A Novel Intervention for High-Need, High-Cost Medicaid Patients: a Study of ECHO Care

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BACKGROUND: A small number of high-need patients account for a disproportionate amount of Medicaid spending, yet typically engage little in outpatient care and have poor outcomes.

OBJECTIVE: To address this issue, we developed ECHO (Extension for Community Health Outcomes) Care™, a complex care intervention in which outpatient intensivist teams (OITs) provided care to high-need high-cost (HNHC) Medicaid patients. Teams were supported using the ECHO model™, a continuing medical education approach that connects specialists with primary care providers for case-based mentoring to treat complex diseases.

DESIGN: Using an interrupted time series analysis of Medicaid claims data, we measured healthcare utilization and expenditures before and after ECHO Care.

PARTICIPANTS: ECHO Care served 770 patients in New Mexico between September 2013 and June 2016. Nearly all had a chronic mental illness, and over three-quarters had a chronic substance use disorder.

INTERVENTION: ECHO Care patients received care from an OIT, which typically included a nurse practitioner or physician assistant, a registered nurse, a licensed mental health provider, and at least one community health worker. Teams focused on addressing patients' physical, behavioral, and social issues.

MAIN MEASURES: We assessed the effect of ECHO Care on Medicaid costs and utilization (inpatient admissions, emergency department (ED) visits, other outpatient visits, and dispensed prescriptions.

KEY RESULTS: ECHO Care was associated with significant changes in patients' use of the healthcare system. At 12 months post-enrollment, the odds of a patient having an inpatient admission and an ED visit were each reduced by approximately 50%, while outpatient visits and prescriptions increased by 23% and 8%, respectively. We found no significant change in overall Medicaid costs associated with ECHO Care.

CONCLUSIONS: ECHO Care shifts healthcare utilization from inpatient to outpatient settings, which suggests decreased patient suffering and greater access to care, including more effective prevention and early intervention for chronic conditions.

KEY WORDS: ECHO model; multidisciplinary primary care teams; complex care; high-need high-cost patients; Medicaid.
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INTRODUCTION

Approximately 5% of the US population accounts for nearly 50% of healthcare expenditures.[1] These high-need, high-cost (HNHC) patients have a complicated relationship with the healthcare system. The care they receive, despite high expenditures, is often poorly matched to their complex health needs; high rate of emergency department (ED) use is a symptom of this mismatch.[2] Further, low-income HNHC patients, such as those insured by Medicaid, often face social barriers to accessing effective care—such as a lack of dependable housing.[3] Pairing HNHC patients with appropriate care is crucial for improving their use of healthcare resources.

Complex care interventions attempt to connect HNHC patients with healthcare that meets their needs. Successful interventions provide patient-centered care through community-based care coordination, integration of medical and behavioral health services, and addressing social barriers.[4] Some of these interventions lead to reduced ED and inpatient hospitalizations; others decrease healthcare expenditures over time.[5–7] Despite these successes, interventions often rely on referral to multiple specialists to address the complex medical needs that are outside the expertise of the primary healthcare team. Although this is common practice, referrals can lead to fragmentation of care and often involve traveling great distances to receive care, which can be burdensome to patients.[8, 9] Supporting primary care teams to manage the complex needs

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of HNHC patients with less dependence on referrals could further reduce patients' barriers to accessing care.

To connect HNHC Medicaid patients across New Mexico (NM) with appropriate care—and to support the teams providing that care—between September 2013 and June 2016, we piloted ECHO Care, a program that integrated the ECHO (Extension for Community Health Outcomes) model with outpatient complex care. The ECHO model connected outpatient intensivist teams (OITs) with a panel of specialists, providing a forum for case-based mentoring and guided practice.[10] Complex care was provided by OITs that exclusively served ECHO Care patients, and included case management, flexible scheduling, integrated physical and behavioral healthcare, and attention to social barriers. To determine whether ECHO Care enrollment correlated with improved healthcare utilization in a cost-effective manner, we analyzed Medicaid claims and internal program costs.

METHODS

The ECHO Care Intervention

Six OITs across NM were modeled after the ambulatory intensive caring unit (aICU) model, in which a dedicated OIT provided intensive primary care and wrap-around services to a small number of HNHC patients.[4, 11, 12] Teams typically consisted of a primary medical provider (nurse practitioner or physician assistant (NP/PA)), a registered nurse, a licensed mental health provider (social worker or counselor), and at least one community health worker (CHW). Teams were supported by a part-time physician—to help with complex medical decision-making and prescribing buprenorphine—and a part-time administrative assistant.

The interdisciplinary nature of the OITs was important to address the physical and behavioral health needs of the ECHO Care patients while simultaneously addressing social barriers that often prevented their engagement in care. Teams used patient-centered approaches, including motivational interviewing, goal setting and coaching, and providing walk-in appointments and after-hours support using a 24-h on-call system. Patient visits by OITs occurred in the clinic (58%) and in patients' homes (40%). Teams' ability to provide home-based care was strengthened by the CHWs, who spent extended time with patients to address their social needs as a foundation for further engagement in care.[13]

In addition to an intensive, in-person training, OITs were supported using the ECHO model, which connected them to a multidisciplinary team of specialists in weekly video-conferenced teleECHO™ sessions. The Complex Care teleECHO provided OITs with expert advice on complex topics using case-based mentoring.[14] ECHO specialists focused on helping the OITs make accurate diagnoses, develop treatment plans, prioritize issues based on the patients' goals, and avoid errors or dangerous interactions among diagnostic and therapeutic approaches. A full description of the Complex Care teleECHO is described in a parallel report.[15]

Patient Enrollment

We selected six OIT sites based on a preliminary analysis of Medicaid claims that estimated the number of eligible HNHC Medicaid patients using criteria that were based on previous complex care intiatives.[16, 17] Specifically, we required patients to: (1) be $\geq$18 years of age; (2) be enrolled in Medicaid Managed Care; (3) have 2 or more chronic conditions; and (4) have either 2 hospitalizations in the past 12 months, with 1 in the last 6 months (excluding hospitalizations due to trauma or pregnancy) or, 3 or more ED visits in the past 6 months. Dual enrollment in Medicare was an exclusion criterion because we were unable to track Medicare claims. Patient referrals occurred on a rolling basis and came from Medicaid Managed Care Organizations (MCOs), hospitals, outpatient providers, and social service agencies.

Data Inclusion Criteria

Only ECHO Care patients with Medicaid data available from at least 3 months pre-enrollment through 1 month post-enrollment were used in our analysis. Of the 770 patients enrolled in ECHO Care, 622 patients met these criteria. However, many of these patients did not have Medicaid data for the complete analysis timeframe—36 months pre-enrollment through 21 months post-enrollment (Appendix Figure 1). The incomplete data results from three factors: some patients were not insured by Medicaid for the full 3 years prior to enrollment in ECHO Care; some patients were disenrolled prior to 21 months; and we only had access to Medicaid data through December 2015, despite the program continuing through June 2016.

Analysis of Healthcare Utilization and Expenditures Using Medicaid Claims

The study protocol was approved by the Institutional Review Board at the University of New Mexico Health Sciences Center (HRPO No. 12-617). We used Medicaid claims data to conduct an interrupted time series (ITS) analysis[18, 19] to compare healthcare utilization and expenditure trends relative to enrollment. We analyzed non-obstetric/non-trauma hospital (inpatient) admissions, ED visits, (non-ED) outpatient visits, dispensed prescriptions, and Medicaid expenditures by month. For pre-enrollment trends, our analysis timeframe ran from 36 to 6 months prior to enrollment. We excluded the 6 months immediately prior to enrollment because ECHO Care patients often had high expenditures and utilization during this time period due to the enrollment criteria, and we wanted to avoid having our results driven by regression to the mean. Our analysis timeframe for the post-enrollment trends ran from enrollment to 21 months after enrollment.

Linear mixed effects and generalized linear mixed effects models were used to analyze the trends associated with each outcome measure. Random effects associated with individual patients and the six OITs were used to characterize both within-patient and within-OIT correlations. Because each month of our study timeframe included a different mix of patients (Appendix Figure 1), the models were adjusted for gender, age, Charlson index, diagnosis of schizophrenia or other psychotic disorders, and diagnosis of chronic substance use disorder. We also characterized the heterogeneity of our study population by reporting means and standard deviations (SD) across our study timeframe for each patient characteristic (Table 1).

Linear models were used for continuous outcomes (i.e., expenditures) and Poisson regression for count outcomes (i.e., outpatient visits and dispensed prescriptions). Although inpatient and ED visits are also count outcomes, they did not meet the criteria for a Poisson regression—e.g., a disproportionate number of patients had no ED or inpatient visits in a given month. Instead, we created dichotomous outcomes (e.g., any ED visit in a given month) and conducted a logistic regression.

Based on the fitted models, we compared the outcomes 12 months after ECHO Care enrollment with the counterfactual outcomes—i.e., assuming the patients had not enrolled in ECHO Care and, instead, continued with pre-enrollment trends. For illustration, we evaluated the actual and counterfactual models at 12 months post-enrollment for a typical patient—i.e., male, with substance use disorder, without schizophrenia or another psychotic disorder, and with the sample's mean age and Charlson index when the model includes these covariates. Confidence intervals were calculated for the difference (linear models) or ratio (generalized linear models) between the actual and counterfactual outcomes. The analyses were conducted using SAS v9.4 and R v3.41.

Analysis of the Changes in Medicaid Costs

Medicaid expenditures do not take into account the cost of the intervention—i.e., the OITs or Complex Care teleECHO—because these components did not result in paid claims. The MCOs paid the OIT salaries and our federal grant covered the teleECHO program. We calculated the average per member per month (PMPM) cost of these components during

Table 1 Characteristics of ECHO Care Patients

	Results at enrollment	Mean (SD) across the study timeframe*
Characteristics from intake assessment data (sample size at enrollment)*		
Female ($n = 622$)	50.3%	55.6% (3.4)
Average age ($n = 622$)	45.1 years	48.7 years (0.5)
Race ($n = 366$)**		
White	64.2%	70.0% (3.8)
American Indian	3.3%	4.1% (0.8)
Black	3.8%	3.7% (0.5)
Other	28.7%	22.1% (4.4)
Hispanic ($n = 383$)	69.7%	73.4% (3.0)
Education ($n = 329$)		
Less than high school diploma	54.7%	56.1% (1.4)
High school diploma	16.4%	14.8% (1.4)
Some college or higher	28.9%	29.1% (0.8)
Not employed ($n = 338$)	90.8%	93.6% (1.7)
Housing problem ($n = 346$)	41.6%	38.4% (2.3)
Feel afraid of partner or other family ($n = 323$)	13.3%	14.8% (1.6)
Self-rated health ($n = 316$)**		
Excellent or very good	3.5%	3.5% (0.4)
Good	18.7%	18.6% (1.2)
Fair	38.3%	37.4% (1.5)
Poor	39.6%	40.4% (0.9)
Characteristics from Medicaid claims data ($n = 622$)†		
Patients with chronic medical conditions		
Chronic physical conditions	99.5%	99.8% (0.2)
Chronic mental health conditions	96.9%	97.4% (0.8)
Mood disorders (depression, bipolar disorders)	86.2%	88.5% (1.6)
Schizophrenia and other psychotic disorders	38.9%	40.1% (2.8)
Chronic substance use disorders	77.8%	77.2% (1.6)
Patients with chronic mental illness and substance use disorder	77.0%	76.7% (1.7)
Mean Charlson index§	4.7	5.2 (0.4)

*In general, the sample size at enrollment was 622 patients and varied from 350 patients at 36 month prior to enrollment in ECHO Care to 107 patients at 21 months post-enrollment (see Appendix Figure 1). For certain intake assessment parameters, the sample size is smaller at enrollment because of non-response

**Percentages do not sum to 100% due to rounding

†ICD diagnostic claims codes were categorized based on the Agency for Healthcare Research and Quality (AHRQ) Clinical Classifications Software (CCS) chronic categories. Further information about the analysis and the definitions of each category can be found in the Appendix Methods

§The Charlson index is used to estimate the survival rate for patients with 17 specific comorbid diseases. The higher the score, the more likely mortality or increased use of healthcare resources. Further details are given in the Appendix Methods

the pilot as well as under other scenarios. As with our utilization analysis, we compared the PMPM Medicaid costs (i.e., Medicaid expenditures plus cost of the intervention) 12 months after ECHO Care enrollment to the counterfactual outcome.

We also grouped costs into six categories—inpatient admissions, ED visits, outpatient visits, dispensed prescriptions, and other—and used the methods described in the section above to determine how they were re-distributed under ECHO Care. "Other" costs included, for example, long-term care, personal care, home health, comprehensive case management, transportation, and laboratory testing.

RESULTS

ECHO Care Demographics

ECHO Care patients had significant health issues, as well as social barriers to care (Table 1). They were primarily Hispanic whites with low levels of education and high levels of unemployment. Over half reported having less than a high school education, and 41.6% indicated a need for reliable housing. The average Charlson index[20] of ECHO Care patients was 4.7 and nearly all (96.9%) had a chronic mental illness, 77.8% had a chronic SUD, while 77.0% had both (Table 1).

Between September 2013 and June 2016, 770 patients enrolled in ECHO Care and remained enrolled for 15 months, on average. Twenty percent of ECHO Care patients became ineligible for the program for reasons that included death, moving out of the area, and placement in a long-term care facility or hospice care (Appendix Table 1). Seventeen percent of ECHO Care patients chose to disenroll for reasons that included disagreement over controlled substance prescribing or their desire to receive care from more than one primary care provider.

Changes in Healthcare Utilization Associated with ECHO Care

ECHO Care patients changed how they utilized the healthcare system. While inpatient admissions and ED visits decreased under ECHO Care, outpatient visits and dispensed prescriptions increased. Twelve months post-enrollment, about 5% of typical patients had an inpatient admission; if the trends before enrollment had continued, 10% would have had an inpatient admission (Fig. 1a, Table 2, which includes the definition of typical patient). Similarly, 12 months post-enrollment, 16% of typical ECHO Care patients had an ED visit, as opposed to 29% had the pre-enrollment trends continued (Fig. 1b, Table 2). The number of outpatient visits increased from a counterfactual of 1.28 visits PMPM to 1.58, and the number of dispensed prescriptions increased from 3.14 to 3.39 PMPM (Fig. 1c, d, Table 2).

We found that patients with higher Charlson indices, with SUD, and with schizophrenia or other psychotic disorders typically had higher healthcare utilization compared with other patients; one exception is that patients with SUD had fewer dispensed prescriptions than patients without SUD. Older patients tended to have more dispensed prescriptions, but fewer ED visits or inpatient admissions, and males had fewer dispensed prescriptions (Appendix Table 2).

Changes in Medicaid Costs Associated with ECHO Care

The shift in healthcare utilization correlated with significant changes in Medicaid expenditures. Expenditures increased during the 36 months before ECHO Care enrollment, even when we excluded the 6 months immediately prior to enrollment, when utilization and expenditures were exceptionally high. After ECHO Care enrollment, expenditures dropped sharply and continued decreasing slowly over time. At 12 months post-enrollment, Medicaid expenditures were $613 PMPM lower than they would have been if the pre-enrollment trends had continued (95% CI $128, $1134; Fig. 2, Table 3, Appendix Table 2).

However, the Medicaid expenditures do not take into account the cost of the intervention, which we estimate range from $407 to $789 PMPM (Appendix Table 3). The latter represents actual costs during the pilot, with $687 for the OIT teams and $102 for the Complex Care teleECHO. As discussed below, we estimate that this intervention cost could be reduced to $407 PMPM. The overall change in Medicaid costs associated with ECHO Care ranges from a savings of $206 PMPM ($613–$407) to an expense of $176 PMPM ($613–$789); however, we cannot definitively say whether ECHO Care resulted in cost savings or in additional costs for either scenario (Table 3, see the 95% CIs).

The shift in healthcare utilization was also associated with significant redistributions in costs, driven almost entirely by inpatient costs decreasing and outpatient costs increasing (Appendix Table 4). When we compared the actual post-enrollment trend with the counterfactual pre-enrollment trend at 12 months post-enrollment, we found that expenditures for both inpatient admissions and ED visits decreased; however, inpatient admissions accounted for about 90% of the reduction. Similarly, we found evidence that costs for outpatient visits (which include the cost of the intervention), dispensed prescriptions, and other categories (such as long-term care) all increased; however, over three-quarters of this increase was driven by outpatient visits (Appendix Table 4).

DISCUSSION

ECHO Care engaged a marginalized population with extremely high rates of mental illness and SUDs, multiple medical comorbidities, social barriers, and high rates of ED use and inpatient hospitalizations. To our knowledge, this is the first pilot to incorporate case-based consultation from specialist physicians for OITs providing complex care. In a parallel report, we showed that OIT participation in the Complex Care teleECHO correlated with high OIT satisfaction and confidence in treating

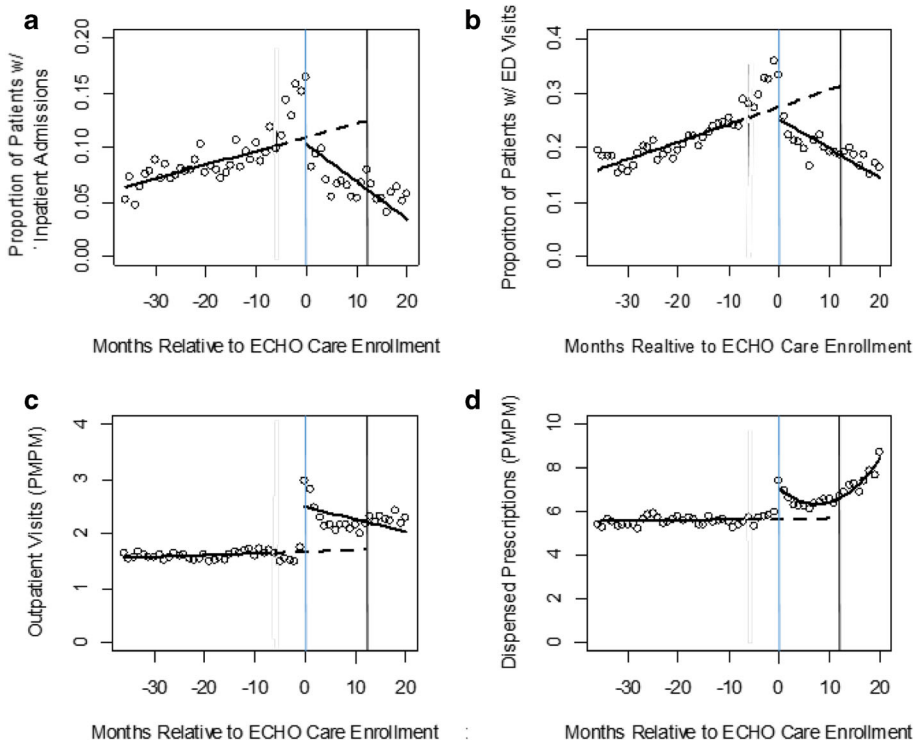

Figure 1 Changes in healthcare utilization associated with ECHO Care enrollment. a Proportion of patients with non-obstetric, non-trauma inpatient admissions. b Proportion of patients with ED visits. c Number of (non-ED) outpatient visits PMPM. d Number of dispensed medications PMPM. Open circles represent all data points over the study period. The two black solid lines represent the regression based on pre- and post-enrollment data, respectively, and the hashed line indicates the counterfactual regression line if the pre-enrollment trend had continued. The pre-enrollment regression does not include the 6 months of data immediately prior to ECHO Care enrollment. The vertical blue line indicates ECHO Care enrollment ($x = 0$), and the black vertical line represents the comparison at 12 months post-intervention.

HNHC patients.[15] Here, we report that ECHO Care was associated with significant improvements in healthcare utilization (Fig. 1, Table 2), a proxy for patient outcomes.[21, 22] ECHO Care patients significantly reduced their use of ED visits and inpatient admissions while increasing their use of outpatient care and dispensed prescriptions (Fig. 1, Table 2). This modified use of healthcare resources is indicative of greater access to effective care, and improved communication and trust with patients' care teams. These findings are complemented by a qualitative analysis of patient experiences with ECHO Care, in which enrollment correlated with improved trust in their healthcare providers and improvements in patient health behaviors.[13]

Several factors should be considered when replicating ECHO Care. To maximize cost-effectiveness, ECHO Care teams should either begin small—with one NP/PA and one CHW—and grow as the patient panel grows or ensure that a full patient panel is enrolled at launch. However, the ratio of patients to care team should be kept relatively low to ensure that patients receive high-intensity care that meets their needs. Future iterations of ECHO Care would benefit from a robust referral system that automatically recruits eligible patients into the program. This could include agreements from state Medicaid agencies, MCOs, hospitals, or other provider groups to refer all patients who meet enrollment criteria.

Table 2 Healthcare Utilization 12 Months After ECHO Care Enrollment Compared with Counterfactual (Pre-enrollment Trend Extended to 12 Months Post-enrollment)

Measure	12 months post-enrollment*		Ratio** (95% CI)
	Without ECHO Care (counterfactual)	With ECHO Care	
% patients with inpatient admissions	10.1%	4.6%	0.42 (0.32, 0.57)
% patients with ED visits	29.3%	16.3%	0.47 (0.39, 0.58)
Outpatient visits PMPM	1.28	1.58	1.23 (1.16, 1.31)
Dispensed prescriptions PMPM	3.14	3.39	1.08 (1.04, 1.12)

**For illustration, the model was evaluated for a male patient with the mean age, with mean Charlson index, with substance use disorder, and without schizophrenia when these covariates were in the model (Appendix Table 2)*

***Odds ratio for logistic regression (inpatient admissions and ED visits); mean ratio for Poisson regression (outpatient visits and dispensed prescriptions). These ratios do not depend on patient characteristics, assuming these characteristics do not influence the pre- and post-enrollment slopes*

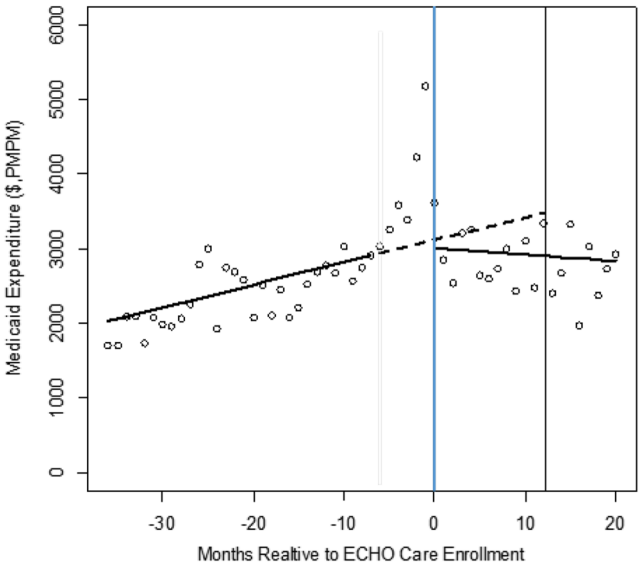

Figure 2 Changes in Medicaid expenditures associated with ECHO Care enrollment. Open circles represent all data points over the study period. The two black solid lines represent the regression based on pre- and post-enrollment data, respectively, and the hashed line indicates the counterfactual regression line if the pre-enrollment trend had continued. The pre-enrollment regression does not include the 6 months of data immediately prior to ECHO Care enrollment. The vertical blue line indicates ECHO Care enrollment ($x = 0$), and the black vertical line represents the comparison at 12 months post-intervention.

The cost of the OITs and the Complex Care teleECHO could be substantially reduced in future implementations by incorporating the lessons learned from this pilot program. The PMPM costs of the OITs were quite high during the first 16 months of the program, at $889 PMPM, because the pilot program began with nearly fully staffed teams, but patient enrollment was gradual. Each team had the capacity to serve approximately 104 patients per month; however, during the first 16 months, the average number of enrolled patients per month was 41. By Q4 2015, the cost had dropped markedly to $425 PMPM primarily due to an increase in the average enrolled patients per month to 86 (Appendix Table 3). If capacity enrollment had been achieved for all teams, the cost would have dropped to $356 PMPM. Similarly, the Complex Care teleECHO had fixed costs of approximately $32,000 per month (mostly due to salaries for specialists), so the PMPM costs dropped as the number of enrolled patients increased. A PMPM payment of $51 would sustain the Complex Care teleECHO, assuming that six OITs had capacity enrollment of 104 patients per month, bringing the total cost to $407 PMPM. While we did not definitely establish whether ECHO Care resulted in cost savings, we found that modest decreases in inpatient admissions can substantially impact overall costs. Shifting healthcare utilization from inpatient to outpatient settings suggests more effective prevention and early intervention of chronic conditions.[23–26] Improved management of chronic conditions may continue to lower costs further over the long term, and mean that patients are not exposed to the health risks and inconvenience associated with hospitalization.[27]

This study had several limitations. First, the lack of a comparison group limited our ability to control for secular trends and regression to the mean. We mitigated this issue by assessing pre-enrollment trends over an extended period and excluding claims data for the 6 months immediately preceding enrollment. Because we analyzed this gradual, long-term trend, it is unlikely that our findings resulted from regression to the mean. Secular trends could contribute to the changes we observed; for example, in January 2014, Medicaid expansion was enacted in NM—enabled by the Affordable Care Act—and other states have observed changes in healthcare costs and utilization as a result of this policy change.[28, 29] However, a preliminary analysis by NORC observed similar changes in ED visits and inpatient admissions and found reductions in Medicaid expenditures when ECHO Care patients were compared with the control group, which corroborates our findings.[30] Further, we did not have Medicaid claims data for all patients from 36 months pre-enrollment through 21 months post-enrollment, although we adjusted for fluctuations in our study population. In addition, our sample size was relatively small, which potentially restricted the statistical power of our analysis. Future studies will benefit from improved patient recruitment to provide a larger analysis sample size. Finally, our study did not determine whether inclusion of the ECHO model affected our results. Future studies could compare ECHO Care with a similar intervention that does not include an ECHO component, which could further validate using this model to support the healthcare workforce in providing complex care.

Table 3 Total Medicaid Costs Associated with ECHO Care, Modeling Two Scenarios for the Cost of the Intervention

Type of PMPM cost	Actual cost of the ECHO Care pilot	Potential cost of the ECHO Care pilot
Cost of the intervention	$789	$407
OITs	$687	$356
Complex Care teleECHO	$102	$51
Change in Medicaid expenditures associated with ECHO Care (95% CI)	−$613 (−$1,134, −$128)	−$613 (−$1,134, −$128)
Total Medicaid costs associated with ECHO Care* (95% CI)	$176 (−$345, $661)	−$206 (−$727, $279)

**Total Medicaid costs include Medicaid expenditures plus the cost of the ECHO Care program (i.e., OITs and the Complex Care teleECHO), which were not captured in Medicaid claims data*

CONCLUSION

The ECHO Care pilot successfully reduced patients' use of inpatient admissions and ED visits while increasing the use of outpatient care. This approach expands on complex care models that connect HNHC patients with appropriate healthcare by using the ECHO model to support OITs.

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Compliance with Ethical Standards:

Conflict of Interest: *The authors declare that they do not have a conflict of interest.*

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