New Jersey, worked closely with ARMC as one of the members of the Atlantic-Cape Community Coalition that was formed under the Centers for Medicare

& Medicaid Services' (CMS) 10th State-ment of Work. HQSI received funding from the CMS to conduct a 12-month Special Innovation Project to evaluate the effectiveness of this app in increasing patient activation and self-manage-ment and reducing hospital readmis-sions. The project had two goals:

1. Determine the effectiveness of smartphone health technology to increase HF patients' self-management and reduce readmissions.

2. Contribute to the body of knowl-edge about smart phone technology's potential to affect positive patient health en-gagement behavior.

Methods

This project was conducted at two ARMC locations – the Atlantic City Campus and the Mainland Campus, each with a cardiac unit. HQSI estimated this project would recruit about 58 patients during the nine-month recruitment time frame. This calculation was based on ARMC's annual HF discharge volume, an 18% ownership of smartphones among Americans aged 65 and older⁵, and an 18% estimate of tablet ownership among the same group⁶. HQSI estimated a 25% overlap among the smartphone and tablet users and assumed a 25% conservative estimate (**Table 1**) for the sample size.

The WOW ME 2000mg™ app for smart devices was designed as an extension of a successful educational paper tool. Since 2011, ARMC's clinical team has used the WOW ME 2000mg™ self-management program (paper tool) for HF patient education. The team encour-

Table 1. Sample Size Estimates

# of unique Medicare patients hospitalized at ARMC (8/2012 – 4/2013)	928
Expected # of patients with Smartphone and/or tablet (25%)	232
Expected # of patients who would download the app (25% success rate)	58

aged patients to track and control symptoms to avoid preventable Emergency Department visits or hospitalizations. ARMC's Heart Failure Resource Center offered additional outpatient clinic visits to HF patients. During these visits, the center's clinical team continued to reinforce the importance of using the tool. The documented success of the center's program showed the HF patient volume drop from 909 admitted patients in 2009 to 663 admitted patients in 2011, as well as patients' reporting a higher quality of life score.⁷ The ARMC nurses were educated through in-services and other internal communication venues. Nurses were encouraged to identify patients who used smart devices, talk with them about the app, and support the patients in downloading the app onto their smart device during the hospitalization. Throughout the hospital stay, the nurses reinforced use of the app. The cardiac resource nurse would also visit each patient to reinforce the use of the WOW ME 2000mg™ program.

To serve as a prompt to input information into the app throughout the day, patients who downloaded the free app were given a medication organizer with a message on it reminding them to use the app to track their symptoms. During the initial recruitment period, ARMC nurses reported difficulties in recruiting patients. This was primarily because the team did not have printed materials to use in educating patients about the mobile app, and most beneficiaries did not own smartphones. In our discussions with the ARMC nurses regarding the low patient enrollment, it was agreed that providing the nurses with an educational tool to promote and support patient enrollment and engagement might positively impact enrollment and participation. A pocket-size flip book, based on a larger model ARMC was using for general patient education, was developed and employed mid-way through the intervention period. The ARMC nurses would give the pocket-sized flip book to the patients to assist with the download of the app and reinforce the use of the app during their hospital stay. Patients kept the flip book to support continued use of the app post-discharge.

Overall Project Hypotheses

1. Patients who download the HF app will experience better outcomes (i.e., fewer ER visits, lower readmission rates, fewer hospitalizations and more timely provider follow-up visits) than their counterparts that did not download the HF app.

2. Patients who download the HF app and use the majority of the steps (those engaged with higher level of self-management) in the app will have better outcomes as specified in the first hypothesis than those who download the app but only use one or two steps.

3. Patients who download the HF app will find the app helpful in monitoring their HF symptoms.

Sampling Frame (inclusion criteria)

The study sample was a convenience sample of patients who:

1. Had a hospital stay during the study time frame (August 2013 through April 2014) at ARMC
2. Had a primary or secondary diagnosis of HF when hospitalized at ARMC
3. Had a smart device (phone, tablet) and received WOW ME 2000mg™ HF app education and downloaded the app with assistance from staff nurse or cardiovascular nurse prior to leaving the hospital
4. Received follow-up phone calls (post-discharge) from cardiovascular resource nurse at day 3, day 14, and day 31.

Study And Comparison Groups

The project had two groups: a study group (patients who used the app after discharge) and a comparison group. The comparison group was randomly selected from patients who did not have a smart device and did not download the app prior to hospital discharge. Limited matching of socio-demographic characteristics (age, gender, race, ZIP codes) and morbidity status (HF discharge) was applied to the extent possible. Although

it would be ideal to compare the study group's results to a control group to control for variables other than the use of the app in affecting patient outcome, it was impossible to find two groups of patients with identical characteristics such as socio-economic status, social and family support/resources, which were important determinants of hospitalizations and health service use.

The comparison group was used to address the question of whether the intervention (the app) made a difference. HQSI attempted to answer the following questions:

- Did patients receiving the intervention have different outcomes from their counterparts who did not receive intervention?
- Did they have better outcomes in the utilization of health services (i.e., readmission, admission, ED, physician follow-up)?

Data Analysis And Project Measures

The following measures calculated from Medicare FFS claims were used to evaluate the usefulness of the HF app to improve health care utilization outcomes. App usage was self-reported data based on patients' answers to questions in the follow-up phone calls (post-discharge) conducted by cardiovascular nurses during at day 3, day 14 and day 31. Results from the comparison group and the study group were analyzed using appropriate Chi-Square or Fisher's exact test. Results by demographic characteristic (age, gender and race) and app usage (those that used all steps in the WOW ME 2000mg™ app vs. those who used selected steps) were summarized by each group.

- Readmission rate at 7, 14, 30 and 60 days post discharge
- ED visit rate at 7, 14, 30 and 60 days post discharge
- Physician office follow-up rate at 7 and 14 days post discharge.

The following exploratory analysis was conducted for the intervention group. One sample t-test and confidence intervals

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were calculated where appropriate to determine if there was any significant difference before and after app usage in reducing hospitalizations and ED visits.

- Number of acute hospitalizations 60 days post discharge as compared to 60 days prior to index hospitalization
- Number of ED visits 60 days post discharge as compared to 60 days prior to index hospitalization.

To analyze whether there was a satisfactory percentage of patients who down-

loaded the HF app finding the app helpful in monitoring their HF symptoms, we hypothesized that 80% of the intervention group that used the HF app would find the app useful. A one-sample Z-test with a significance level of 0.05 was used to determine whether we reject or accept the null hypothesis.

Results

ARMC started patient recruitment and tracking on August 1, 2013 and continued through April 30, 2014 (nine months

total). **Table 2** shows the number of patients recruited and their demographic characteristics. Among the 19 recruited patients, eight had Medicare FFS as their primary insurance. The average age among the recruited patients was 59 with the majority (63.2%) younger than 65. Among the Medicare patients, 75% were male and the majority was White.

Post discharge follow-up calls conducted by ARMC reached 17 of 19 (89.5%) patients on day 3, 16 (84.2%) on days 14 and 15 (79.0%) on day 31, as noted in **Table 3**. Fourteen of 19 patients

Table 2. Characteristics of Recruited Patients (N=19)

Insurance Coverage	N	% of total
Medicare	8	42.1
Non-Medicare	11	57.9
Race (Medicare only)		
White	5	62.5
Black	2	25.0
Asian	1	12.5
Hispanic	0	0.0
Other	0	0.0
Gender (Medicare only)		
Male	6	75.0
Female	2	25.0
Age (mean = 59.05 ± 13.42)		
<65	12	63.2
65-74	4	21.1
75-84	3	15.8

Table 3. Responses from Follow-up Calls among Recruited Patients (N=19)

	Day 3			Day 14			Day 31			Total % yes
	# answer	# yes	% yes	# answer	# yes	% yes	# answer	# yes	% yes	
Used the App	17	10	58.8	16	9	56.3	15	9	60.0	58.3%
<i>Among those used App</i>										
Find it Helpful	10	9	90.0	9	8	88.9	9	6	66.7	82.1%
App usage										
W (weight yourself daily)	10	10	100.0	9	9	100.0	9	9	100.0	100.0%
O (output/intake monitoring)	10	3	30.0	9	6	66.7	9	2	22.2	39.3%
W (walk and be active)	10	0	0.0	9	0	0.0	9	0	0.0	0.0%
M (medication adherence)	10	1	10.0	9	1	11.1	9	2	22.2	14.3%
E (evaluation of symptoms/follow-up)	10	6	60.0	9	7	77.8	9	5	55.6	64.3%
2000 (2000 mg of sodium/ml of fluid)	10	6	60.0	9	5	55.6	9	6	66.7	60.7%

NOTE: 14 out of 19 patients answered all day 3, day 14, and day 31 questions; 1 out of 19 patients never answered one of day3, day 14, and day 31 questions due to wrong phone number.

answered follow-up questions on all three calls. The app usage was determined based on patients' responses to the follow-up question, "Are you using the Heart Failure app?" and remained fairly stable for day 3 (58.8%), day 14 (56.3%) and day 31 (60.0%). Among the six screen options for HF management, **W** (weigh yourself daily) was the most used and was used consistently (100%) from day 3 to day 31, followed by **E** (evaluation of symptoms/follow-up) and 2000 (2000mg of sodium/ml of fluid). Very few used the app for output/intake

monitoring (**O**) and medication adherence (**M**). No one used the **W** (walk and be active). **Figure 1** illustrates the usage pattern based on the answers from the three follow-up calls.

Table 4 displays the subgroup analysis on app usage pattern that was conducted for Medicare FFS versus non-Medicare FFS patients. Patients with Medicare FFS coverage showed a lower utilization of the app two weeks after discharge while the non-Medicare FFS patients had a higher utilization rate. However, due to the small sample size, there was no sta-

tistically significant difference.

Health service utilization rates on readmission, ED visits, physician office follow-up and observation stays were calculated from Medicare FFS claims and included the study group (N=7) and the comparison group (N=259) as shown in **Table 5** (page 30). Results by demographic characteristic (age, gender and race) and app usage (those that used all steps in the WOW ME 2000mg™ app vs. those that used selected steps) were not presented due to the small sample size.

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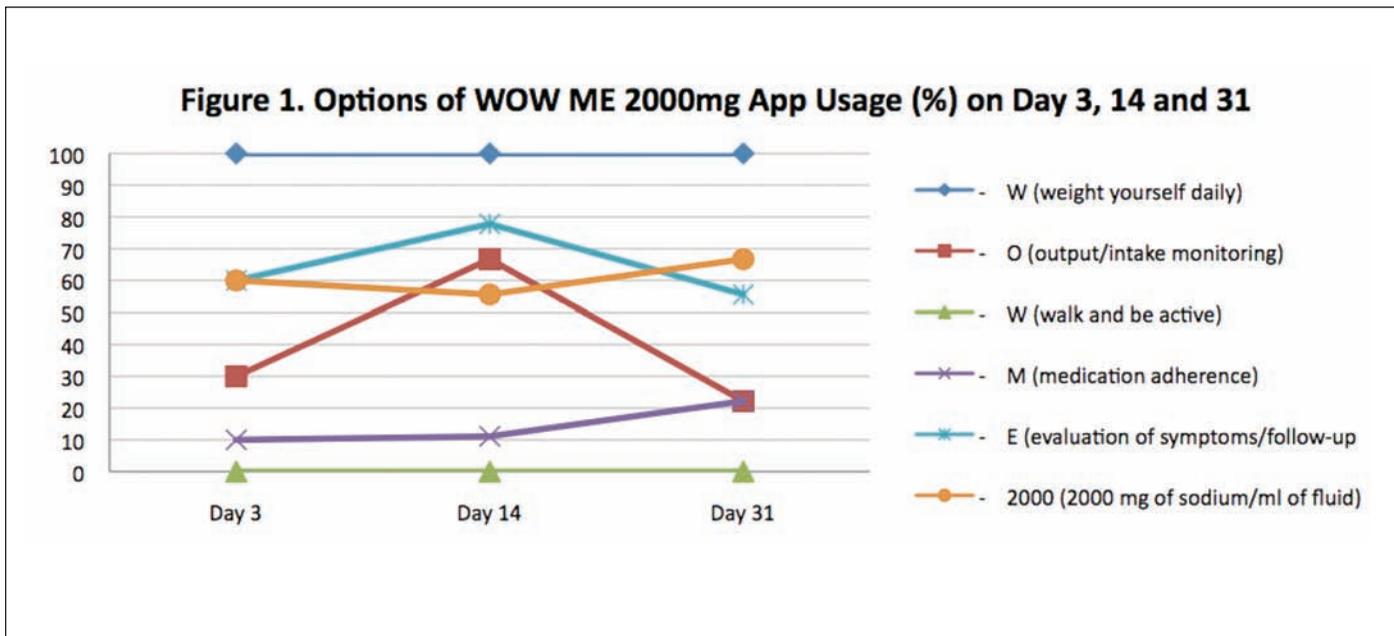


Table 4. App Recruitment, Usage and Helpfulness by insurance coverage

Insurance Type	Follow-up Day	Answered calls vs recruited		Used vs. Recruited			Helpful vs Used app			
		recruited	answered calls	% answer	recruited	used app	% use	used HF app	helpful	% helpful
Medicare	3	8	7	87.5	8	5	62.5	5	5	100.0
	14	8	6	75.0	8	3	37.5	3	3	100.0
	31	8	6	75.0	8	3	37.5	3	2	66.7
Non-Medicare	3	11	10	90.9	11	5	45.5	5	4	80.0
	14	11	10	90.9	11	6	54.6	6	5	83.3
	31	11	9	81.8	11	6	54.6	6	4	66.7
average				84.2			49.1			82.1

Among the seven Medicare patients with claims available for analysis, one patient had a readmission within seven days and that same patient later died. The deceased patient was in poor health with an automatic implantable cardioverter defibrillator (AICD) and was receiving peritoneal dialysis. The readmission rate within 60 days for the study group was 28.6% compared to 35.5% for the comparison group. The same results were found for the ED visit rates as re-hospitalized patients were admitted through ED. Results for observation stay were not presented because there were no observation stays for the study group and only one patient in the comparison group had an observation stay. Although the physician office follow-up rate was 25.1% higher in the study group than the comparison group, no statistical significance can be drawn due to the small sample size.

Discussion

HQSI originally projected to have a study group of about 58 patients. However, only 19 were successfully recruited of which eight were Medicare FFS beneficiaries. Various hospital and patient fac-

tors contributed to this low recruitment number as noted below:

Low smart device ownership: Most patients approached by ARMC nurses for this project did not own smart devices. This may be due in large part to the age of the target population.

Low receptiveness/engagement: As reported by ARMC nurses, most HF patients were not receptive to the concept of using a smart device to monitor their health, especially after a cardiac event (hospitalization). This finding is similar to a report from Pew Research⁸, which indicated that patients who use smart devices for monitoring their health tend to be younger, more highly educated, or more affluent. In contrast, the older, less affluent populations who often have more health problems, such as the HF patients the project hospital serves, are less likely to use digital tools, such as a smart device. Seniors who have significant physical or health conditions can find reading the small font size on a smart device challenging due to visual impairment. Seniors might also lack the manual dexterity for using smart devices and may be skeptical about the benefits of technology. While an iPad or similar device might help seniors visually and solve the

problem of small fonts on a smart phone, the trust in technology might need more time. Patient feedback from follow-up calls validated the above findings. Some comments are listed below.

- “We really don’t use our cell phone much.”
- “We’re really not into that stuff.”
- “I downloaded it but I need my daughter to show me how to use it.”
- “I keep forgetting about it.”
- “My wife uses it more than I do.”
- “I don’t think I want to use it. I’m not that familiar with that stuff.”

One year project: Time constraints limited the scope of this project to patients admitted to the two cardiac units, which provided a much smaller beneficiary pool. A longer timeline would have led to hospital-wide spread and more complete data collection of Medicare beneficiaries’ use of smart devices for HF self-management.

The study group showed lower readmission rates but higher ER visits and physician follow-up rates as compared to the comparison group. Although these differences were not statistically signifi-

Table 5. Utilization of Health Services after index hospitalization among Recruited Patients: Study group (N=7) vs Comparison group (N=259)

	Rate (%) of recruited	Rate (%) of comparison group	Difference	Significance (p value)
Readmission				
7 day	14.29	8.49	5.79	0.7009
14 day	14.29	15.06	-0.77	0.9591
30 day	14.29	22.78	-8.49	0.5786
60 day	28.57	35.52	-6.95	0.7220
Emergency Department				
7 day	14.29	7.72	6.56	0.6638
14 day	14.29	14.29	0.00	1.0000
30 day	14.29	21.62	-7.34	0.6302
60 day	42.86	32.05	10.81	0.6146
Physician Office follow-up				
7 day	57.14	41.70	15.44	0.4772
14 day	85.71	60.62	25.10	0.1327

cant, mainly due to the small study group with seven Medicare patients, the results were favorable in two ways. First, it can indicate that the app might have increased patients' management of HF in detecting early warning signs and thus, a higher rate in ER visits. Second, the timely physician office follow-up within seven and 14 days could be the result of using the app that kept them in touch with the physicians as early warning signs of HF began. However, these were assumptions and can only be validated with results from a larger study with a larger sample size. Additionally, the study used patient self-reported app usage data that could have inherent questions with reliability and validity. As a result of these limitations, we were not able to draw a valid conclusion on the effectiveness of the app in reducing readmissions. We were not able to draw valid conclusions based on demographic characteristics, such as gender, age and racial differences in the effectiveness of HF app in assisting patients in self-management of their HF symptoms because of the small sample size.

Toward the end of the study, in April 2014, it was reported that a not yet published study from the Mayo Clinic,² engaged 44 patients recovering from stent replacement in online and smartphone usage for three months. Twenty-five patients used the app along with cardiac rehabilitation and 19 were in the control group that participated in regular cardiac rehabilitation. This study had the 25 participants self-report their weight, blood pressure, blood sugar, minutes of physical activity and daily diet. The second function of this app was aimed at showing the patients things they could do to help them avoid a secondary heart event, such as adding fish to their diet or adding exercise into their routine. The age of the participants was not mentioned. According to this study, patients who used the assigned cardiac app or reported online, had 40% fewer readmissions to either the hospital or an emergency room within 90 days, were nine pounds lighter and about 8mmHg lower on average blood pressure. There was a dose-response between the use of the intervention and secondary measures of car-

diovascular disease that were examined.

Similar to our study, the unpublished study from Mayo Clinic also relied on the self-reported patient data to measure app usage. Ours relied on patient answers to the nurse phone calls, while Mayo clinic relied on patient self-reported data on weight, blood pressure, blood sugar, physical activity and daily diet. Both apps had the primary function of tracking patient daily vitals and activities that were important in preventing unnecessary ED visits and hospital readmissions. Both were set up as a patient-centered self-monitoring system and to provide educational content.

We cannot compare the two study populations because age and other socio-demographic characteristics which are important predictors of app usage, were not mentioned in the Mayo Clinic study. Both apps have built in components for lifestyle changes (i.e., physical activity). Our study indicated no use of this component.

Conclusion

The project was designed to evaluate and demonstrate the effectiveness of mobile device technology in patient activation, engagement and management of HF and support CMS's three part aim: better health, better health care, and lower costs. HQSI hypothesized that patient care can be improved by engaging patients to take more control of their illness through the use of mobile technology. Based on the findings, HQSI was not able to draw a valid conclusion mainly due to

the small sample size. However, as one of the first of its kind, this study was an important contribution to the body of knowledge on Medicare beneficiaries' receptiveness to self-care management using a smart device application.

Further study in the use of the app in managing HF is needed. Patient factors need to be taken into consideration when designing such a study. Patients who are older, less affluent and with limiting physical conditions will not be ideal candidates for such a study due to their low receptiveness to using a device with which they are not familiar.

Seniors may learn faster if a future app study partnered with a video or podcast to demonstrate the use of the app. This can be something that participants can continue to play back if they have questions based on the written instructions. Sometimes by watching someone else do a task, the observer can learn to do so more easily than by reading instructions. Additionally, for seniors, the app is likely to have a higher level of receptiveness if used on a tablet with larger screen size than on a smartphone.

While increasing numbers of health related apps have raised questions regarding their effectiveness,⁴ the HQSI and Mayo Clinic studies demonstrated some ways apps could engage patients in self-management of their chronic condition. Future studies in patient activation techniques that utilize mobile technology for health management are needed. The design of such studies should take the age of the population into consideration. **RR**

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