

# C-TRAIN: THE CARE TRANSITIONS INNOVATION

## ANALYSIS OF PROGRAM IMPACTS

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# C-TRAIN

## OVERVIEW

This report summarizes results from a study of the Care Transitions Innovation (C-Train) program. C-Train is a multicomponent hospital-to-home transitional care intervention that identifies high-risk hospitalized adults and provides medication and chronic illness self-management support, assistance in navigating the health system, and a bridge to outpatient care. The program aims to improve patients' transitional care experience, increase their connections to primary care after a hospitalization, and reduce subsequent ED use and readmissions.

From 2013-2015, with support from the Health Commons Grant, the C-Train program expanded to four Portland hospitals. In this report, we examine the program's expansion and assess its effect on three key outcomes: post-discharge primary care connections, post-discharge ED use, and readmissions.

## DATA & METHODS

We used program records, patient surveys, and claims data to evaluate C-Train implementation and outcomes. To assess outcomes, we identified hospital stays associated with C-Train cases, then created a comparison cohort of patients with similar hospital stays that occurred in comparable settings, but without C-Train. We used propensity score modeling to equate baseline characteristics between C-Train and non C-Train participants, then examined the outcomes of program participants over time and compared results to those of our comparison group. We estimated the likelihood of primary care connection, ED visits, and readmissions after discharge using a logistic regression model that evaluated the impact of the program while controlling for baseline characteristics of members as well as the effects of site and time.

## KEY FINDINGS

### PROGRAM IMPLEMENTATION

**SUCCESSFUL SCALING:** C-Train teams served over 698 Health Share cases at four sites over 28 study months, with most patients (59%) receiving face-to-face post-discharge follow-up from an RN. Nearly 8 in 10 (79%) received telephone follow-up.

**TARGETING COMPLEX PATIENTS:** C-Train served highly medically and socially vulnerable patients. Nearly a third (32%) of patients served were homeless at discharge, 43% had a substance use disorder, and 68% struggled with mental illness.

**PATIENT ENGAGEMENT:** A total of 62% of cases had their transitional care fulfilled, while transitional care for 29% of eligible cases was considered incomplete.

### PROGRAM OUTCOMES

**PRIMARY CARE:** C-Train significantly increased rates of primary care follow-up at 7, 30, and 90 days after discharge versus the comparison group. Controlling for other key covariates, C-Train engagement increased the odds of a post-discharge primary care visit within 7 days by 54%.

**POST-DISCHARGE ED USE:** We did not find evidence that C-Train impacted ED use at 30 or 90 days post-discharge. Results were comparable to those of the comparison group.

**READMISSIONS:** We observed a slight downward trend in readmissions at 30 days post-discharge, but it did not achieve statistical significance.

## THE BOTTOM LINE

C-Train scaled to four hospital and reached a population of medically and socioeconomically disadvantaged patients at high risk for readmission. Results indicate that the program was successful in conducting intensive post-discharge follow-up and improving connections between this vulnerable population and primary care; however, these efforts did not result in decreased post-discharge ED use or fewer readmissions. These results are consistent with previously published studies of other similar transition programs, which have seen mixed results around readmissions.

Better post-discharge follow-up and primary care connections improve care transitions for vulnerable patients, but these results suggest they may not influence ED and readmission outcomes. This may indicate a need for alternative approaches or more optimal patient selection. It may also suggest that many readmissions in this population are not preventable.

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# C-TRAIN

## INTRODUCTION

This report summarizes findings from a study of the Care Transitions Innovation (C-Train), implemented at four hospitals in Portland, Oregon with support from the CMMI-funded *Health Commons Grant*. Conducted at the Providence Center for Outcomes Research & Education (CORE), the study was designed to describe program implementation and assess impacts on key outcomes as patients transition from hospital to home.

## BACKGROUND

C-Train is a hospital-to-home transitional care program developed, implemented, and evaluated at Oregon Health & Science University (OHSU) between 2009 – 2012 (1, 2). Under the Health Commons Grant, C-Train was expanded at OHSU and newly implemented at three Legacy hospitals in Portland. C-Train served as a key piece of the grant's strategy to improve hospital-to-home transitions and to connect high-risk hospitalized adults to a stable primary care medical home environment.

## KEY CONTEXT

Hospital-to-home transitions represent an abrupt shift from provider-supported care in the hospital to an outpatient environment where patients must self-manage complex medical problems, administer medications, and access ambulatory care independently. Poorly executed care transitions from hospital to home may contribute to higher risk of readmission and emergency department use, threaten patient safety, and detract from patient-centered care. After hospital discharge, patients report confusion about their medications, difficulty accessing providers, and uncertainty as to whom to contact if questions arise (3). These challenges are compounded in socioeconomically disad-

vantaged adults, many of whom are not established with primary care, have higher prevalence of mental health and substance use disorders, and struggle to access medications and timely outpatient care (4, 5). Reducing readmissions has become an important focus of recent health policy initiatives designed to spur transitional care quality improvement and reduce the overall cost of care.

Although an anticipated reduction in hospital readmissions, and the associated cost savings, has been the main driver of health policy interest in transitional care interventions, there are other potential benefits that are beginning to receive more attention. Quality measures that report patients' transitional care experience (6), and transitional care interventions may be an important foundation for health system integration efforts (7).

In this report, we examine the effects of the C-Train program implementation efforts on patient-centered process of care outcomes. We also report the effects of the C-Train program on primary care visits, ED visits, and hospital readmissions following hospital discharge.

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## KEY OBJECTIVES

### 1. ASSESS IMPLEMENTATION & SPREAD OF CTRAIN.

- Describe C-Train patients.
- Measure C-Train processes.
- Report patient experiences.

### 2. ASSESS OUTCOMES FOR PATIENTS IN THREE DIMENSIONS:

- Primary care visits at 7, 30, and 90 days following discharge.
- ED visits at 30 and 90 days following discharge.
- Re-admission at 30 and 90 days.

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# PROGRAM SNAPSHOT

## PROGRAM OVERVIEW

With support from the Health Commons Grant, the C-Train program was expanded at OHSU and implemented in three Portland-area Legacy hospitals (Emanuel, Good Samaritan, and Mt. Hood) between 2012 and 2015. C-Train targets adults at high risk for readmission with intensive transitional care support and efforts to integrate hospital and community care, including four main components:

**Transitional care nurses** who provide coaching, education, and care coordination, including post-discharge phone calls and home or in-person clinic/community visits for highest risk patients. Some patients received multiple home or community visits, when nurses felt additional care would mitigate risk or promote engagement in care.

**Inpatient pharmacy consultation** including detailed medication reconciliation; patient education, including use of pill boxes and visual medication calendars; tailoring medications to those available through Health Share formularies; and guidance to inpatient providers on simplifying complex regimens to improve adherence.

**Post-hospital primary care linkages** whereby each hospital team identified key partner clinics across the community, based on density of shared patients and geographic needs of patients. Champions were identified at each clinic site and participated in cross-site meetings to promote care coordination and quality improvement.

**System integration** through monthly quality improvement meetings between hospital and primary care teams, and

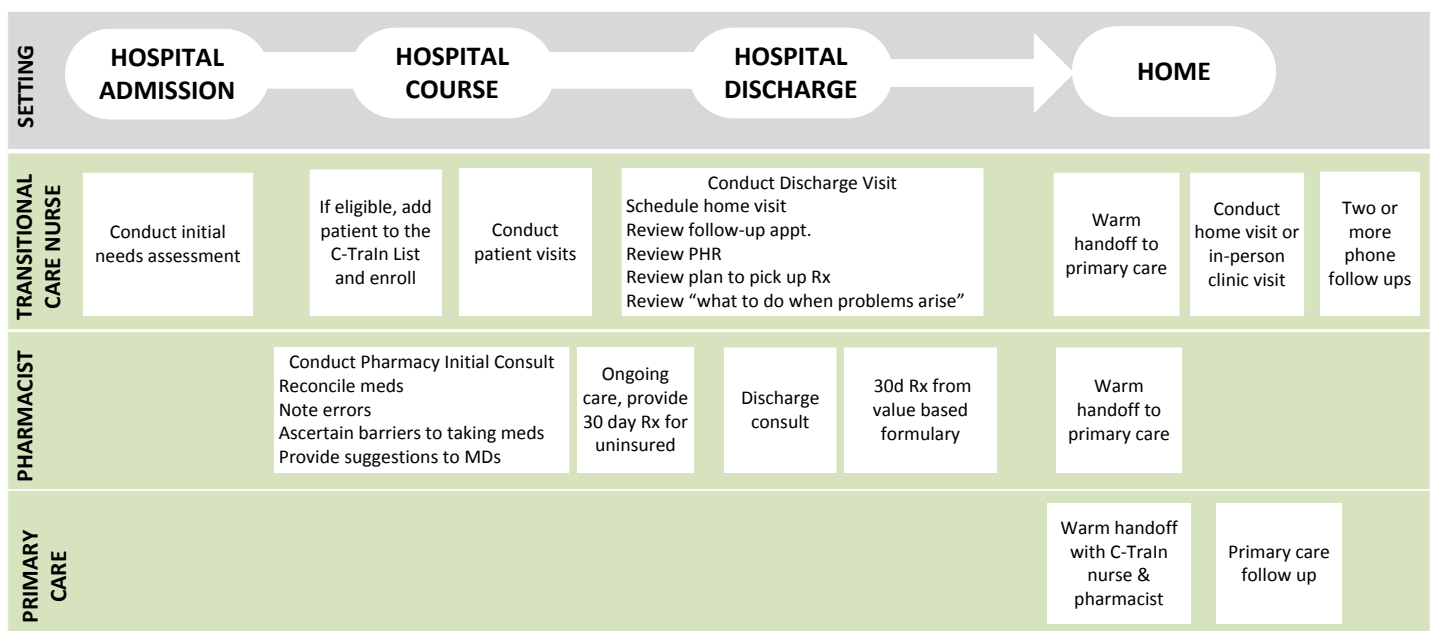
## TARGET POPULATION

Across all sites, C-Train teams targeted adults who were high risk for readmission, based on an assessment of psychosocial risk, medical complexity, and prior utilization patterns. At OHSU, initially teams focused on uninsured, as well as Medicaid and Dual-Medicaid-Medicare eligible adults admitted to the medical and surgical wards. At Legacy hospitals, teams initially targeted Health Share Medicaid patients only. However, all sites eventually expanded to include non-Health Share patient due to the challenge of implementing a system-wide intervention for a small subset of patients based on insurance criteria alone.

## WORKFLOW

Exhibit 1 details the C-Train program's workflow. C-Train nurses identify patients early in hospitalization through review of electronic medical record lists of referral from inpatient teams. Nurses perform an in-depth needs assessment and work with eligible patients; inpatient and community staff plan for post-discharge care needs. Consultation continues throughout hospitalization, including work with pharmacists. After discharge, program nurses serve as a key point-of-contact, performing home visits, accompanying patients to outpatient follow up appointments, and providing continued telephonic support. Clients are typically enrolled for a period of 30-45 days after discharge.

Exhibit 1. C-Train Workflow



# METHODOLOGY

## OUTCOME MEASURES

We assessed the program's impact on three key outcome measures:

**PRIMARY CARE CONNECTIONS:** The percent of discharges with a follow-up visit in primary care within 7, 30, and 90 days.

**ED VISITS:** The percent of discharges with a subsequent ED visit within 30 and 90 days.

**READMISSIONS:** The percent of discharges with a readmission to the hospital within 30 and 90 days.

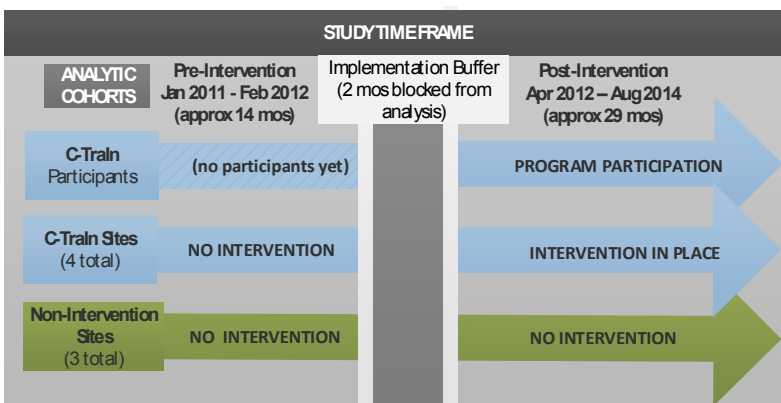
**PROGRAM & SITE LEVEL IMPACTS:** We were interested in assessing the impact of C-Train as a *program* (by comparing outcomes for participants to outcomes for non-participants), and in understanding potential *site-level* impacts of implementing the C-Train program in a hospital. If, for example, implementing C-Train resulted in a general shift in how care transitions were managed at a given hospital, we might see reduced overall readmission rates at that hospital including among patients not enrolled in the program. Our analysis includes assessment of both the program and site-level impacts of C-Train implementation (for site-level analysis, see Appendix pages 9-10)

## STUDY DESIGN

**POPULATION:** Study participants included Health Share members 18 and older who were hospitalized at one of seven hospital sites (4 C-Train sites and 3 control sites) between April 2012 to August 2014. Our unit of analysis for this study was a discharge event; individual members could have multiple discharge events during the time period.

We collected all Health Share discharges, 19,989, at the hospital sites during the study window. We excluded discharges from patients under 18 and those with admissions that would not qualify them for C-Train (Exhibit 2). We matched discharges against C-Train program records to identify our treatment cohort. Our control sample consisted of discharges not associated with program participation from the same providers during the same time frame, ensuring that all patients in the sample received their inpatient care in a comparable setting. At least three months of pre-hospitalization coverage were required in order to ensure availability of baseline data. Our exclusion criteria are detailed in Exhibit 2; the final dataset included 313 discharges from C-Train participants and 9,847 discharges from comparison cases.

Exhibit 3. Study Panel Time Frame



## DATA SOURCES

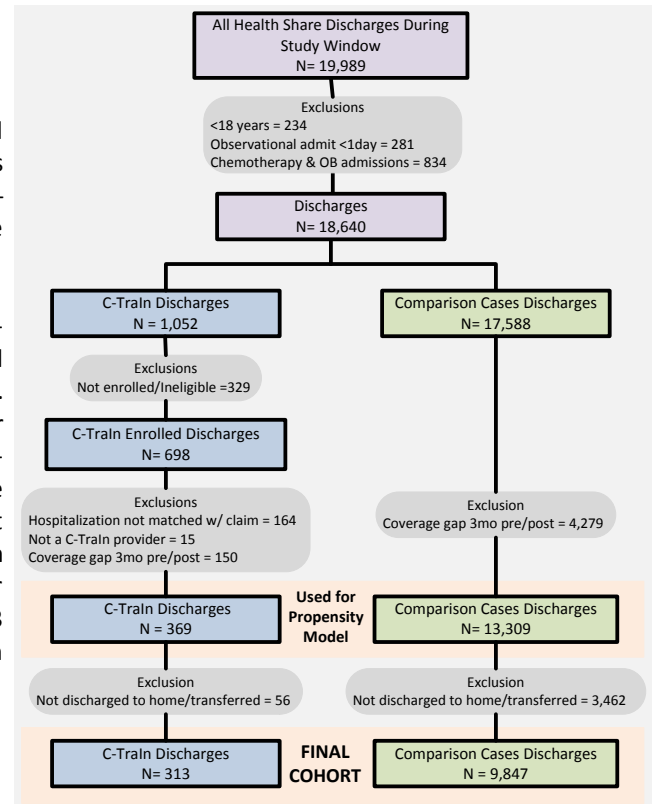
### MEDICAID CLAIMS DATA

Utilization, health information, enrollment data, coverage span history, administrative and demographic information on Health Share membership.

### C-TRAIN PROGRAM DATA

Program registry data detailing Health Share clients served by the program, organized by hospitalization event.

Exhibit 2. Case Selection & Exclusion Criteria



**DATA:** We treated each qualifying discharge as a marker date, then used claims data to construct a dataset capturing the members' utilization before and after that marker date. We compared key outcomes for each cohort before and after C-Train implementation (Exhibit 3).

**COHORTS:** We measured program impact on post-discharge utilization for our C-Train members, then compared those outcomes to our control group of non-participants. We clustered data by site in order to directly examine outcomes for participants and also examine site-level outcomes for the hospitals that implemented C-Train.

# PROPNESITY SCORE WEIGHTING

We performed the propensity models on C-Train and comparison cases prior to excluding cases that were not discharged to home or cases that were transferred (Exhibit 2). Although we selected controls based on similar experiences, our comparison discharges differed in important ways from those of C-Train participants. To reduce bias introduced by these differences, we used information about C-Train participants to build a propensity model that could be used to “balance” C-Train and comparison discharges.

The goal of the propensity model is to build the simplest model that balances the observable confounding covariates between the C-Train and non-C-Train populations. We estimated a logistic regression model to generate propensity scores indicating the probability of having participated in the program based on a variety of measurable characteristics (Exhibit 4). We use the model’s resulting probabilities of program participation to compute propensity score weights, then applied these weights to our comparison population. Weighting the comparison group in this manner allows us to keep all comparable discharges in the final analysis, but ensure that the contribution of each individual discharge is based on its similarity to a “C-Train-like” discharge. Discharges that look more like C-Train cases are effectively weighted up, while those that look less like C-Train cases are weighted down, creating an overall comparison group profile that, after weighting, closely matches the C-Train population (Exhibit 4).

Exhibit 4. Propensity weighting of covariates

	C-Train Discharges N=369 (events)	Non Participant Discharges N=13,309 (events)	
		Pre-Weighting	Post-Weighting
<b>Demographics</b>			
Age, mean	53.0	52.8	52.9
Female, %	53.4	56.7	53.1
<b>Race/Ethnicity</b>			
Non-Hispanic White, %	67.2	69.9	67.2
Black/African Amer., %	21.7	15.9	21.6
Hispanic, %	4.1	4.4	4.1
Other/Unknown, %	7.0	9.7	7.1
<b>Language</b>			
English, %	96.5	90.5	96.5
Spanish, %	0.8	1.5	0.8
Other, %	2.7	8.0	2.7
<b>County</b>			
Multnomah, %	87.3	78.0	87.2
Clackamas, %	4.9	11.8	4.9
Washington, %	7.9	10.2	7.9
<b>Visit Information</b>			
Length of Stay, days	7.1	5.1	7.3
<b>Health Status</b>			
Risk Score	3.4	3.7	3.4
Disabled, %	61.2	57.1	61.6
Dual Eligible, %	23.6	39.0	23.3
Severe Psychiatric Disorder, %	13.3	19.5	13.3
Chemical Dependency, %	24.9	18.5	24.9
<b>Other CMMI Interventions</b>			
ICCT, %	12.5	6.3	11.2
<b>Utilization (-3 to 0 months)</b>			
Pre-ED visits (PMPM)	0.5	0.5	0.5
Pre-PCP visits (PMPM)	0.7	0.4	0.7
Pre-IP (PMPM)	0.2	0.2	0.2
<b>Utilization (-12 to -3 months)</b>			
Pre-ED visits (PMPM)	0.4	0.4	0.4
Pre-PCP visits (PMPM)	0.5	0.3	0.5
Pre-IP (PMPM)	0.1	0.1	0.1

# OUTCOMES MODELING

To assess the impact of the program on our key outcomes, we used multivariate logistic regression models to estimate the odds of primary care follow up, ED visits, and readmission while controlling for potential confounders. We weighted the outcomes models using scores generated from the propensity model to adjust the influence of non-C-Train participants proportional to their propensity for C-Train engagement in order to estimate C-Train effects in a population most representing the C-Train selection criteria. We used generalized estimating equations (GEE) to account for multiple hospitalizations and the longitudinal nature of our data.

Our regression models assess the impact of program participation while also controlling for changes in outcomes over time and by site, allowing us to distinguish program-specific effects from larger community or site-specific trends in outcomes that may be a

Exhibit 5. Multivariate Logistic Regression Model

		Interpreting the Outcomes Model				
Model Component	Intercept OR	Site OR	Time OR	Time*Site OR	C-Train OR	
What is Being Measured	Average baseline rate for the population	Difference from population baseline rate for each intervention site	Change in outcome rate for the population from pre-intervention period to post-intervention period	Change in outcome rate for each intervention site from pre-intervention to post-intervention, separate from change in whole population	Change in outcome due to participation in the C-Train program	
How it is Interpreted	Tells us the average rate that the other factors we look at modify	Tells us site-specific baseline rate before implementation to estimate outcome change over time	Tells us if there is general change in rate over time, separate from program and site-based efforts	Tells us if there were other trends affecting the outcome rate at the implementation sites, separate from the program that need to be taken into account	Tells us the change in rate due to C-Train participation, separate from the effects of time, site, and other factors controlled for in the model	

The model also controls for demographic covariates, prior utilization, and inpatient encounter details

# PROGRAM IMPLEMENTATION

## WHO WAS SERVED?

Nurses performed a needs assessment on 819 C-Train patients between April 2012 and August 2014, including both Health Share and non-Health Share patients (Exhibit 6). C-Train patients profile as a highly vulnerable population who face significant psychosocial barriers to successful health self-management. Nearly a third (32%) of C-Train patients were homeless at time of discharge and had limited transportation resources, 39% reported difficulty managing their medications, 40% had alcohol use disorders, and 43% had substance use disorders. More than two in three (68%) had co-occurring depression or other mental illness challenges. Given their medical complexity and intense psychosocial challenges, C-Train patients represent a population primed for potential readmission.

During the study window of April 2012 to August 2014, a total of 1,052 **Health Share** cases were screened for the C-Train program; 698 were enrolled across the four hospitals (Exhibit 7). At the time of this report there were 38 open cases. Most (219) cases were from OHSU, but Legacy hospitals make up the bulk of total C-Train cases (Exhibit 7).

In 430 of 698 cases (62%), transitional care needs were considered fulfilled, either because their case was considered complete (n=334) or because there was a warm handoff to another outreach team (n=96) (Exhibit 8). Transitional care was considered incomplete for 205 of the 698 cases (29%) due to disengagement post enrollment (n=163) or being lost to follow-up (n=42) (Exhibit 8).

**ANALYTIC COHORT:** The analytic cohort we use to study the program effects consists of 313 of the 698 total cases (see page 3 for additional exclusions). We excluded those who died or were discharged to care facilities from our study population, but did not otherwise limit or analysis based on program disposition (Exhibit 8).

## WHAT SERVICES DID PATIENTS RECEIVE?

C-Train staff recorded their activities throughout the study period, cataloguing the work done with each enrolled case (Exhibit 9). There were 19 of the 698 enrolled Health Share C-Train cases that did not have a complete form. Thus, of these 679 cases, the program engaged with them for a median length of 36 days after discharge. A total of 457 cases (67%) had a pharmacy consult as part of their program experience, and transitional care nurses reached 76% of cases by phone after hospitalization for follow-up, with 400 (59%) receiving an in-home or

**Exhibit 9. C-Train Follow-up Process Measures**

Post Discharge Follow-up	N	%	Median (range)
Received inpatient pharmacy consult	457	67%	1 (0-6)
RN home or community visit	400	59%	1 (0 - 27)
Had RN phone call	514	76%	3 (0 - 50)
Had RN digital encounter (text message)	46	7%	0 (0 - 50)
Engagement after hospitalization in days	698	NA	36 (1-406)

## BOTTOM LINE

C-Train enrolled 819 cases in 28 months, 698 of which were Health Share members. Enrolled patients had high medical and social needs. C-Train was implemented across four hospitals with a high degree of fidelity, with the majority of patients received follow-up phone calls, text messages, and home visits.

**Exhibit 6. Patient Needs Assessment**

	OHSU C-TRAIN (n=326)		Legacy C-TRAIN (n=493)		All-C-TRAIN (n=819)	
	n	%	n	%	n	%
Homeless	132	41%	127	27%	259	32%
Limited transportation	86	27%	167	35%	253	32%
Social isolation	259	79%	225	48%	484	61%
Complex medications	109	34%	198	42%	307	39%
Alcohol abuse	182	57%	131	28%	313	40%
Substance-abuse	196	61%	142	30%	338	43%
Cognitive dysfunction	162	50%	144	31%	306	38%
Depression/mental illness	187	60%	350	74%	537	68%

**Exhibit 7. Distribution of Health Share C-Train Cases**

<b>698</b>	Total enrolled C-Train cases
<b>219</b>	OHSU C-Train cases
<b>181</b>	Legacy Emanuel cases
<b>158</b>	Legacy Good Samaritan cases
<b>140</b>	Legacy Mt. Hood cases
<b>38</b>	C-Train cases still open
<b>354</b>	C-Train cases screened out

**Exhibit 8. Disposition of Health Share C-Train Cases**

<b>334</b>	Transitional care complete
<b>163</b>	Disengaged post enrollment
<b>96</b>	Warm handoff
<b>42</b>	Lost to follow-up at 30 days
<b>22</b>	Declined enrollment
<b>14</b>	Deceased
<b>8</b>	Discharged to hospice
<b>7</b>	Discharged to care facility
<b>1</b>	Termed off Medicaid
<b>11</b>	Other

# PROGRAM OUTCOMES

## WHAT DID WE STUDY?

We analyzed Medicaid claims data to assess the impact of C-Train on three key post-discharge outcomes: primary care physician (PCP) follow-up, ED visits, and readmissions. Primary care visits were assessed at 7, 30, and 90 days post-discharge; ED visits and readmissions were assessed at 30 and 90 days post-discharge. We examined each outcome in two distinct ways:

**RATES:** First, we determined the percent of C-Train participants that had at least one of each type of post-discharge visit compared to our propensity-weighted comparison cases.

**ODDS RATIOS:** Second, we estimated the influence C-Train participation had on the odds of having each type of post-discharge visit while accounting for other key covariates such as site, time, demographics, historic utilization, and medical complexity. Results were expressed as odds ratios (ORs) that represent C-Train patients' probability of experiencing the event in question relative to the propensity-weighted comparison group. An OR greater than 1.0 indicates the event is more likely among C-Train patients than controls, while an OR less than 1 indicates the outcome is less likely to occur compared to controls.

### MEASUREMENT DEFINITIONS

**Primary Care Follow-Up:** An office visit after hospital discharge.

**ED Visit:** A visit to any emergency department that did not result in a hospitalization

**Readmission:** An admission to any hospital after the first hospitaliza-

## WHAT WERE THE RESULTS?

**PRIMARY CARE CONNECTION:** C-Train significantly increased rates of primary care follow up at 7, 30, and 90 days after discharge, a key program goal (Exhibit 10). At 30 days following discharge, approximately 75% of program participants had a follow up visit with a PCP compared to 63% of non-participants. Controlling for other key covariates, we found that C-Train engagement resulted in significantly increased odds of having a PCP follow up visit within 7, 30, and 90 days after discharge (Exhibit 11).

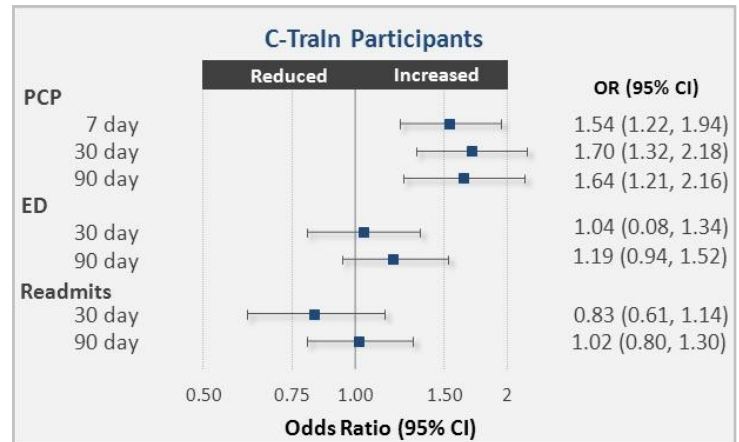
**ED UTILIZATION:** We saw no evidence of significant differences in ED utilization at 30 or 90 days after hospitalization (Exhibit 10). Controlling for other factors, C-Train did not impact the odds of having an ED visit 30 or 90 days after discharge (Exhibit 11), although there was a slight trend towards increased ED visits at 90 days.

**READMISSIONS:** We saw no significant differences in all-cause readmission rates for C-Train participants compared to our propensity weighted comparison group (Exhibit 10). After controlling for other covariates, we found a non-significant downward trend in the odds of having a readmission at 30 days, and no change at 90 days (Exhibit 11).

Exhibit 10. Rate of Having Any Visit Following Discharge<sup>1</sup>

	Non Participants	C-Train Participants	p-value <sup>2</sup>
<b>PCP</b>			
7 Day	32.9%	42.8%	<.001
30 Day	63.1%	75.3%	<.001
90 Day	78.3%	86.5%	<.001
<b>ED</b>			
30 Day	33.3%	33.6%	0.911
90 Day	53.2%	56.1%	0.281
<b>Readmits</b>			
30 Day	18.8%	17.3%	0.480
90 Day	34.4%	35.8%	0.581

Exhibit 11. Odds of Having a Visit Following Discharge



(1.) Rates are weighted by propensity score to balance demographics and utilization.

(2.) Two-tailed chi-squared test, p<0.05 is considered significant.

## BOTTOM LINE

C-Train significantly increased primary care follow-up after discharge at 7, 30, and 90 days. C-Train did not reduce ED utilization at 30 days, and at 90 days there was a non-significant increase in ED use associated with C-Train. The 30-day hospital readmission rates were lower in C-Train patients, but the difference was not statistically significant, and 90-day readmissions were unchanged.



# CONCLUSIONS

## PROGRAM & STUDY GOALS

C-Train was implemented at four Portland hospitals in order to improve transitional care quality for medically and socially vulnerable hospitalized adults. Primary goals were to increase connection with primary care and reduce high cost ED visits and readmissions. We assessed the implementation of C-Train across the four sites, then studies the impact C-Train had on our three main outcomes of interest: post-discharge primary care follow-up, post-discharge ED visits, and readmission rates.

## PROGRAM IMPLEMENTATION

Patients served by C-Train had high medical and psychosocial needs including high rates of substance, mental illness, unemployment, and homelessness. This aligns with the program's intention of targeting vulnerable patients who are highly susceptible to poor transitions outcomes.

In keeping with the program model, most C-Train patients received post-discharge pharmacy consults (67%), face-to-face follow-up visits (59%), and phone-follow up (76%). C-Train nurses assessed that 62% of patients had their transitional care needs met, though nurses worked with some patients longer than the intended 30 days after their initial hospitalization.

## PROGRAM OUTCOMES

**PARTICIPANTS vs. NON-PARTICIPANTS:** We compared utilization outcomes for C-Train participants with propensity weighted controls. C-Train participants had significantly higher rates of primary care follow-up at 7, 30, and 90 days post discharge compared to non-participants, a key program goal. However, there was no difference in ED utilization or readmission rates. These results are consistent with previous evaluations of many hospital-to-home transitions programs. A single-site cluster randomized trial of C-Train performed at OHSU found that, although patients reported significant improvements in transitional care quality, there was no impact on ED utilization and a non-significant decrease in 30 day readmissions (8). Another study that also focused on socioeconomically vulnerable adults in Philadelphia found improvements in the processes of care and patient experience, but no consistent effect on readmissions (9).

**POTENTIAL EXPLANATIONS:** There are several potential reasons why C-Train did not impact post-discharge ED use and readmissions, despite succeeding in its goal of increasing patients' connection with primary care and providing high-

intensity coaching and care coordination. Although C-Train was developed through local needs assessment and tailored over time to different settings and emerging patient needs, a different or more intensive intervention may help reduce readmissions in this population. C-Train did not limit patients to specific chronic illnesses, and it is possible that selecting patients based on specific illnesses might yield different results. It is also possible that many readmissions are simply not preventable. Estimates of proportions of readmissions that are preventable vary widely, ranging in the literature from 5 to 79% (10). This may be particularly true in the socioeconomically disadvantaged patients C-Train targets, for whom intensive self-management and other transitions activities may be less feasible or a lower priority than other needs.

**LIMITATIONS:** Our study has several important limitations. First, this was not a randomized control trial; rather, we compare C-Train patients with propensity-weighted control patients. Although we made every effort to develop a comparable control group, it is possible our sampling strategy resulted in groups that are different in ways we did not or could not measure. Notably, the C-Train group had high rates of homelessness, limited social support, and other psychosocial barriers we could not account for in the comparison population. Because C-Train teams select patients for social and medical risk, challenges such as these are likely more prevalent among C-Train patients than in comparable populations. As a result, our method might underestimate or fail to detect the true impact of C-Train. Also, our small sample may mean we were unable to detect significant differences in ED rates or readmissions. Another limitation is that claims data includes all-cause readmissions, which do not distinguish between planned and preventable readmissions.

## BOTTOM LINE

C-Train engaged many of Health Share's most vulnerable patients and increased primary care follow up at 7, 30, and 90 days after hospital discharge. However, we found no statistically significant differences in ED use or hospital readmission at 30 or 90 days after discharge. These findings and implementation lessons may be of particular importance as C-Train continues to invest in a strategy to effectively link patients with primary care after hospitalization and identify areas for system-wide improvements to reduce costly ED use and readmissions.

### References

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# SITE-WIDE TRENDS

## WHY STUDY SITE TRENDS?

In addition to working with enrolled patients, C-Train also implemented system-level changes at each hospital where it was implemented. At each site, C-Train worked to increase connections across the care continuum, improve linkages between hospitals and clinics, and convene regular meetings to bring together providers around integration strategy. These efforts could contribute to larger, system-wide trends around post-discharge utilization by changing the way participating hospitals deal with the myriad of issues surrounding care transitions.

We evaluated site-wide utilization trends to determine potential impacts on post-discharge utilization at the hospital level, comparing sites that implemented C-Train to those that did not. Specifically, we analyzed Medicaid claims data for all cases from a site, whether they were enrolled in C-Train or not, to assess whether our outcomes of interest differed at hospitals with a C-Train program compared to those without one. We controlled for key covariates such as demographic, historic utilization, and health differences between cases at the different sites, but we were unable to control for other explicit efforts or programs at each site that may have affected the outcomes. Therefore, results may not exclusively reflect the influence of the C-Train program on hospital-wide outcomes.

### MEASUREMENT DEFINITIONS

**Primary Care Follow-Up:** An office visit after hospital discharge.

**ED Visit:** A visit to any emergency department that did not result in a hospitalization

**Readmission:** An admission to any hospital after the first hospitalization.

## WHAT WERE THE FINDINGS?

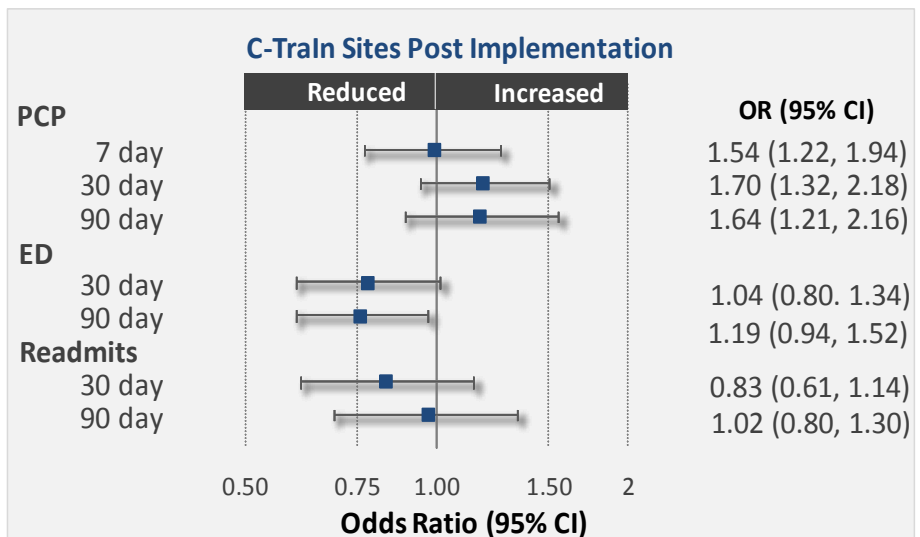
### ACROSS ALL C-TRAIN SITES:

**PRIMARY CARE CONNECTIONS:** We did not see evidence that C-Train sites significantly differed in terms of the odds of having a follow-up PCP visit within 7, 30, or 90 days after discharge (Exhibit 11). However, C-Train participation had higher odds of a PCP follow-up (page 7), which suggests that this was due to C-Train effects and not other site-level changes.

**ED UTILIZATION:** We observed a decreased likelihood of ED visits at 30 and 90 days post discharge among patients at C-Train sites. The decrease at 90 days is statistically significant (Exhibit 11). These differences in ED utilization likely reflects other efforts at the treatment sites because differences were not observed among C-Train participants.

**READMISSIONS:** We did not find evidence that discharges from C-Train sites had significantly different odds of readmission compared to our comparison (non-C-Train) sites (Exhibit 11).

**Exhibit 11. Odds of Having a Visit Following Discharge at C-Train Site**



# SITE-WIDE TRENDS

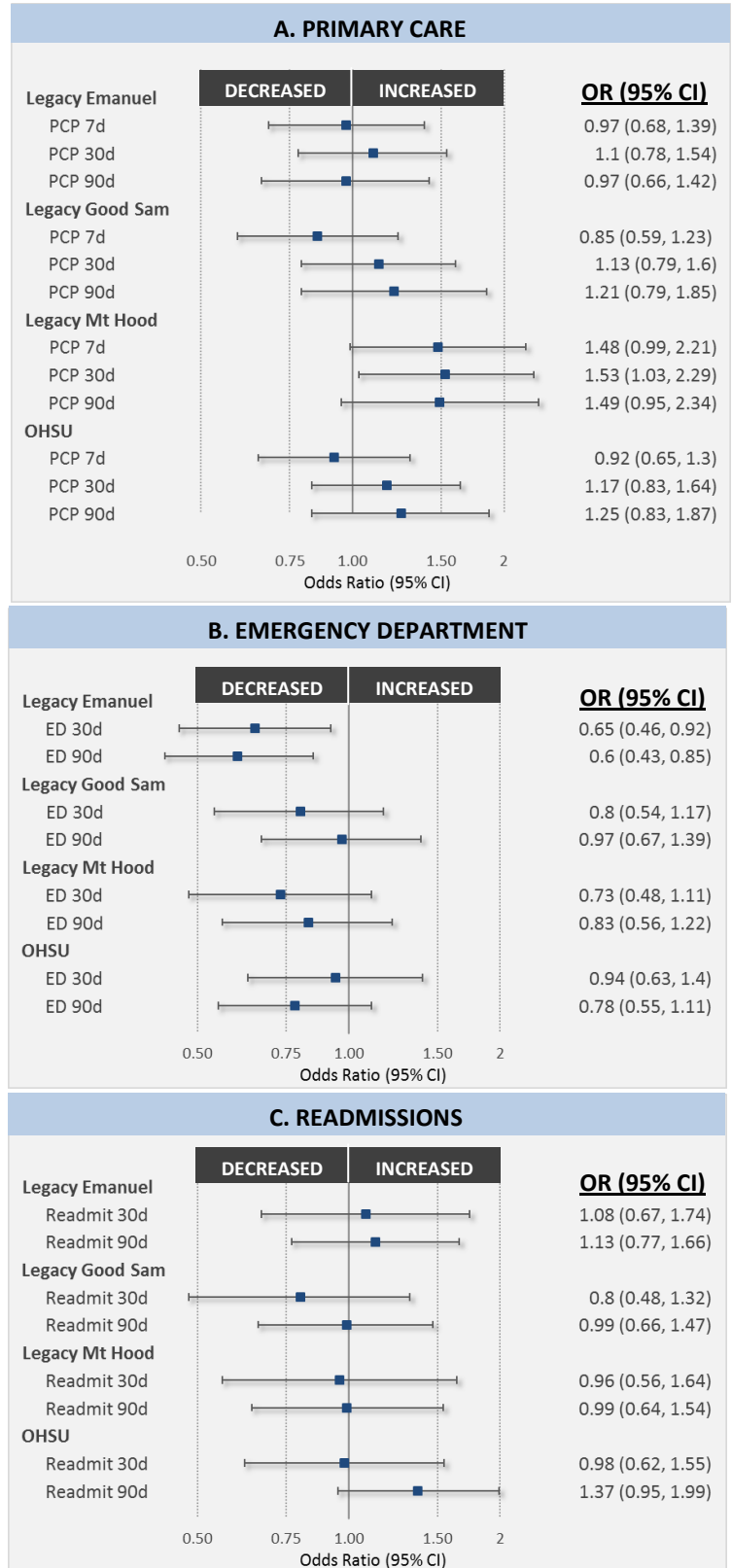
## AT INDIVIDUAL C-TRAIN HOSPITALS:

**PRIMARY CARE CONNECTIONS:** All patients seen at Legacy Mt. Hood had a significantly increased likelihood of having a post-discharge primary care visit at almost all measured time points (Exhibit 16A). We did not observe any other significant changes in primary care at the other three C-Train hospital sites.

**EMERGENCY DEPARTMENT:** At Legacy Emanuel, we observed a hospital-wide significant decrease in the likelihood of having an emergency department visit at 30 and 90 days following discharge (Exhibit 16B). There were no other significant changes observed at each hospital, although there was a downward trend at select time points following discharge for Legacy Mt. Hood and OHSU.

**READMISSIONS:** There were no significant hospital-wide changes in readmissions (Exhibit 16C). We did observe a trend towards increased readmissions at OHSU at 90 days for all Health Share patients.

Exhibit 16. Odds of Having Visit Following Discharge at a C-Train Hospital



# PATIENT-REPORTED DATA

## PATIENT SURVEYS

We conducted a patient survey designed to collect demographic and other information from program participants. We sent 291 enrolled Health Share patients a survey 1-2 weeks after their discharge from the hospital. A total of 97 patients (33%) responded.

**Exhibit 12. Patient Experiences**

DEMOGRAPHICS (94 survey respondents)		
SEX/RACE	Female	53%
	White, non-hispanic	71%
	Non-white	29%
EDUCATION	<High School	20%
	High School/GED	45%
	2-yr. degree	26%
	College or above	9%
EMPLOYMENT	Employed	8%
	Not Employed	62%
	Retired	30%
HOUSING	Rent	67%
	Friends/Family	23%
	Facility	6%
	Shelter/Street/Hotel	2%

## PROFILES FROM PATIENT SURVEYS

Exhibit 12 details the demographic information we obtained from our surveys. Data from survey respondents suggest that nearly a third (29%) of C-Traln patients are non-white. In contrast to the needs assessments (Exhibit 6, page 5), survey respondents did not report high levels of current homelessness; it could be that homeless participants were much less likely to receive and complete the survey and are thus unrepresented in survey data. The majority of respondents (67%) reported that they rented housing and 23% lived with friends or family members. A total of 20% of the respondents did not have a high school degree and 45% did not continue their education beyond completing high school/GED. Only 8% reported current employment, while 62% were unemployed and 30% were retired. .

## WHAT WERE PATIENT EXPERIENCES LIKE?

Patient surveys largely agreed with program records (Exhibit 8, page 5).

*Connection at the hospital:* Patients reported that a nurse or social worker helped 90% of them make a discharge plan, helped 87% make a follow-up appointment, and talked with 93% about their medications (Exhibit 13).

*Connection after discharge:* Following discharge from the hospital, 89% of patients surveyed reported that they were contacted by transitional care RN to check-in and see how they were doing; 46% received additional assistance in the form of food, housing, or transportation; and 98% reported that they were able to get the care that they needed (Exhibit 13). However, only 37% of respondents knew who to contact with their health questions (Exhibit 13).

**Exhibit 13. Patient Experiences**

While in the hospital a nurse/social worker did the following:	
90%	Helped you make a discharge plan.
87%	Helped you make a follow-up appointment.
93%	Talked with you about your medications.

After you left the hospital the following happened:	
89%	A nurse contacted you to see how you were doing.
46%	A nurse helped you with food, housing, or transportation.
98%	You were able to get the care you needed.
37%	You knew who to contact with questions concerning your health.