A Comprehensive Hospital-Based Intervention to Reduce Readmissions for Chronically Ill Patients: A Randomized Controlled Trial

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ABSTRACT

Objectives

Medicare penalizes hospitals with 30-day readmissions above their expected rates. Hospitals have responded by implementing transitional care interventions; however, there is limited evidence to inform the development of a successful intervention.

Study Design

Parallel-group, stratified, randomized controlled trial.

Methods

A total of 512 patients hospitalized at 2 community hospitals, with congestive heart failure (CHF) or chronic obstructive pulmonary disease (COPD), were randomly assigned to the intervention (n = 253) or usual care (n = 259). The intervention encompassed a 90-day hospital-based transitional care program. The primary end points were 30- and 90-day all-cause readmissions. Secondary measures included all-cause emergency department (ED) visits and mortality.

Results

On average, study participants were 67 years of age, 57% female, and 70% insured by Medicare. There was no statistical difference between treatment groups on 30-day readmission incidence rates (difference, 0.040; 95% CI, –0.047 to 0.127; $P = .36$), or 90-day readmission incidence rates (difference of 0.035; 95% CI –0.122 to 0.192; $P = .66$). Groups also did not differ in ED visit incidence rates at 30 or 90 days. The mortality rate among patients with CHF showed no difference between groups (risk ratio = 0.90; 95% CI, 0.40-2.05). However, for COPD, mortality at 90 days was lower in the intervention group than in the usual care group (risk ratio = 0.28; 95% CI, 0.10-0.83).

Conclusions

Stand-alone community hospitals may be unable to prevent readmissions despite the use of comprehensive, evidence-based intervention components that are within their control. Better collaboration between hospitals and community-based providers is needed to ensure continuity of care for discharged patients.

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CMS is implementing an array of policies intended to reduce readmissions because they are both costly and thought to be mostly avoidable.[1] The CMS approach includes both penalties for hospitals if 30-day readmission rates for specified conditions exceed expected risk-adjusted rates, and support for demonstration projects aimed to enhance the patient's transition from hospital to community.[2] The commercial sector is also signaling a move in a similar direction. With the addition of all-cause readmission rates to the Healthcare Effectiveness Data and Information Set (HEDIS), health plans are positioned to create new incentives for hospitals to reduce readmissions.[3]

While hospitals have responded by implementing interventions to reduce 30-day readmissions, existing empirical evidence offers limited guidance on how to develop a successful program. Out of 43 studies in a recent systematic review of interventions to reduce readmissions, only 16 were deemed effective, and no single intervention component was consistently associated with effectiveness.[4] Moreover, many of these interventions were developed and tested in academic settings or integrated delivery systems, leaving open the question of how even effective interventions would fare in stand-alone community-based hospitals. The lack of proven successful and generalizable models argues for continued innovation and experimentation with interventions designed to reduce readmissions.

In this study, we examined whether a comprehensive hospital-based transitional care intervention reduces readmissions for participants with congestive heart failure (CHF) and chronic obstructive pulmonary disease (COPD). We selected these conditions because they represent 2 of the top 3 readmitting diagnoses among Medicare beneficiaries.[1] In addition, hospitals are currently penalized by CMS for 30-day readmissions among CHF patients, and COPD will be included as a measure in 2015. We hypothesized that rates of readmission would be lower for participants receiving the

Take-Away Points

- Our results suggest the need to continue experimenting with new interventions targeting readmissions, especially for severely ill patients. Our addition of interactive voice response and motivational interviewing–based health coaching to the transitional care model did not improve outcomes.
- Our findings suggest that correcting improper use of the inhaler and increasing adherence to inhaled medications may reduce 90-day mortality for chronic obstructive pulmonary disease patients.
- Hospitals, without collaborative relationships with community-based providers, may have limited ability to reduce readmissions, as they cannot ensure timely and continuous care for patients after discharge.
- A challenging road lies ahead for stand-alone community hospitals seeking to decrease readmissions and avoid financial penalties.

intervention, as would the secondary outcomes of emergency department (ED) visits and mortality rates.

METHODS

Trial Design and Setting

We conducted a parallel-group, stratified, randomized controlled trial at 2 independent, nonprofit hospitals: a 124-bed acute care facility located in Grants Pass, Oregon, and a 387-bed full-service tertiary facility in Medford, Oregon. The 2 hospitals serve 9 counties in southern Oregon and northern California (total population 574,214 in 2012) and had combined annual acute discharges of 21,430 in 2012. The Southern Oregon Institutional Review Board approved the study protocol and provided oversight for the duration of the trial.

Participants

Study participants were enrolled between June 2010 and November 2012, with follow-up activities provided until the end of January 2013. During the enrollment period, the hospital census report was reviewed daily at each hospital to identify hospitalized patients with a primary diagnosis of CHF or COPD using codes from the *International Classification of Diseases, 9th Revision, Clinical Modification*. Patients were eligible for inclusion if they: were at least 18 years of age; resided in any of the 9 counties served by the hospitals; were community-dwelling; had sufficient cognitive ability to communicate and reason (determined by study nurse); had access to a telephone; could communicate in English; and were not currently participating in another intervention aimed at reducing readmissions.

Randomization

Prior to study commencement, the principal investigator (AL) generated a randomization sequence to allocate participants to treatment arms using random permuted blocks.[5] There were 4 strata (2 hospitals and 2 disease conditions) and 5 permuted blocks allocated in equal proportions, with a minimum size of 2 and maximum size of 10. The treatments were allocated in a 1:1 ratio, with 18 extra allocations provided to maintain the integrity of the final block in each stratum. The allocation sequence was concealed via sequentially numbered, opaque sealed envelopes. After participants signed the consent form and provided baseline information, the envelope was opened by study staff in their presence, simultaneously revealing the treatment allocation to both participant and study staff.

Intervention

The intervention included a comprehensive set of components commonly found in the transitional care model.[6] Following the taxonomy proposed by Hansen et al,[4] these components included: 1) pre-discharge components: patient education, discharge planning, medication reconciliation, follow-up appointment scheduled; 2) post discharge components: timely follow-up, follow-up telephone call, availability of patient hotline; and 3) bridging components: transition/health coach, patient-centered discharge instructions.

To enhance the innovative nature of the intervention, 2 post discharge components were added—motivational interviewing–based health coaching (MI) and symptom monitoring using interactive voice response (IVR). MI is a standardized, evidence-based health coaching approach described as a "collaborative, goal-oriented style of communication with particular attention to the language of change."[7] MI and IVR were selected because the literature supports their efficacy for: coaching in short duration interventions[8]; promoting activation for self-management[9,10]; addressing challenging behavior changes such as treatment compliance and smoking cessation[11,12]; and reducing hospitalizations for both CHF and COPD.[4,13,14] (A complete description of intervention components is provided in Table 1.)

The MI component included 1 initial session from a study nurse during the index hospital stay to prepare participants to transition back to the community setting. A follow-up session was scheduled within 2 days of discharge, with additional sessions scheduled during the subsequent 90-day period based on the participant's patient activation level, health literacy, severity of health condition, and preference. All sessions were delivered by 1 of 2 experienced nurses trained in administering transitional care and MI.

Table 1. Intervention Components

Components	Description
Pre-discharge components	
Patient education	Single motivational interview session with study nurse to provide patient education. Content was customized to participant based on the Elicit-Provide-Elicit strategy.[7]
Discharge planning	Usual care discharge planning provided by hospital discharge staff.
Medication reconciliation	Usual care medication reconciliation provided by hospital nursing staff.
Follow-up appointment scheduled	The study nurse made an appointment with the participants for a follow-up health coaching call within 1 to 2 days post discharge.
Post discharge components	
Timely follow-up	Participant's PCP (if known) was sent a notification letter about the hospitalization and need for timely follow-up. Participants were encouraged to make an appointment with their PCP. If participants had an acute exacerbation (discovered via MI session or IVR), study nurse called the PCP or coached the participant to contact the PCP.
Follow-up telephone call	Study nurse scheduled multiple follow-up MI sessions with participants.
Motivational interviewing	Participants received MI sessions at a frequency of their choosing in which a study nurse applied the health coaching framework to build rapport, explore the patient's ambivalence and motivations for change, selectively evoke change talk toward a targeted goal (eg, treatment plan adherence), and strengthen commitment to goal realization. (For more information on MI, see www.motivationalinterview.org.)
Patient hotline	Participants were given the telephone number of their study nurse and were encouraged to call with health concerns or treatment plan questions.
Interactive voice response symptom monitoring (IVR)	Daily IVR response to the same 5 questions that captured changes in symptoms as compared with "yesterday." Study nurses monitored responses and followed up on alerts indicating symptoms of an acute exacerbation in order to assess the urgency and make appropriate recommendations including timely follow-up with PCP.
Bridging components	
Transition/health coach	Study nurses acted as transition coach,[31] with the goal of encouraging participants to assert a more active role in managing his/her chronic condition, to provide continuity across settings, and to ensure that the patient's needs are met.
Patient-centered discharge instruction	After the usual care discharge planning, study nurses used the Elicit-Provide-Elicit strategy[7] to ensure that participants understood the treatment plan. Study nurses also used MI-based strategies to explore challenges or barriers, as well as to strengthen commitment to the plan.

IVR indicates interactive voice response monitoring; MI indicates motivational interviewing; PCP indicates primary care physician.

The nurses were regularly monitored by an MI expert (SWB), using the Motivational Interviewing Treatment Integrity (MITI) tool, to ensure proficiency levels in MI associated with positive clinical outcomes.[15] From multiple random checks, the average global clinician ratings for the 2 nurse-coaches were 3.9 and 4.2 out of 5 (with 3.5 or above indicating proficiency); their average percentage of using MI-adherent strategies were 91% and 99% (with 90% or above indicating proficiency).

The IVR component included daily symptom monitoring using an IVR system (Pharos Innovations, Northfield, Illinois) up to 30 days post discharge, with the 2 study nurses responding to symptom alerts within 24 hours.

Although the Transitional Care Model sometimes includes home visits, we did not include this in the intervention due to funding constraints and the lack of evidence that it is a compelling component. We also could not ensure provider continuity of care, given that the funding was restricted to hospital staff, and community-based providers were not obligated to participate in this hospital-based intervention.

Usual Care

Participants randomized to the control condition received usual care from the hospital, with transitional care typically consisting of brief patient education and

discharge planning delivered in the traditional medical model.[16]

Data and Outcomes

The primary outcomes, 30- and 90-day all-cause readmissions, were created from the hospitals' electronic medical record (EMR) system data. Secondary outcomes included: 30- and 90-day all-cause ED visits, also retrieved from the hospitals' EMRs; and mortality rates at 90 days, obtained by linking patient Social Security numbers to the Social Security Death Index and searching obituaries in the regional newspapers. As suggested during the peer-review process, we also created a composite rate variable that captured all unplanned returns to the hospital, composed of both readmissions and ED visits.

Self-reported sociodemographic characteristics, comorbidities, severity level of the primary condition (based on New York Heart Association [NYHA] functional classification for CHF and Global Initiative for Chronic Obstructive Lung Disease [GOLD] classification for COPD),[17] and contact information of the participant's community-based primary care provider (PCP) were collected during recruitment. Participants also completed the Patient Activation Measure (PAM) during recruitment (baseline) and by mail at 30- and 90-day time points. The PAM assesses knowledge, skills, beliefs, and behaviors needed to enable patients to manage their health and care.[18,19] To assess the level of patient engagement with the novel components of our intervention (MI and IVR), we collected the following process measures: the number of MI sessions completed, IVR usage, and the relationship between IVR alert triggers and subsequent acute care utilization.

Statistical Analysis

Sample size calculations were estimated for over-dispersed Poisson observations,[20] based on the hospitals' prior 90-day readmission incidence rate of 0.51 per person. We calculated sample size separately for each condition to enable sufficient power to conduct subgroup analyses, resulting in sample sizes of 119 participants per group needed to detect a 0.23 incidence rate reduction of readmissions during a 90-day time period (2-tailed, $\alpha = 0.05$, power = 0.80). The projected intervention effect size was based on successful randomized trials with similar emphases, follow-up periods, and sample sizes.[21-24]

All analyses were performed on the whole sample and separately by condition. Analyses were conducted from an intention-to-treat perspective. Baseline comparability of the intervention and usual care groups was evaluated using χ^2 tests for categorical variables and *t* tests for continuous variables. We assessed the impact of the intervention on readmission incidence rates, ED visit incidence rates, and the composite rate using negative binomial regression. This model was chosen based on goodness of fit statistics that favored negative binomial over other count models.[25] A count model is the most appropriate statistical approach given that some patients may experience multiple readmissions, and the data are expected to be highly skewed. Methods that recast the outcome as a binary variable, such as time-to-event analysis, introduce measurement bias by masking potential differences between study groups in their distribution of readmissions.

Differences in mortality rates between treatment and control groups were estimated using logistic regression and calculated as both risk differences and risk ratios, using the adjustment method proposed by Norton et al.[26]

The analysis plan originally called for adjustment to outcome models if significant imbalances on baseline characteristics were observed, or if important prognostic variables were identified. While no such concerns were substantiated, we nonetheless present all outcomes as both unadjusted and adjusted for all baseline covariates. For all analyses, *P* values were based on 2-tailed tests with values less than .05 considered statistically significant. Regression-based analyses estimated 95% confidence intervals using robust standard errors. All statistical analyses were conducted using Stata version 12.1 (Statacorp LP, College Station, Texas).

RESULTS

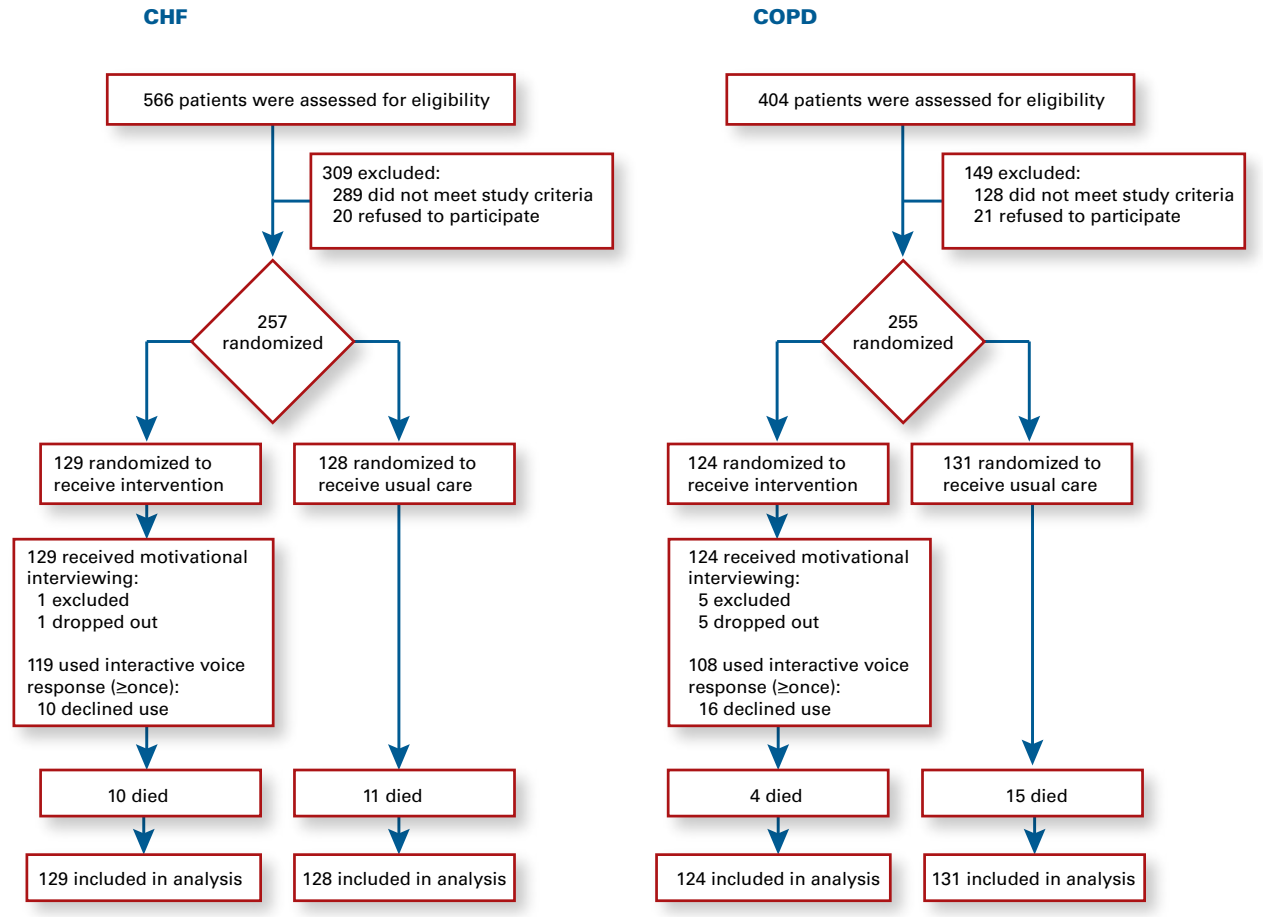
Study Flow

Of 566 patients with CHF assessed for eligibility, 277 met inclusion criteria, of whom 93% (n = 257) agreed to participate and provided baseline data (**Figure**). Of these, 128 patients were assigned to usual care and 129 patients were assigned to the intervention. Among 404 screened COPD patients, 276 met inclusion criteria, of whom 255 (92%) agreed to participate and were randomized to either usual care (n = 131) or intervention (n = 124).

Baseline Characteristics

Intervention and usual care groups were comparable on all baseline demographic and health characteristics, including illness severity of the primary condition, comorbidities, and prior 12-month hospital utilization. This was true for the pooled study population (**Table 2**) as well as for the CHF and COPD groups, independently (**eAppendix A** and **B**, available at **www.ajmc.com**). In general, participants were predominately female, married (or living with a caregiver), older than 65 years, insured by

Figure. Flow of Participants Through the Study, by Condition



CHF indicates congestive heart failure; COPD, chronic obstructive pulmonary disease.

Medicare, and ill with several comorbidities. Participants had also utilized substantial acute hospital services in the prior year.

Process Measures: MI and IVR

Intervention group participants had an average of 6 (SD = 3) nurse-coaching sessions during the 90-day post discharge period from the initial hospitalization. In the intervention group, 227 individuals (90%) used the IVR system at least once in the 30-day period following discharge, and 90 individuals (40%) used the system daily for the entire 30-day period. Of the 227 participants who used the IVR at least once over the 30-day post discharge period, 72 (32%) experienced at least 1 acute event, with a total of 92 acute events (readmissions or ED visits). For 59 events (64%), participants triggered a symptom alert on same day as the acute event, and, for 53 events (58%), they triggered an alert on the prior day. For 13 events (14%), participants triggered an alert on both days.

Primary Outcomes

We found no statistically significant differences in either 30-day or 90-day readmission incidence rates (Table 3). The 30-day readmission rates were 0.23 per person for the intervention group and 0.19 per person for the usual care group (difference, 0.04; 95% CI, –0.05 to 0.13; P = .36). The 90-day readmission incidence rates were 0.51 and 0.48 per person for the intervention and usual care groups, respectively (difference, 0.04; 95% CI, –0.12 to 0.19; P = .66). Similar results were found when the data were analyzed separately by condition (Table 3), and when adjusted for baseline covariates (eAppendix C).

Secondary Outcomes

Overall, as well as by condition, there was no statistically significant difference in ED visit incidence rates between intervention and usual care groups. For the entire sample, the 30-day ED visit incidence rate was 0.17 per person in the intervention group and 0.15 per person in

Table 2. Baseline Characteristics of All Study Participants

Characteristic	Number (%)[a]		*P*
	Usual care (n = 259)	Intervention (n = 253)	
Primary condition			
CHF	128 (49.4%)	129 (51.0%)	.72
COPD	131 (50.6%)	124 (49.0%)	
Female	153 (59.1%)	142 (56.1%)	.50
Age, mean (SD)	67.67 (11.78)	65.81 (12.15)	.08
Insurance			
Medicare	187 (72.2%)	171 (67.6%)	.59
Medicaid	22 (8.5%)	30 (11.9%)	
Commercial	34 (13.1%)	35 (13.8%)	
None	16 (6.2%)	17 (6.7%)	
Living Conditions			
With spouse/caregiver	174 (67.2%)	158 (62.5%)	.71
Alone	80 (30.9%)	89 (35.2%)	
Other	3 (1.2%)	3 (1.2%)	
Homeless	2 (0.8%)	3 (1.2%)	
NYHA level 3 & 4	124 (96.9%)	121 (93.8%)	.24
GOLD level 3 & 4	128 (97.7%)	124 (100.0%)	.09
Comorbidities			
Cerebrovascular disease	104 (40.2%)	120 (47.4%)	.10
Diabetes	95 (36.7%)	109 (43.1%)	.14
Obesity	77 (29.7%)	95 (37.5%)	.06
Chronic pain	60 (23.2%)	68 (26.9%)	.33
Renal disease	56 (21.6%)	61 (24.1%)	.50
Acute myocardial infarction	54 (20.8%)	49 (19.4%)	.68
Peptic ulcer disease	43 (16.6%)	44 (17.4%)	.81
Depression	32 (12.4%)	38 (15.0%)	.38
Cancer	28 (10.8%)	29 (11.5%)	.81
Mental disorder	28 (10.8%)	35 (13.8%)	.30
Liver disease	19 (7.3%)	21 (8.3%)	.68
PAM, mean (SD)	54.35 (12.52)	53.70 (14.82)	.59
Hospital utilization in prior 12 months			
Admissions (all cause), mean (SD)	1.72 (1.23)	1.85 (1.42)	.29
Hospital days (all cause), mean (SD)	8.10 (7.88)	8.72 (9.38)	.42
ED visits (all cause), mean (SD)	0.83 (1.85)	0.98 (1.85)	.36
CHF admissions, mean (SD)	0.40 (0.59)	0.46 (0.65)	.45
CHF hospital days, mean (SD)	2.04 (4.00)	2.02 (3.69)	.97
COPD admissions, mean (SD)	0.65 (0.88)	0.65 (0.78)	.97
COPD hospital days, mean (SD)	2.75 (3.99)	2.94 (4.75)	.73
LOS of index admission, mean (SD)	5.36 (3.90)	5.12 (4.21)	.51

CHF indicates congestive heart failure; COPD, chronic obstructive pulmonary disease; ED, emergency department; GOLD, Global Initiative for Chronic Obstructive Lung Disease; LOS, length of stay; NYHA, New York Heart Association; PAM, patient activation measure.
[a]Unless otherwise noted.

the usual care group (difference, 0.03; 95% CI, –0.05 to 0.11; *P* = .50). The 90-day ED visit incidence rates were 0.36 and 0.31 per person for intervention and usual care groups, respectively (difference, 0.05; 95% CI, –0.07 to 0.18; *P* = .41). Results were similar for CHF and COPD, when analyzed separately (Table 3), and when adjusted for baseline covariates (eAppendix C). Similarly, there was no statistically significant difference between groups in the composite rate, whether assessed in aggregate or separately by condition (Table 3).

Table 3. 30- and 90-day Readmission Incidence Rates and Emergency Department (ED) Visit Incidence Rates, by Study Group and Condition

Outcome[a]	Intervention	Usual care	Mean Difference (95% CI)	P[b]
Overall				
30-day readmission rate	0.233 (0.539)	0.193 (0.459)	0.040 (–0.047 to 0.127)	.364
90-day readmission rate	0.514 (0.894)	0.479 (0.869)	0.035 (–0.122 to 0.192)	.661
30-day ED visit rate	0.174 (0.473)	0.147 (0.459)	0.027 (–0.052 to 0.107)	.503
90-day ED visit rate	0.360 (0.735)	0.305 (0.823)	0.055 (–0.075 to 0.184)	.408
30-day composite rate[c]	0.407 (0.727)	0.340 (0.671)	0.067 (–0.053 to 0.187)	.271
90-day composite rate[c]	0.874 (1.291)	0.784 (1.294)	0.090 (–0.131 to 0.310)	.425
Congestive Heart Failure				
30-day readmission rate	0.248 (0.573)	0.188 (0.465)	0.061 (–0.066 to 0.187)	.347
90-day readmission rate	0.527 (0.961)	0.398 (0.807)	0.129 (0–.090 to 0.348)	.249
30-day ED visit rate	0.217 (0.544)	0.133 (0.459)	0.084 (–0.035 to 0.204)	.166
90-day ED visit rate	0.426 (0.818)	0.344 (1.007)	0.083 (0–.131 to 0.296)	.449
30-day composite rate[c]	0.465 (0.811)	0.320 (0.687)	0.145 (–0.033 to 0.322)	.110
90-day composite rate[c]	0.953 (1.419)	0.742 (1.427)	0.211 (–0.119 to 0.542)	.210
Chronic Obstructive Pulmonary Disease				
30-day readmission rate	0.218 (0.503)	0.198 (0.454)	0.019 (–0.099 to 0.138)	.750
90-day readmission rate	0.500 (0.821)	0.557 (0.921)	–0.057 (–0.279 to 0.165)	.613
30-day ED visit rate	0.129 (0.382)	0.160 (0.461)	–0.031 (–0.135 to 0.073)	.556
90-day ED visit rate	0.290 (0.635)	0.267 (0.593)	0.023 (–0.126 to 0.172)	.761
30-day composite rate[c]	0.347 (0.625)	0.359 (0.657)	–0.012 (–0.172 to 0.148)	.883
90-day composite rate[c]	0.790 (1.142)	0.824 (1.153)	–0.034 (–0.325 to 0.257)	.818

[a]Values represent rate per person over the specified period and (standard deviations) unless otherwise specified.
[b]Estimated using negative binomial regression.
[c]Composite rate includes both readmissions and ED visits over the specified period.

In the overall sample, 14 (5.5%) participants in the intervention group died within 90 days compared with 26 (10.0%) of participants in the usual care group (Table 4). While not statistically significant (P = .06), this difference was primarily driven by COPD participants, and among these participants, the 90-day mortality rate was significantly lower in the intervention group compared with the usual care group. Four (3.2%) individuals in the intervention group died by 90 days, compared with 15 (11.5%) receiving usual care (P = .81; risk ration = 0.90, 95% CI 0.40-2.05; risk difference = -0.01, 95% CI -0.08 to 0.06). Among CHF participants, there was no statistically significant difference between groups in the rates of death at 90 days. Ten (7.8%) participants in the intervention group

Table 4. Mortality Rates at 90 Days, by Study Group and Condition

Mortality (≤90 days)[a]	Intervention	Usual Care	Risk Ratio (95% CI)	Risk Difference (95% CI)	*P*
Overall	14 (5.5)	26 (10.0)	0.55 (0.29-1.03)	–0.05 (–0.09 to 0.00)	.06
CHF	10 (7.8)	11 (8.6)	0.90 (0.40-2.05)	–0.01 (–0.08 to 0.06)	.81
COPD	4 (3.2)	15 (11.5)	0.28 (0.10-0.83)	–0.08 (–0.15 to –0.02)	.01

CHF indicates congestive heart failure; COPD, chronic obstructive pulmonary disease.
[a]Values presented as number (%).

died by 90 days compared with 11 (8.6%) of those receiving usual care (P = .81; risk ration = 0.90, 95% CI 0.40-2.05; risk difference = -0.01, 95% CI -0.08 to 0.06). Results were similar when mortality rates were adjusted for baseline covariates (**eAppendix D**).

DISCUSSION

To inform the design of hospital efforts to avoid financial penalties for readmissions, we tested a comprehensive set of transitional care activities under a hospital's control,[4,6] and added 2 additional components—MI-based health coaching and symptom monitoring using IVR. Despite the robustness of the intervention, it failed to reduce readmissions or ED visits for participants hospitalized for CHF or COPD.

There are several potential explanations for the lack of effect. The first is the possibility that the intervention was poorly executed. While IVR adherence was below 100%, engagement rates were similar to those reported in Chaudhry et al[27] that utilized the same IVR system in their randomized controlled trial of CHF patients (which failed to find a reduction in all-cause 180 day readmissions). Similarly, the quality of MI was at levels above the proficiency threshold, and MI has been found to be an effective intervention for the complex conditions found in healthcare settings.[28] Moreover, PAM scores, a measure of patient activation and a marker for patient self-management, showed significantly greater increases among the intervention participants over the 90-day post discharge period (data available from the authors).

A second explanation is that the study population was sufficiently ill to the extent that readmissions were not avoidable. Indeed, a recent study indicated that only 10% of the acute care costs incurred in a cohort of high-cost Medicare patients, with clinical characteristics similar to those of our study population, were considered preventable.[29] However, other studies have successfully reduced readmissions in chronically ill individuals using many of the same intervention components as those used in the current study.[22-24,30]

A third explanation is that the intervention components that we were not able to include—home visits and ambulatory follow-up care—were essential. That is, even increasing self-management skills and patient activation among intervention participants may not have been sufficient to overcome shortcomings in patients' clinical management after they were discharged. While home visits might have helped reduce readmissions, only 3 of 9 studies reviewed by Hansen et al[4] that included such visits found statistically significant reductions in readmissions. Given that our study participants had ready access to the study nurses, the lack of home visits is unlikely to explain the null finding.

On the other hand, evidence does suggest that patients receiving early follow-up ambulatory care after discharge have lower rates of all-cause 30-day readmission.[31,32] Study nurses did send letters to the PCPs of the intervention participants after discharge, call clinic staff to assist with follow-up appointments, and encourage participants to visit their PCP when experiencing a change in symptoms or health status. However, as our study did not include the active or formal participation of community-based providers, these activities may not have been sufficient to ensure robust provider continuity and timely clinic follow-up. We have reason to believe this to be the primary factor limiting the effectiveness of the intervention. In an extensive review of intervention group cases with the nurses at the completion of the study, in all but 1 case, the patients' providers either declined to schedule a same-day appointment or instructed the study nurses to send the patients directly to the ED. In the single case where the physician did schedule a same-day visit, the acute exacerbation was resolved in the outpatient setting. Thus, there is anecdotal evidence to suggest that in our study, early and effective primary medical care could have prevented at least some readmissions.

Taken together, there is a real possibility that standalone community hospitals may have limited impact on the prevention of readmission for severely ill patients with COPD or CHF, despite the use of comprehensive, evidence-based interventions that are within their con-

trol. Nonetheless, instituting programs that increase patient engagement in self-management may still be beneficial, and the reduction in mortality among COPD patients in our study is particularly encouraging. Improved self-management may have been beneficial to COPD patients in our study because of the nature of the self-care regimens. Vestbo et al[33] found that adherence to inhaled medication was significantly associated with reduced risk of death due to exacerbations in COPD, and it appears that this effect was nearly immediate. Our study nurses reported that, at enrollment, many COPD participants had either been nonadherent to their inhaled medications or had been using inhalers incorrectly. Intervention participants received substantial instruction on the correct use of these medications, and the MI sessions focused on evoking the benefits of the treatment plan. This may explain the reduction in mortality among COPD patients that we found.

Our study had multiple strengths. First, we had 512 participants, which is larger than the 73% of the randomized control trials reported by Hansen et al.[4] Second, we selected 2 medical conditions that have high readmission prevalence and are the focus of Medicare's policy to penalize hospitals for 30-day readmissions. Third, our robust intervention included MI and IVR, 2 separately effective interventions that heretofore have not been included, or studied, as integral components of the transitional care model. And fourth, our study was conducted in 2 standalone community hospitals, rather than in an academic hospital or integrated health system where most clinical trials are typically conducted.

Our study also had limitations. We did not have access to data on readmissions or ED visits that may have occurred at other facilities, beyond self-reported data from participants. However, we can presume any missed data to be evenly distributed between intervention and control groups due to randomization. Additionally, our study was conducted at 2 hospitals in southern Oregon, which may limit the generalizability of the results to other areas of the country, although no specific factors emerged suggesting unique geographic influences on the intervention. Finally, as described above, we did not include home visits or have the ability to ensure timely follow-up ambulatory care.

In summary, a comprehensive hospital-based intervention failed to reduce 30- or 90-day readmissions as well as ED visits for patients with CHF or COPD, compared with usual care. It did, however, reduce 90-day mortality among COPD patients. Our results suggest the need to continue to experiment with new interventions targeting readmissions—in particular, those focused on building collaborative relationships between hospitals and community-based providers. In the interim, our results point to a challenging road ahead for hospitals seeking to decrease readmissions for chronically ill patients and avoid financial penalties.

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