CLINICAL RESEARCH STUDY

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Improving Transitions to Postacute Care for Elderly Patients Using a Novel Video-Conferencing Program: ECHO-Care Transitions

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ABSTRACT

PURPOSE: Within 30 days of hospital discharge to a skilled nursing facility, older adults are at high risk for death, re-hospitalization, and high-cost health care. The purpose of this study was to examine whether a novel videoconference program called Extension for Community Health Outcomes-Care Transitions (ECHO-CT) that connects an interdisciplinary hospital-based team with clinicians at skilled nursing facilities reduces patient mortality, hospital readmission, skilled nursing facility length of stay, and 30-day health care costs.

METHODS: We undertook a prospective cohort study comparing cost and health care utilization outcomes between ECHO-CT facilities and matched comparisons from January 2014-December 2014.

RESULTS: Thirty-day readmission rates were significantly lower in the intervention group (odds ratio 0.57; 95% CI, 0.34-0.96; *P*-value .04), as were the 30-day total health care cost ($2602.19 lower; 95% CI, −$4133.90 to −$1070.48; *P*-value <.001) and the average length of stay at the skilled nursing facility (−5.52 days; 95% CI, −9.61 to −1.43; $P = .001$). The 30-day mortality rate was not significantly lower in the intervention group (odds ratio 0.38; 95% CI, 0.11-1.24; $P = .11$).

CONCLUSION: Patients discharged to skilled nursing facilities participating in the ECHO-CT program had shorter lengths of stay, lower 30-day rehospitalization rates, and lower 30-day health care costs compared with those in matched skilled nursing facilities delivering usual care. ECHO-CT may improve patient transitions to postacute care at lower overall cost.

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KEYWORDS: Care transitions; ECHO; Readmissions

As the population of the US ages, ensuring efficient and effective transitions of care for elderly patients from the hospital to postacute care settings has become increasingly urgent. Older adults are disproportionately affected by poor transitions of care because they account for a large percentage of transfers between health care sites. Frail older

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Conflict of Interest: None.

Authorship: LAL and MLPM conceived of the project. LAL, MLPM, and GF served as principal investigators for ECHO-CT during the period studied. JEK helped collect data, conducted the statistical analysis, and contributed to revisions and submission of the manuscript. AA provided patient data and participated in manuscript preparation. TGT and ABD guided the statistical analysis. MS wrote the first draft of the manuscript. ABM wrote subsequent and final drafts of the manuscript and served as a principal investigator for the ECHO-CT project at the time of article submission. All of the authors made comments and revisions to the final manuscript.

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adults, or those with cognitive impairment, often cannot participate in the discharge process, which increases the risk that information is lost or incomplete during care transitions. This imperfect process predisposes older patients to hospital readmission from skilled nursing facilities.[1] In many cases, adverse health outcomes are tied to poor-quality transitions, including inconsistencies with medications and follow-up care.[2] Coordination of care across institutions is cited in the literature as a challenge facing teams hoping to secure effective transitions for their patients,[3] but fragmentation across settings, disjointed communication, a paucity of effective transportation options, and lack of standardization, often coupled with adverse financial incentives, pose formidable barriers.[4-6] The current system of transitioning patients results in excessive costs. In one study, 24% of Medicare beneficiaries were readmitted to the hospital from a skilled nursing facility within 30 days at a cost of $4.34 billion. Rehospitalizations from skilled nursing facilities increased by 29% from 2000-2006.[7] Furthermore, in a study of 3254 Medicare beneficiaries admitted to a skilled nursing facility, 18% were re-hospitalized within 30 days, and a third of these re-hospitalizations occurred within a week of discharge.[8] Therefore, a coordinated team effort between hospital and skilled nursing facility is needed to ensure patient safety and improve the value of care provided.

CLINICAL SIGNIFICANCE

- The Extension for Community Health Outcomes-Care Transitions (ECHO-CT) program connects a hospital-based team with clinicians at postacute care facilities to discuss issues arising during transitions of care.
- Patients discharged to facilities participating in the program had shorter skilled nursing facility lengths of stay, lower rehospitalization rates, and lower health care costs compared with those in matched skilled nursing facilities delivering usual care.
- The ECHO-CT program may improve outcomes and lower costs in the postdischarge period.

Project Extension for Community Healthcare Outcomes (ECHO) began at the University of New Mexico in 2003 under the guidance of Sanjeev Arora, a hepatologist who recognized the need to empower rural health care providers with the skills necessary to effectively treat patients with hepatitis C.[9] Project ECHO uses video-communication technology to connect relatively isolated rural providers with subspecialist experts at the academic medical center to improve care delivery at remote health care sites. Project ECHO now addresses 60 disease areas and operates out of 94 academic and expert hubs in the US, and in 16 other countries.[10]

In 2013 we adopted the ECHO model to improve transitions of care for older adult patients discharged from Beth Israel Deaconess Medical Center medical and surgical inpatient services to postacute care settings. The aim of this study was to determine the impact of the ECHO-Care Transitions (CT) intervention on patient mortality, hospital readmission, skilled nursing facility length of stay, and cost of health care within a 30-day period after discharge.

METHODS

Design

We conducted a prospective cohort study comparing the 1-year outcomes of skilled nursing facilities participating in the ECHO-CT program to those receiving standard care, while adjusting for baseline differences in facility case mix (aggregated patient comorbidity) and the baseline rate of the outcome of interest.

Subject Inclusion and Exclusion Criteria

All patients discharged in 2014 from the hospital to a skilled nursing facility for short-term rehabilitation, as defined by <100 days of skilled nursing facility care, were eligible for this study. The intervention group consisted of pioneer accountable care organization beneficiaries discharged to a partnering skilled nursing facility who were discussed during an ECHO-CT session; the standard-care group consisted of accountable care organization beneficiaries discharged from the hospital to another (non-ECHO-CT partner) skilled nursing facility. Participating and nonparticipating skilled nursing facilities were matched as described below. Patients were identified from a weekly hospital report using the criteria stated above (total N = 1059). Patients who were not members of the accountable care organization were excluded from the study because data for these individuals were not available (n = 271). Standard-care patients who were discharged to a skilled nursing facility that was dissimilar in size and Center for Medicare and Medicaid Services (CMS) quality rating from the intervention facilities were excluded (n = 292) in order to control for institutional level biases on patient outcomes. Patients were excluded if discharged to a facility from which baseline differences in facility case mix and the outcome of interest could not be obtained (n = 113). Patients with missing data were also excluded from the study (n = 21).

In order to establish baseline data (facility case mix and outcomes of interest), data on patients discharged in 2013 were collected, following the same inclusion/exclusion criteria as for the 2014 group.

Intervention

ECHO-CT video-conference sessions were conducted weekly for 1.5 hours, and consisted of discrete, 15-minute,

face-to-face discussions between the hospital and skilled nursing facility care teams using secure video-communication technology (provided by Polycom, San Jose, Calif). This technology allows for secure pathways for connection and encryption and a mechanism to inform medical center staff of all participants on the call. Additionally, the call is monitored in real time, allowing for information technology staff on the project to know at all times who is on the call and how they are connected. Skilled nursing facility participants included nurses, doctors, and occasionally, physical therapists and trainees. The hospital-based team included a pharmacist, social worker, hospitalist facilitator, and project manager. In addition, trainees, primary care physicians, and the primary inpatient team frequently attended. All but 17 patients discharged from the hospital over the week prior to the conference were discussed. Discussions of an individual patient varied in duration from a few minutes to up to 10 minutes, depending on medical complexity and postdischarge concerns that arose at the skilled nursing facility. During this time, a thorough patient review was conducted. This included a summary of the hospital course, an update on the patient's current condition, a review of medications, and discussion of challenges or questions related to the care plan. Most commonly, interventions involved tailoring disease management of the following conditions: musculoskeletal pain, hip fracture, gastrointestinal pathology, heart failure, renal failure, and delirium. For example: in a patient admitted with heart failure, volume status and recent labs would be discussed and a diuretic management plan would be revised based on this information and the patient's history of diuretic use as provided by the pharmacist. Additionally, the team addressed prescribing discrepancies and deficiencies, such as discrepant doses or durations of medications between the hospital, skilled nursing facility, and home medication list, or the omission of recommended drugs such as calcium and vitamin D after a fracture.[11] Each review concluded with an opportunity for the team to reflect on areas for improvement in the care transition process. The sessions encouraged bidirectional collaboration and learning between providers at the hospital and postacute care facilities. The agenda for each discussion as well as details of the case were saved in a secure drive following the session. Additionally, a note was placed in the hospital medical record detailing the conversation for other providers who may be involved in the patient's care.

Description of Variables

Age was calculated as the difference between the date of birth and the date of hospital discharge. Sex was supplied by the accountable care organization and obtained from the CMS. Because patient comorbidity is believed to significantly affect readmission, risk of death, treatment, and cost of care, all analyses were adjusted for the Charlson comorbidity index score.[12] We calculated the Charlson comorbidity index using patients' chronic conditions that were reported in Medicare claims data supplied by the accountable care organization.

The outcome variables, measured from the day of hospital discharge, included 30-day hospital readmission rate and 30-day mortality. We also measured skilled nursing facility length of stay for patients who were not readmitted to the hospital or did not die within 30 days of discharge. Total cost of health care within a 30-day period from hospital discharge was calculated from Medicare claims data provided by the accountable care organization.

Matching

Each skilled nursing facility in the ECHO-CT group was matched to between 4 and 11 standard-care facilities based on their CMS 5-star rating and size (stratified by $<$100 beds, 100-140 beds, and $>$140 beds) as reported on the CMS nursing home compare website.[13]

Statistical Analysis

In general, individual-level data were not available for the same individuals in 2013 and 2014. In order to ensure model coherence and prevent double expression of covariate measurements, we used individual-level covariates obtained on participants in 2014 while generating facility-specific means generated from individuals observed in 2013. The 2013 facility-level averages of the Charlson comorbidity index and the outcome variables were used to adjust for baseline facility differences between those exposed to the ECHO-CT intervention and those receiving standard care. As our intervention began at the end of 2013, we did not include ECHO participants (n = 49) in calculating these averages.

To determine the effect of the ECHO-CT intervention on the outcomes, we used multivariate conditional logistic regression at the individual level (for categorical outcomes) to estimate odds ratios (OR) and 95% confidence intervals (CI), or linear regression at the individual level (for continuous outcomes) to calculate differences and CI, using generalized estimating equations to account for the facility-level clustering and matched study design. Each model adjusted for age, sex, 2014 Charlson comorbidity index (individual level), the 2013 Charlson (facility level), and the 2013 facility average of the relevant outcome variable. All analyses were conducted using SAS version 9.4 (SAS Institute, Inc, Cary, NC).

This research was approved by the Institutional Review board at Beth Israel Deaconess Medical Center in Boston, Mass.

RESULTS

Group Characteristics

The characteristics of the ECHO-CT and standard-care comparison groups prior to (2013) and during (2014) the intervention are shown in **Table 1**. In 2014, there were 148

Table 1 Facility Characteristics

	ECHO-CT Preintervention (2013)	ECHO-CT Postintervention (2014)	Standard-Care Preintervention (2013)	Standard-Care Postintervention (2014)
Number of patients	213	148	220	214
Number of facilities	6	6	41	41
Sex (female), n (%)	142 (66.7)	105 (71)	134 (60.9)	125 (58.4)
30-day readmission rate, n (%)	39 (18.3)	23 (15.5)	40 (18.2)	52 (24.3)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Age at time of discharge (y)	80.6 (10.8)	81.3 (11.0)	81.0 (9.5)	79.9 (10.0)
Charlson comorbidity index	5.8 (3.2)	5.8 (3.4)	6.5 (3.2)	6.5 (3.5)
Hospital length of stay (d)	6.1 (4.2)	5.3 (2.9)	6.8 (5.3)	6.3 (4.4)
SNF length of stay (d)	21.2 (14.2)	19.9 (10.2)	27.8 (20.6)	26.4 (18.4)
30-day health care cost 30 day (dollars per patient)	17,053 (10,239)	17,443 (9633)	18,212 (11,427)	20,294 (12,701)

ECHO-CT = Extension for Community Health Outcomes-Care Transitions; SNF = skilled nursing facility.

patients who received the intervention and 214 in the comparison group, such that a total of 362 individuals were eligible for analyses (Table 1). There were 213 patients discharged to partnering skilled nursing facilities (6 facilities) during the preintervention phase of the study (2013) and there were 220 patients discharged to standard-care skilled nursing facilities (41 facilities), such that 433 individuals contributed data to the facility-level summaries used as covariates.

The mean age at time of discharge was roughly the same for both years and both groups (intervention and standard care). The proportion of women to men increased in the intervention group (from 66.7% to 71%), while it decreased in the standard-care group (from 60.9% to 58.4%). The mean Charlson comorbidity index remained stable in the intervention group (5.8) and in the comparison group (6.5).

Unadjusted Analyses

In 2013, the readmission rate for patients was approximately equal between the intervention and standard-care groups. In 2014, the readmission rate fell in the intervention group (from 18.2% to 15.5%), whereas it rose in the standard-care group (from 18.3% to 24.3%; Figure). The skilled nursing facility length of stay was higher in the standard-care group initially, and was reduced by 1.3 days in the intervention group and 1.4 days in the standard-care group. Thirty-day total health care cost increased in both groups; however, the increase was smaller in the intervention group than it was in the standard-care group ($390 vs $2082, respectively; Figure). The 30-day mortality rate fell in both groups. Given low event rates, mortality rates are not reported.

Adjusted Analyses

After adjusting for covariates and baseline (2013) rates of the relevant outcome, readmission rates were lower in the intervention group than in the standard-care group (OR 0.57; 95% CI, 0.34-0.96; $P = .034$; Table 2). The adjusted difference between the intervention and standard-care group in 2014 also showed a reduction in skilled nursing facility length of stay (mean estimate −5.52 days; 95% CI, −9.61 to −1.43; $P = .01$).

The adjusted 30-day total health care cost analysis revealed significant savings in the intervention group compared with the standard-care group (mean estimate −$2602.19 per patient; 95% CI, −$4133.90-$1070.48; $P < .001$). The decrease in the 30-day mortality rate was not significantly different between the intervention and the standard-care group (OR 0.38; 95% CI, 0.11-1.24, $P = .11$).

DISCUSSION

Our study demonstrated that participation in ECHO-CT was associated with reduced hospital readmission rates, skilled nursing facility length of stay, and total health care spending within a 30-day period from hospital discharge. No significant difference was found in 30-day mortality rates. These encouraging clinical outcomes may be due to a number of aspects of the video-communication intervention. When considered in light of our previously published medication reconciliation data, it is possible that a reduction in medication errors prevented prolonged skilled nursing facility stays and rehospitalizations.[11] The presence of the pharmacist was helpful in identifying medication-related errors arising in the postdischarge period. For example, a medication may not have been appropriately adjusted to account for changing renal function, or a medication may not have been stopped or started at the appropriate time. These errors were often identified and corrected by the multidisciplinary team, likely contributing to our improved outcomes.

Additionally, the positive outcomes observed in this study may have resulted from improved care coordination, identification of and adherence to goals of care, and disease management, as these topics were frequently discussed in the multidisciplinary meetings. While our study did not show improvements in mortality, this may be due to the relatively few deaths and short follow-up period.

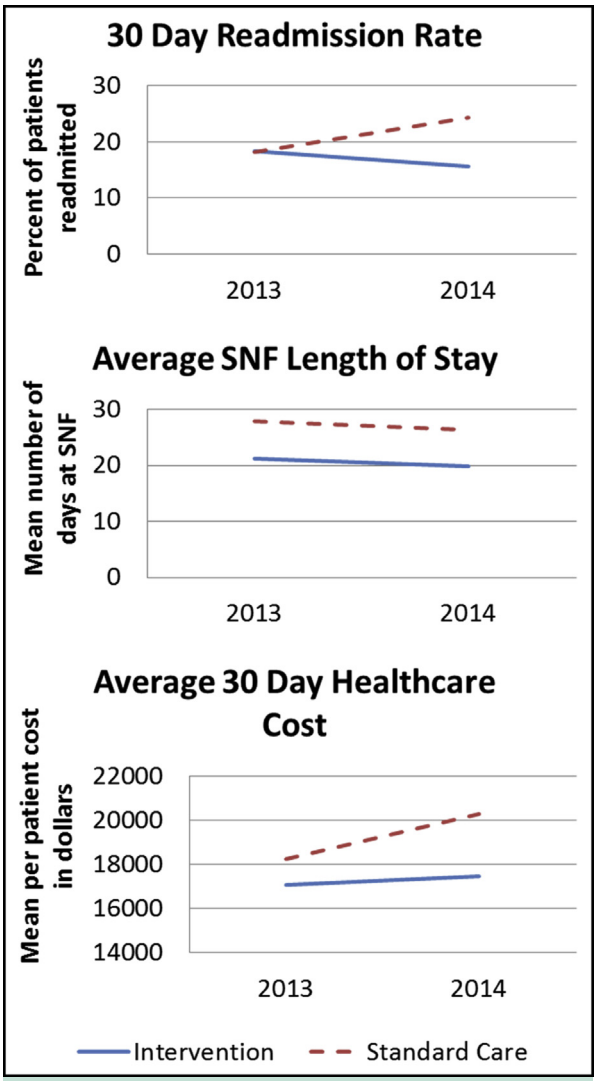

Figure Average changes in outcome measures from 2013 baseline to 2014. SNF = skilled nursing facility.

Mortality benefits may be observed over a longer time period. Other groups have reported benefits of telehealth outside of those measured in our study, such as functional improvement[14]; therefore, it is also possible that the benefits of ECHO-CT extend beyond the outcomes measured in this study.

The reduction in average cost of about $2600 per patient may translate into a large savings for health care organizations. For example, enrolling 400 patients in the ECHO-CT model would result in a savings of approximately $1.04 million. We estimate that yearly operational costs of the program for 400 patients are $120,000, which suggests that the program offers nearly a ninefold return on investment.

Our study had several limitations. Because we were unable to assess the root cause of a rehospitalization or prolonged length of stay, we cannot be certain that the ECHO-CT intervention included processes that would affect these outcomes. Also, without a randomized controlled design, we cannot exclude the possibility of unmeasured confounders that could have affected our results. For example, skilled nursing facilities selected for our intervention needed to demonstrate commitment to participating in these sessions; this may have led to a group of intervention facilities that were overall more committed to improvement and innovation. This may have resulted in improved outcomes that cannot solely be attributed to our intervention. In selecting matched standard-care skilled nursing facilities, our data did not allow us to ascertain if any of the beds marked for a short-term stay were actually being used for long-term care. Therefore, facilities were matched on total bed size rather than number of short-stay beds. The designation of short- vs long-term care could represent differences in staffing and care of patients, which then could introduce hidden differences between facilities. Additionally, there may have been misclassification in a patient's designation as short-term rehabilitation or as long-term care (ie, length of stay >100 days). Any misclassification would be expected to occur equally across intervention and standard-care sites and is therefore unlikely to influence outcomes. Finally, other interventions or processes in the hospital and skilled nursing facilities aimed at improving transitions of care may have affected outcomes. Differences in care delivery and number of patients per provider, as well as practice styles of individual providers, were not standardized across sites and may have influenced results. However, these factors are likely to be randomly distributed across our intervention and standard-care groups and are therefore unlikely to bias our results.

Overall, our data suggest that a video-communication platform to improve interdisciplinary teamwork between discharging and receiving facilities is a cost-effective investment of resources for a health care system and can improve patient outcomes. Future studies are needed to

Table 2 Adjusted Analyses of Outcomes Associated with the ECHO-CT Intervention

Model	Odds Ratio	Confidence Intervals		*P*-Value
30-day readmission	0.57	0.34	0.96	.04
30-day mortality	0.38	0.11	1.24	.11
	Mean Estimate			
SNF length of stay (d)	−5.52	−9.61	−1.43	.01
30-day health care cost ($ per patient)	−2602.19	−4133.90	−1070.48	<.001

ECHO-CT = Extension for Community Health Outcomes-Care Transitions; SNF = skilled nursing facility.

determine whether these benefits can be replicated at other hospitals and partnering postacute care sites.

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