Supplementary Information

Evaluation of a Readmission Prevention Intervention Targeted with Predictive Analytics in an Integrated Health System: An Observational Study

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Table of Contents

Supplementary Table SM1 ..... **3**
Supplementary Figures/Tables SR1-SR12 ..... **4-16**
Appendix A: Data Collection **17**
Appendix B: Implementation of the Difference-in-Differences Analysis **18-19**
Appendix C: RDD Assumptions and Placebo Plots **20-36**
Appendix D: Definitions of Primary Condition Supergroups **37-38**
Appendix E: TSL Risk Score Implementation Details **39-45**
Appendix F: Internal Transitions Program Documentation **46-69**
References **70**

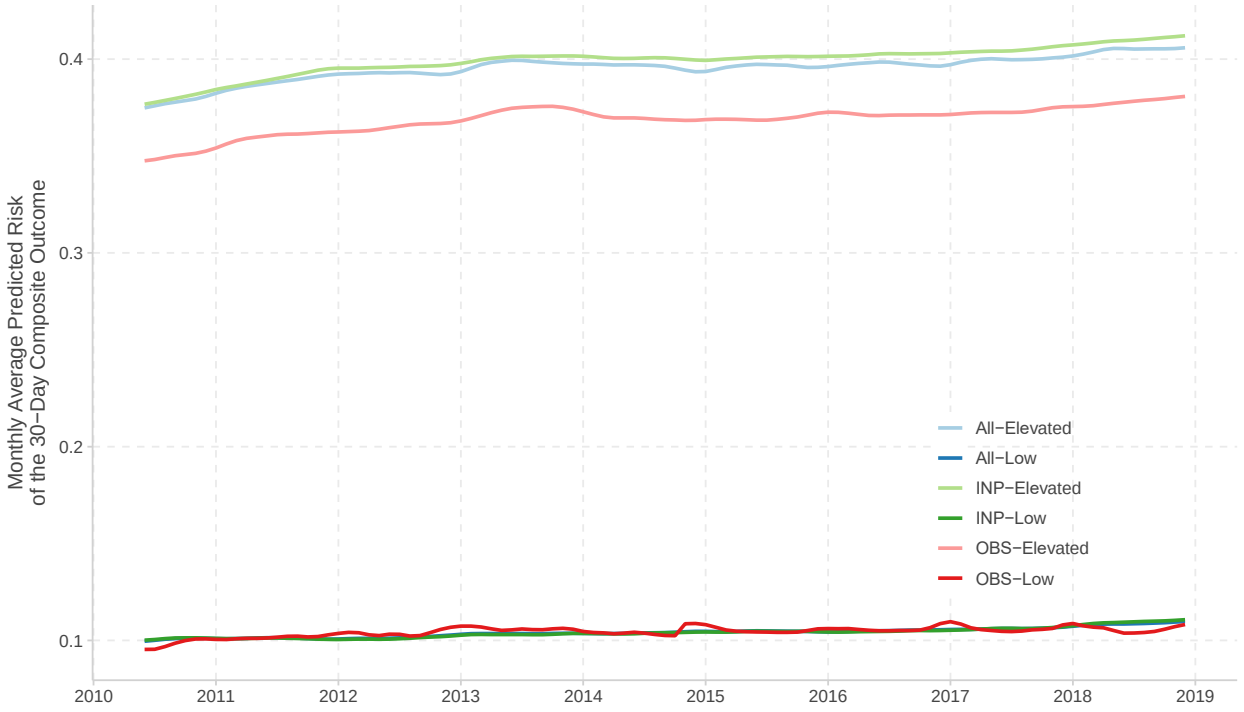
Supplementary Table SM1

Protocol Component	Description
Eligibility criteria	All adult patients discharged alive from a Kaiser Permanente Northern California hospital between January 2016 and December 2018 who were not admitted with a principal diagnosis of childbirth, nor underwent same-day surgery.
Treatment strategies[1]	The two trial arms consist of (1) a care coordination intervention delivered primarily via telephone in the 30 days following an index discharge (*treatment)*; and (2) usual post-discharge care (*comparator).*
Assignment procedures	The risk score-intervention dyad will be rolled out to KPNC hospitals in a stepped-wedge design fashion, with a sequence of hospitals "going live" in a random order. Following "go live", participants predicted to be at elevated risk of 30-day readmission or post-discharge mortality will be randomized to the treatment or usual care arms.
Follow-up period	Begins at randomization (8:00 AM on the day of discharge, concomitant with the generation of the risk estimate) and ends on the 30th day following the index discharge.
Outcome	Non-elective re-hospitalization and post-discharge mortality in the 30 days following an index discharge.
Causal contrasts of interest[2]	Intention-to-treat effect, i.e., the effect of being assigned to be enrolled in the Transitions Program versus usual care, and where applicable, per-protocol effect, i.e., the effect of enrollment in the Transitions Program versus usual care.
Analysis plan	Intention-to-treat, per-protocol analysis

[1]In contrast to the intervention as designed, this assumes that there is no distinction between the high and medium-risk subgroups in terms of the intensity of outreach, as was actually observed in our study.

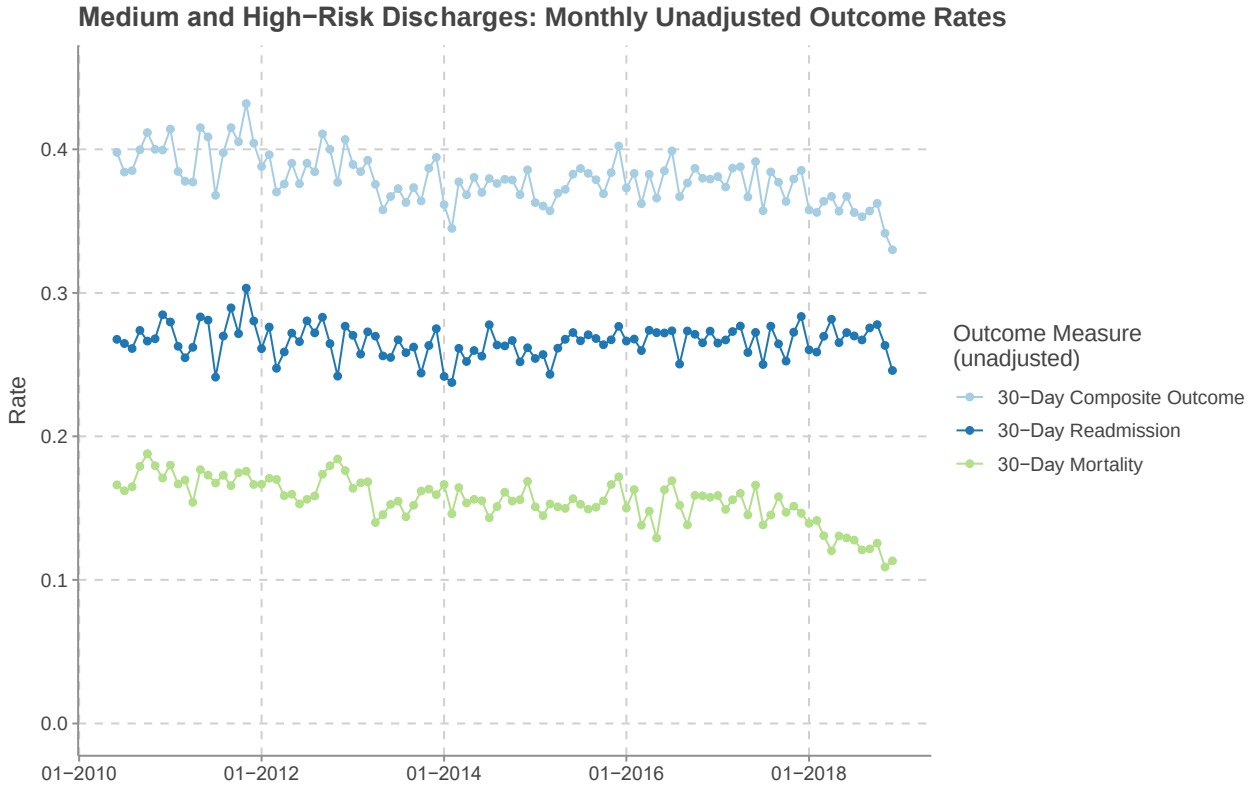
[2]We estimate the observational analogues of the intention-to-treat effect in our analysis: both a global effect (from the difference-in-differences estimates) as well as a local average treatment effect from the "sharp" regression discontinuity (RD) estimates. Similarly, as a sensitivity analysis using a "fuzzy" RD, we also estimate the observational analog of the per-protocol effect which applies only to patients near the 25% risk score threshold used for enrollment.

Supplementary Figure SR1



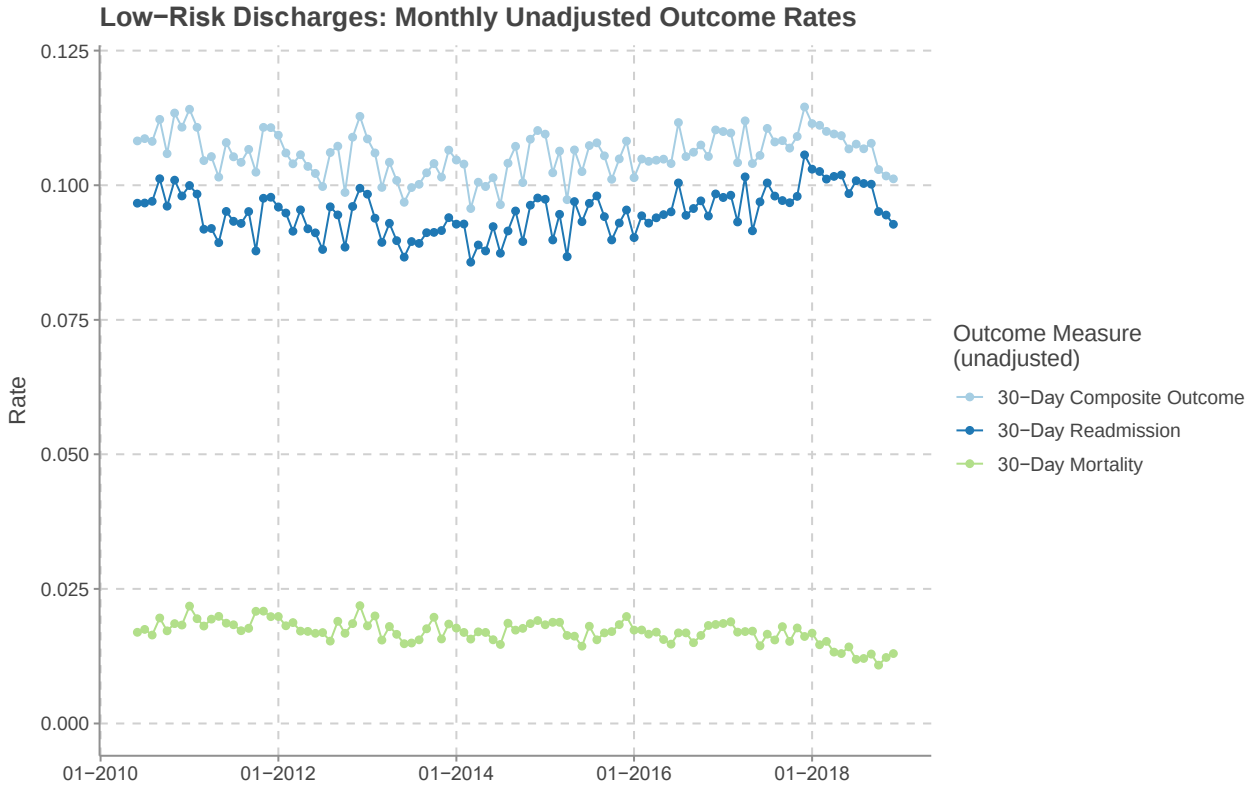
This figure presents the monthly average predicted risk of the composite outcome of 30-day post-discharge non-elective readmission or mortality among all KPNC hospital discharges from June 2010 to December 2018, stratified by intervention and comparator groups, as well as admission type: all (inpatient and observation), inpatient only, and observation only. In this sense, this figure represents a stratified analogue of Figure 1A in the main text. All the predicted risk time series have been smoothed using the X11 method, as with Figure 1A.

Supplementary Figure SR2



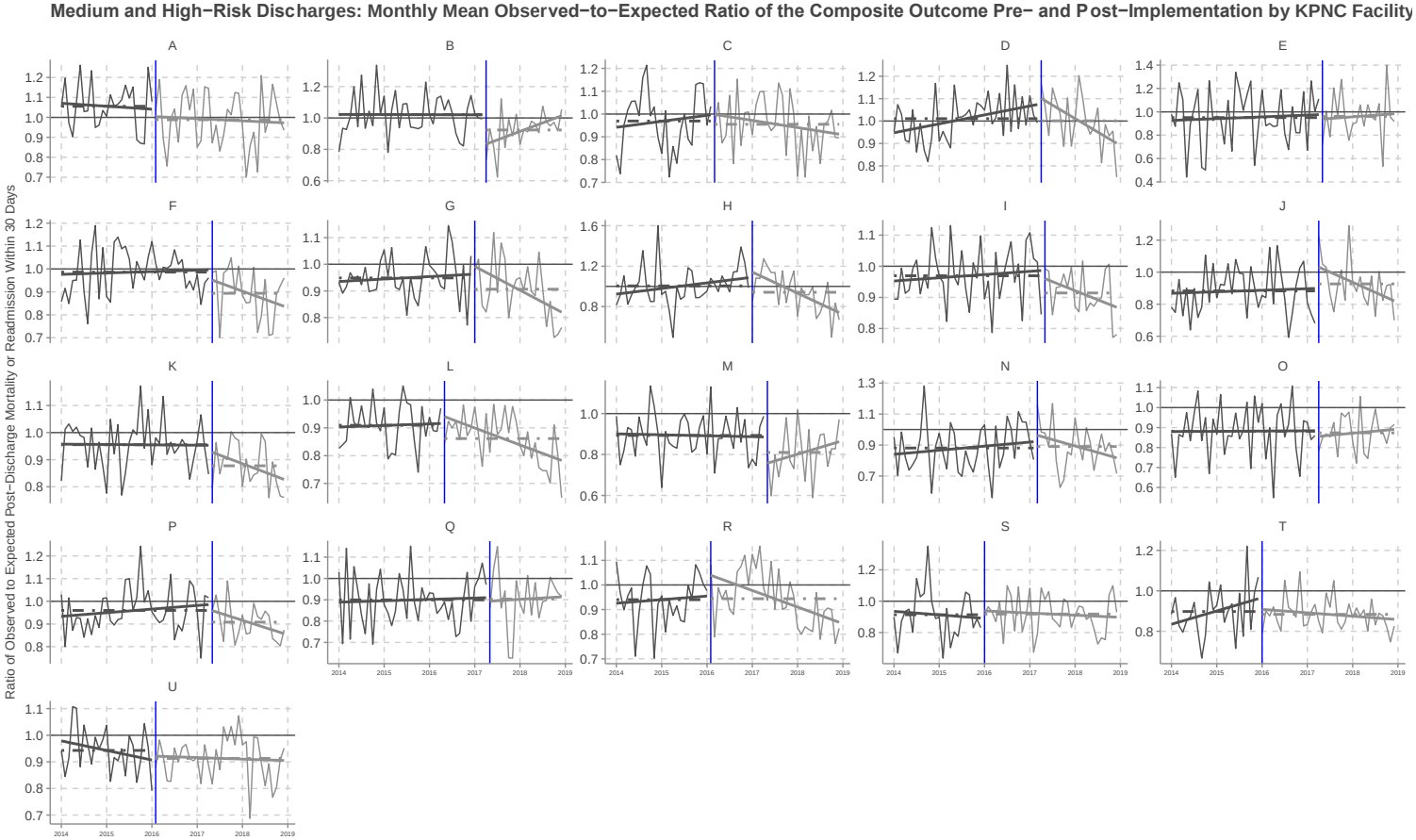
Monthly mean unadjusted outcome rates for the 3 outcomes for all medium and high-risk ("elevated risk") index discharges throughout the study period.

Supplementary Figure SR3



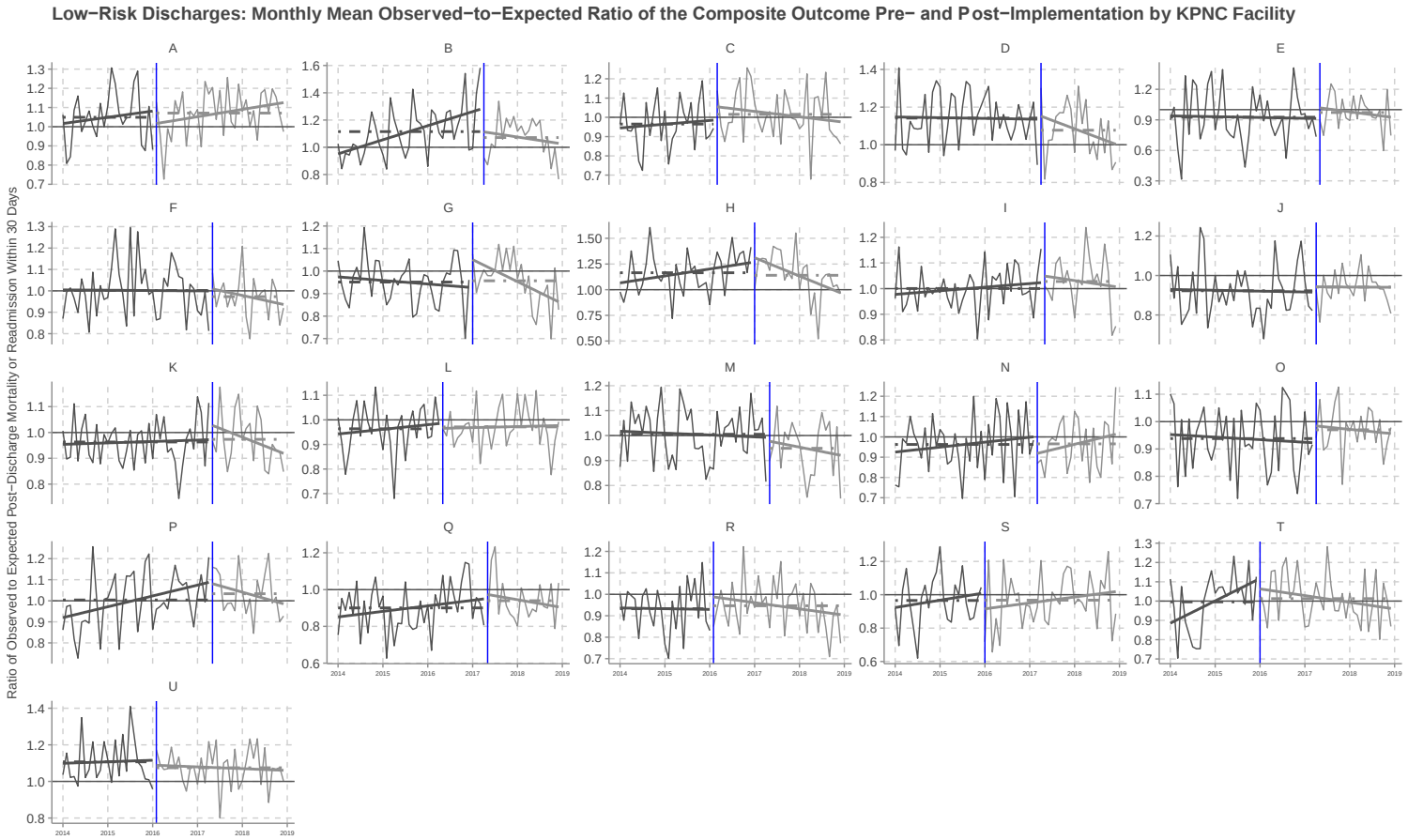
Monthly mean unadjusted outcome rates for the 3 outcomes for all low-risk index discharges throughout the study period.

Supplementary Figure SR4



Trends of the observed-to-expected outcome ratio (analogous to Figure 1, Panel B in the main text) before and after Transitions Program implementation, stratified by KPNC facility (coded as A, B, …, U) for medium and high-risk (“elevated risk”) index discharges. The “go-live” date for each facility is marked by a vertical blue line.

Supplementary Figure SR5



Trends of the observed-to-expected outcome ratio (analogous to Figure 1, Panel B in the main text) before and after Transitions Program implementation, stratified by KPNC facility (coded as A, B, …, U) for low-risk index discharges. The “go-live” date for each facility is marked by a vertical blue line.

Supplementary Table SR6

Admission year	LAPS2 at admission, mean (SD)	LAPS2 at discharge, mean (SD)	COPS2 at admission, mean (SD)
2010	51.7 (36.7)	43.7 (26.5)	36.1 (38.3)
2011	53.0 (37.9)	44.3 (27.2)	38.0 (40.8)
2012	53.6 (38.4)	44.6 (27.5)	40.2 (43.0)
2013	55.2 (38.8)	44.2 (27.7)	44.3 (46.4)
2014	55.0 (38.4)	43.6 (27.6)	45.3 (46.6)
2015	56.2 (38.9)	44.0 (27.7)	46.0 (46.7)
2016	56.8 (39.1)	44.7 (28.0)	46.1 (46.8)
2017	57.8 (39.3)	45.1 (28.2)	48.8 (49.2)
2018	59.4 (39.1)	45.6 (28.3)	52.0 (51.6)

Trends of the Laboratory-based Acute Physiology score, version 2 (LAPS2) recorded at admission and discharge, and of the Comorbidity Point Score, version 2 (COPS2) recorded at admission, from 2010 to 2018, for all index discharges in the cohort.

Supplementary Table SR7

	Low risk (<25%) (comparator)			High and medium risk (≥25%) (intervention)		
Admit year	LAPS2 on admission, mean (SD)	LAPS2 at discharge, mean (SD)	COPS2 on admission, mean (SD)	LAPS2 on admission, mean (SD)	LAPS2 at discharge, mean (SD)	COPS2 on admission, mean (SD)
2010	44.3 (30.5)	40.9 (24.3)	27.4 (27.8)	99.9 (37.2)	62.1 (32.1)	92.2 (48.9)
2011	44.9 (31.5)	41.1 (24.7)	27.9 (28.4)	101.1 (37.7)	63.7 (32.7)	98.3 (50.7)
2012	45.0 (31.7)	41.0 (24.8)	28.8 (29.1)	100.9 (37.6)	64.2 (32.8)	102.7 (52.4)
2013	46.0 (32.1)	40.4 (24.8)	30.9 (30.8)	100.4 (37.0)	63.2 (32.8)	109.9 (53.8)
2014	46.0 (31.9)	39.9 (24.8)	31.9 (31.3)	99.4 (36.8)	62.0 (32.8)	111.0 (53.2)
2015	46.7 (32.1)	40.2 (25.0)	32.4 (31.6)	100.7 (37.2)	61.7 (32.6)	109.9 (52.5)
2016	47.3 (32.4)	40.9 (25.3)	32.4 (31.5)	101.3 (37.4)	62.7 (32.9)	110.3 (53.0)
2017	48.0 (32.5)	41.0 (25.4)	33.6 (32.4)	100.1 (37.7)	62.7 (32.6)	114.6 (54.7)
2018	49.3 (32.4)	41.4 (25.5)	35.1 (33.5)	99.3 (37.7)	62.4 (32.4)	119.0 (56.3)

Trends of the Laboratory-based Acute Physiology score, version 2 (LAPS2) recorded at admission and discharge, and of the Comorbidity Point Score, version 2 (COPS2) recorded at

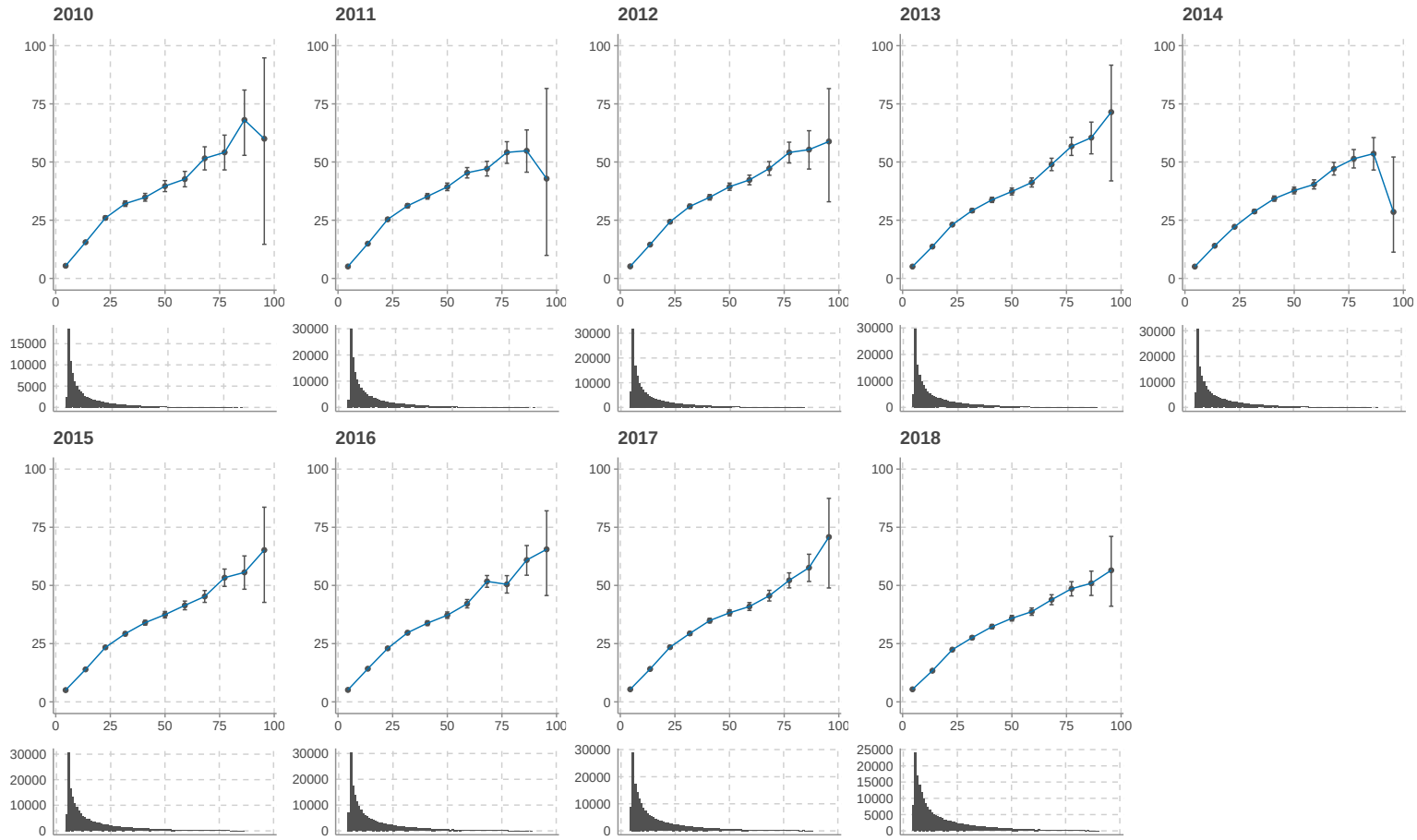
admission, from 2010 to 2018, for all index discharges in the cohort and stratified by risk subgroup.

Supplementary Table SR8

	Low risk (<25%) (comparator)		High and medium risk (≥25%) (intervention)	
Admission year	Risk score, mean (SD)	Risk score, median	Risk score, mean (SD)	Risk score, median
2010	10.1 (0.05)	8.1	38.0 (11.9)	34.3
2011	10.1 (0.05)	8.2	38.9 (12.4)	35.2
2012	10.2 (0.05)	8.2	39.3 (12.7)	35.5
2013	10.4 (0.05)	8.5	39.9 (13.1)	36.1
2014	10.4 (0.05)	8.5	39.7 (12.9)	36.0
2015	10.5 (0.05)	8.6	39.7 (12.8)	36.1
2016	10.5 (0.05)	8.7	39.8 (13.0)	36.0
2017	10.6 (0.05)	8.9	40.1 (13.2)	36.2
2018	10.9 (0.05)	9.1	40.5 (13.4)	36.7

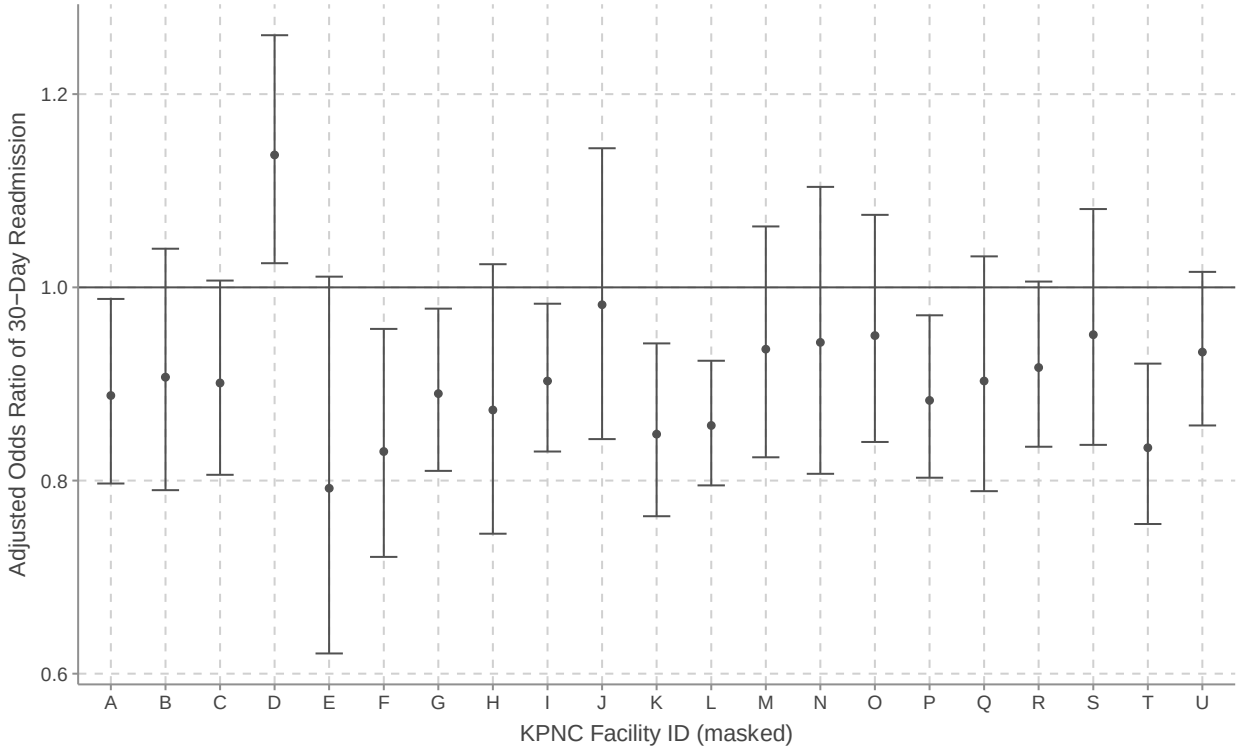
Trends of the risk score of the composite outcome of 30-day readmission and/or death used to assign the Transitions Program intervention, from 2010 to 2018, for all index discharges in the cohort and stratified by risk subgroup. The scores are expressed as percentages ranging from 0 to 100%.

Supplementary Figure SR9



Calibration of the TSL predictive model used to assign the Transitions Program intervention, stratified by year from 2010 to 2018. The *x*-axis denotes the midpoint of the predicted (or expected) outcome rates for each data bin, whereas the *y*-axis gives the observed outcome rate for that bin. Error bars denote 95% confidence intervals. The histogram below each bin shows the distribution of risk across all index discharges derived from that year on the same scale.

Supplementary Figure SR10



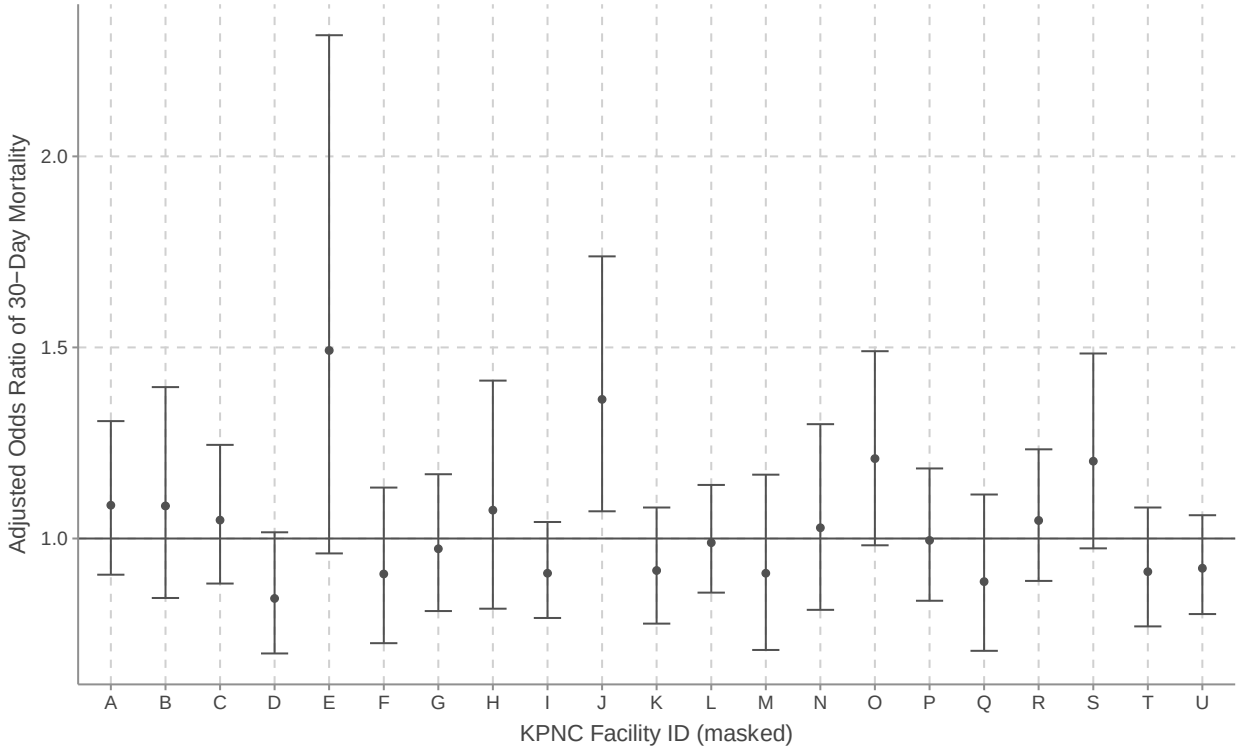
Difference-in-differences estimates of the odds ratio of 30-day readmission, stratified by KPNC facility (coded as A, B, …, U) and 95% confidence intervals. These odds ratios were derived by subsetting the index discharges for each facility and fitting the model described in Appendix B to each facility subset separately.

Supplementary Table SR11

The following table gives the 21 KPNC facility-specific (coded as A, B, …, U) RDD estimates for both outcomes: 30-day non-elective readmission and 30-day mortality, together with their 95% confidence intervals. These estimates are expressed as absolute risk reductions, and bold font denotes statistically significant estimates at the 95% confidence level.

ID	30-day readmission	95% CI	30-day mortality	95% CI
A	**-3.9%**	**-5.9% to -1.9%**	**1.4%**	**0.0% to 2.7%**
B	**-5.5%**	**-8.5% to -2.5%**	0.7%	-1.4% to 2.7%
C	**-4.3%**	**-6.3% to -2.4%**	0.8%	-0.8% to 2.3%
D	-2.2%	-4.5% to 0.1%	-1.2%	-2.9% to 0.6%
E	-1.6%	-6.6% to 3.4%	1.0%	-2.5% to 4.4%
F	1.2%	-1.5% to 4.0%	0.3%	-1.8% to 2.3%
G	-0.4%	-2.3% to 1.5%	0.2%	-1.4% to 1.9%
H	**-4.3%**	**-7.7% to -0.9%**	0.8%	-1.4% to 3.0%
I	**-1.9%**	**-3.6% to -0.1%**	**-1.7%**	**-3.3% to -0.1%**
J	-1.9%	-4.7% to 0.9%	-0.6%	-3.2% to 2.1%
K	**-3.8%**	**-5.8% to -1.9%**	-1.9%	-4.0% to 0.2%
L	-1.1%	-2.6% to 0.3%	-0.1%	-1.4% to 1.2%
M	**-5.3%**	**-7.8% to -2.9%**	0.7%	-0.8% to 2.1%
N	-1.8%	-4.6% to 1.1%	-1.2%	-3.9% to 1.5%
O	-0.3%	-2.7% to 2.1%	**2.2%**	**0.4% to 4.0%**
P	**-3.8%**	**-5.8% to -1.7%**	0.7%	-0.6% to 2.0%
Q	-0.3%	-3.1% to 2.4%	-1.5%	-3.9% to 0.9%
R	**-2.4%**	**-4.1% to -0.7%**	0.7%	-0.8% to 2.2%
S	-1.9%	-4.1% to 0.2%	-0.4%	-2.4% to 1.6%
T	**-4.3%**	**-6.2% to -2.4%**	-0.4%	-2.2% to 1.3%
U	**-3.8%**	**-5.5% to -2.2%**	-0.6%	-2.2% to 1.0%

Supplementary Figure SR12



Difference-in-differences estimates of the odds ratio of 30-day mortality, stratified by KPNC facility (coded as A, B, …, U) and 95% confidence intervals. These odds ratios were derived by subsetting the index discharges for each facility and fitting the model described in Appendix B to each facility subset separately.

Appendix A: Data collection

For each index discharge, we captured the following covariates: KFHP membership, longitudinal comorbidity burden, acute severity of illness during the hospitalization, and admission and discharge code status.[1] Each month, all adult KPNC enrollees are assigned a COmorbidity Point Score (version 2) (COPS2), with increasing scores associated with increasing mortality risk. Appendix E (Table E5) describes the 42 comorbidity groups and their corresponding scores. Based on KPNC's experience with its early warning system, now operational in all 21 hospitals,[2-4] inpatients with COPS2 ≥65 are routinely evaluated by palliative care teams, as a score above this threshold is associated with high risk of in-hospital deterioration.

At KPNC, patients are also assigned a Laboratory-based Acute Physiology Score (version 2) (LAPS2) every hour after hospitalization, including a score assigned at 0800 on the discharge day (LAPS2dc). Increasing LAPS2 scores reflect worsening physiologic instability; for example, in July 2018, the median hourly LAPS2 among all KPNC intensive care unit patients was 110, whereas the median ward score was 52. Details on the LAPS2 scoring system are given in Appendix E (Tables E3, E4a, and E4b). Finally, we also classified each patient's care directive as "full code" or not (which included "partial code," "do not resuscitate," and "comfort care only").[1]

In addition, we also captured the following covariates for each index hospitalization: age at hospitalization; sex; hospitalization venue (ED or not); total length of stay (LOS); whether a patient experienced any overnight inpatient hospitalization in the 7 days before the index hospitalization, and separately, in the 8 to 30-day period prior;[5] discharge disposition (home; regular or custodial skilled nursing facility, SNF; and Home Health services); and referral to hospice. We also captured discharge diagnoses in the form of ICD codes and assigned a primary condition category to each index discharge based on groupings defined in Appendix D.

Appendix B: Implementation of the difference-in-differences analysis

The difference-in-differences analysis was implemented using a generalized linear mixed model with a logit link function. For each hospitalization i, this model assumed the following specification:

$$logit(Y_i) = \beta_0 + \beta X_i + \beta_{year} \cdot year_i + \beta_{dose} \cdot dose_i + \beta_{live} \cdot live_i + \beta_* \cdot dose_i \cdot live_i + \alpha_{H[i]} + \alpha_{year[i]},$$

where:

Y_i denotes the binary outcome of re-hospitalization or death;

β_0 denotes an overall intercept;

X_i is a vector of patient-level covariates with respect to hospitalization i (described below);

$year_i$ is the year of admission;

$dose_i$ is an indicator variable denoting a predicted risk score of ≥25% at discharge;

$live_i$ is an indicator variable denoting that the Transitions Program had been implemented ("gone live") at that hospital;

$dose_i \cdot live_i$ is the interaction between these two indicator variables, denoting that the patient received the Transitions intervention (hence making β_* the effect of interest);

$\alpha_{H[i]}$ is a random-effects term with a hospital-level random effect (α_{H_i}) for the discharging hospital $H[i]$; and

$\alpha_{year[i]}$ is a random-effects term for the year of discharge for hospitalization i, $year[i]$, (coded as 0…8 to facilitate convergence).

The models adjusted for the following covariates X_i: age at admission (scaled by 100 to facilitate convergence); male gender; COmorbidity Point Score, version 2 (COPS2; scaled by 100); length of stay (LOS; with durations greater than 30 days set to 30 days); diagnostic supergroup categories (described in Appendix E); Laboratory-based Acute Physiology Score,

version 2, at admission and discharge (LAPS2, LAPS2dc; scaled by 100); Kaiser Foundation Health Plan membership status at admission; and observation stay status (except for the inpatient and HEDIS-only analyses). B-splines were used to transform LOS.

All models were estimated using the function `glmer` provided by the `lme4` package (version 1.1-21) for R 3.6.1. The BOBYQA algorithm (Bound Optimization by Quadratic Approximation) was used to optimize all objective functions, with a maximum of 2×10^5 function calls allowed. These settings correspond to passing `control=glmerControl(optimizer='bobyqa', optCtrl=list(maxfun=2e5))` to `glmer()`.

Finally, we also modified the specification of this model slightly in order to assess associations between the implementation of the Transitions Program and length of stay (LOS) among medium and high-risk (>25%) patients at their index hospitalization. We used the same model specification as above, but without a link function (thus making it a linear mixed-effects model). Similarly, we used this approach to also assess associations between implementation and the severity of illness at the beginning of a subsequent 30-day readmission, if there was one. These results are presented at the end of the Results section, under “Other associations with Transitions Program implementation.”

Appendix C: RDD assumptions and placebo plots

C1: Validity conditions for the RD design

Following Moscoe *et al*.,[6] there are several validity conditions with respect to the data-generating process that must be met as a prerequisite to an RDD analysis. We restate these conditions here and address them in the context of our analysis.

1. *The decision rule and cutoff value are known*

   These assumptions hold as both the decision rule and cutoff value are specified: assignment is based on the predicted risk of non-elective readmission or death within 30 days of discharge, with the intervention assigned if this value is greater than 25%. This process is automated in the electronic health record for every patient just before discharge.

2. *The assignment variable is continuous near the cutoff value*

   The predictive algorithm is based on logistic regression, which produces risk scores in the form of continuous probability values, and which are used for treatment assignment. Moreover, near the cutoff value of a predicted risk of 25%, the actual scores are also as good as continuous; see Figure C1a.

3. *Potential outcomes are continuous at the threshold*

   This condition is equivalent to the patients just above and below the cutoff value being "comparable", in the sense of balance on their observed covariates. Viewed as a balancing score (see Hansen[7]), the risk score projects a multidimensional covariate vector into a scalar value which functions as a similarity measure (akin to a propensity

score), which facilitates balance near the cutoff value, and possibly to a greater extent than a single covariate serving as an assignment variable would.

In addition, we also cite the “no-manipulability” condition, which (related to #3 above) stipulates that the value of the assignment variable should not be able to be manipulated by decision-makers, which may manifest as “bunching” on either side of the cutoff value. This is not present in our data, as can be seen in Figure C1a below.

Our overall analytic approach, which combines the RDD with difference-in-difference analyses, resembles that in Walkey *et al*.,[8] with the exception that our risk score is continuous instead of discrete. Unlike in the difference-in-differences analysis, we do not adjust for covariates directly in the RDD, instead taking advantage of the balancing properties of risk scores (see #3 above). All regression discontinuities were estimated using the functions `RDEstimate` provided by the `rdd` package (version 0.57), in addition to the functions `rdd_reg_lm` and `rdd_reg_np` provided by the `rddtools` package (version 0.4.0) for R 3.6.1. A linear specification was used for the readmission outcomes, while a local linear specification was used for the mortality outcomes. Where applicable, bandwidths were selected using the Imbens-Kalyanaraman method.[9]

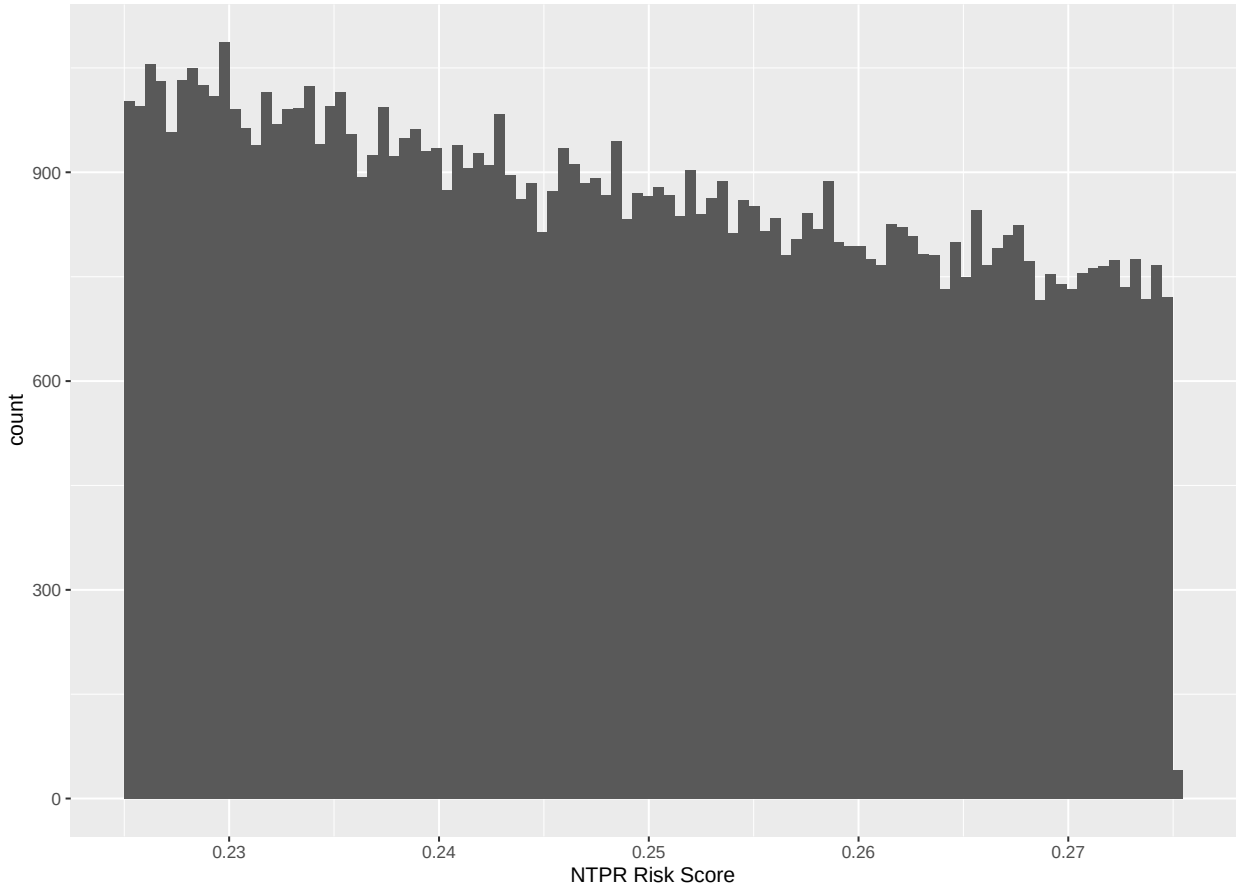


Figure C1a: Histogram of the risk score used for Transitions treatment assignment in the range 0.225-0.275, and thus centered on the cutoff value of 0.25.

C2: RD plots

Here, we present seven plots each of which corresponds to a RD estimate from Table 4 in the manuscript. For the purposes of these plots, the raw data were binned prior to plotting, with the number of bins being chosen automatically.

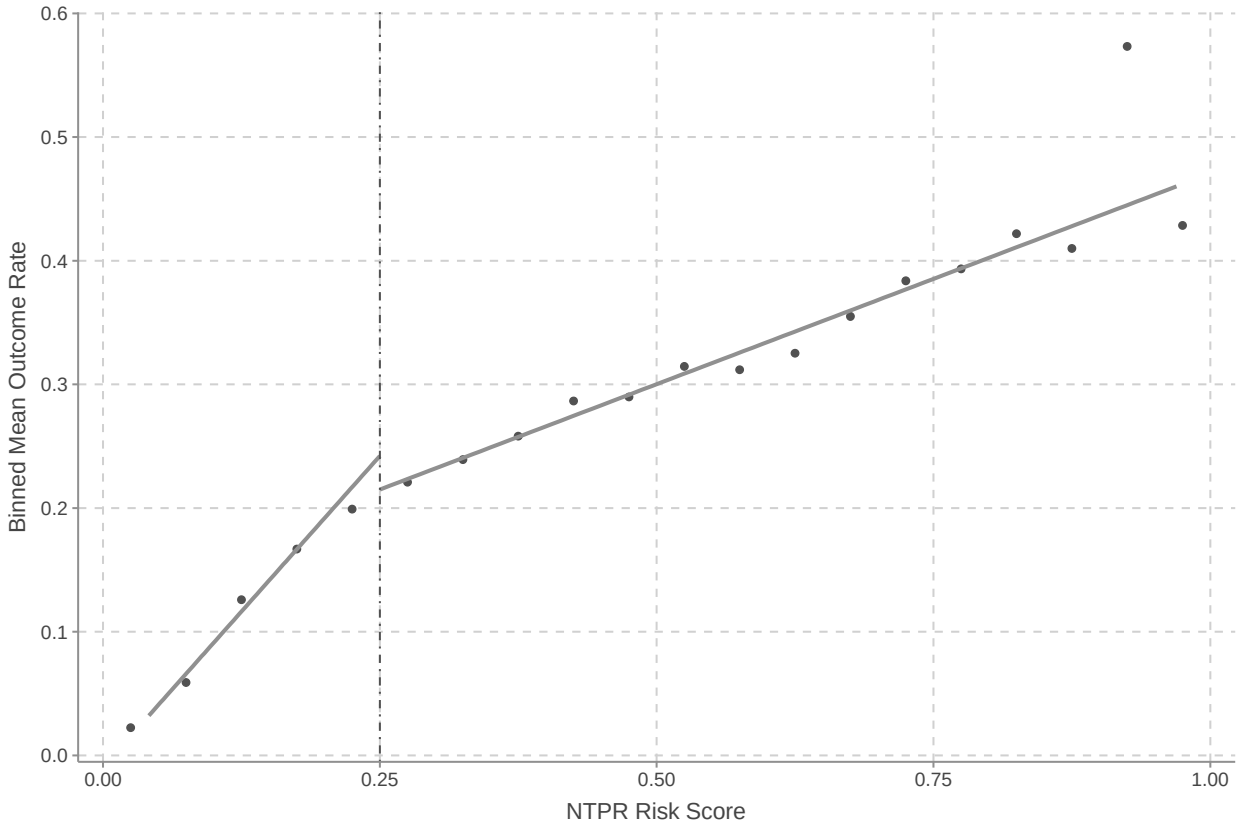


Figure C2a: 30-day non-elective re-hospitalization, all index discharges (inpatient and observation)

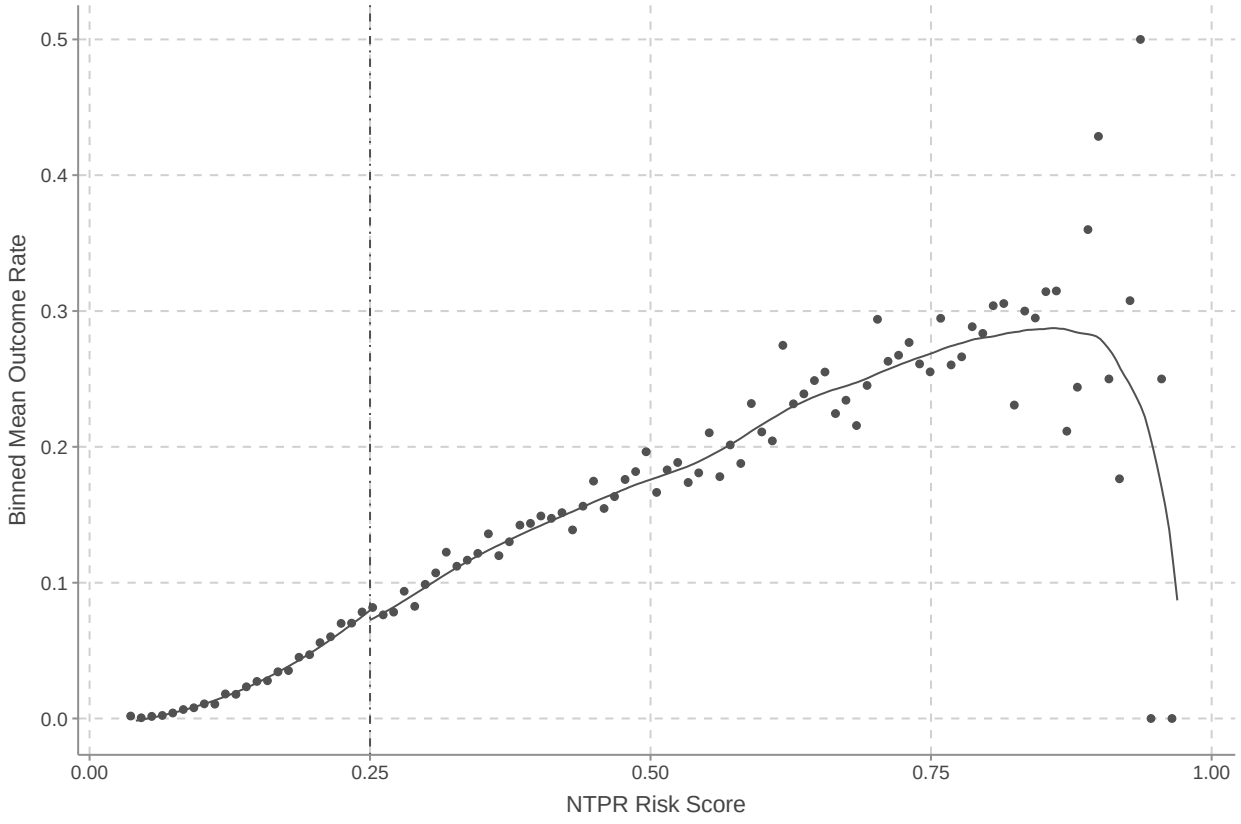


Figure C2b: 30-day post-discharge mortality, all index discharges (inpatient and observation)

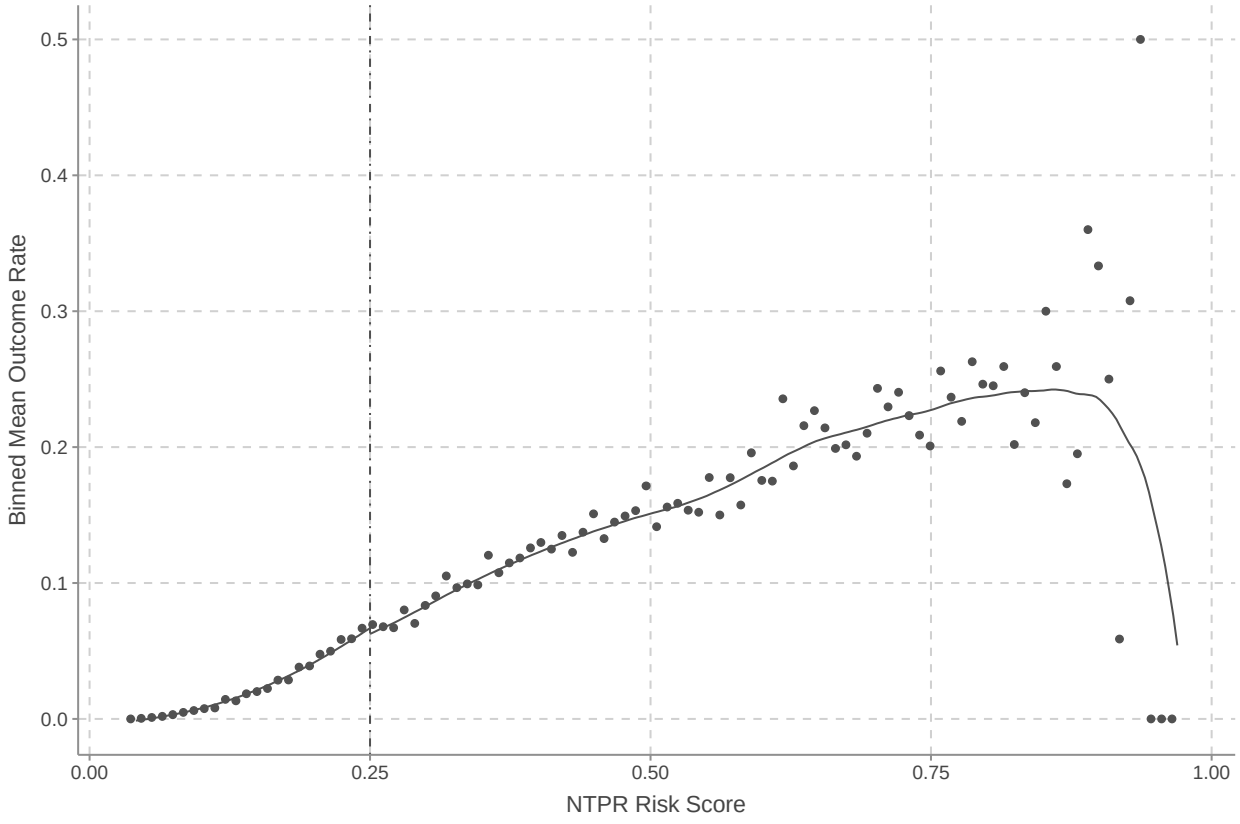


Figure C2c: 30-day out-of-hospital post-discharge mortality, all index discharges (inpatient and observation)

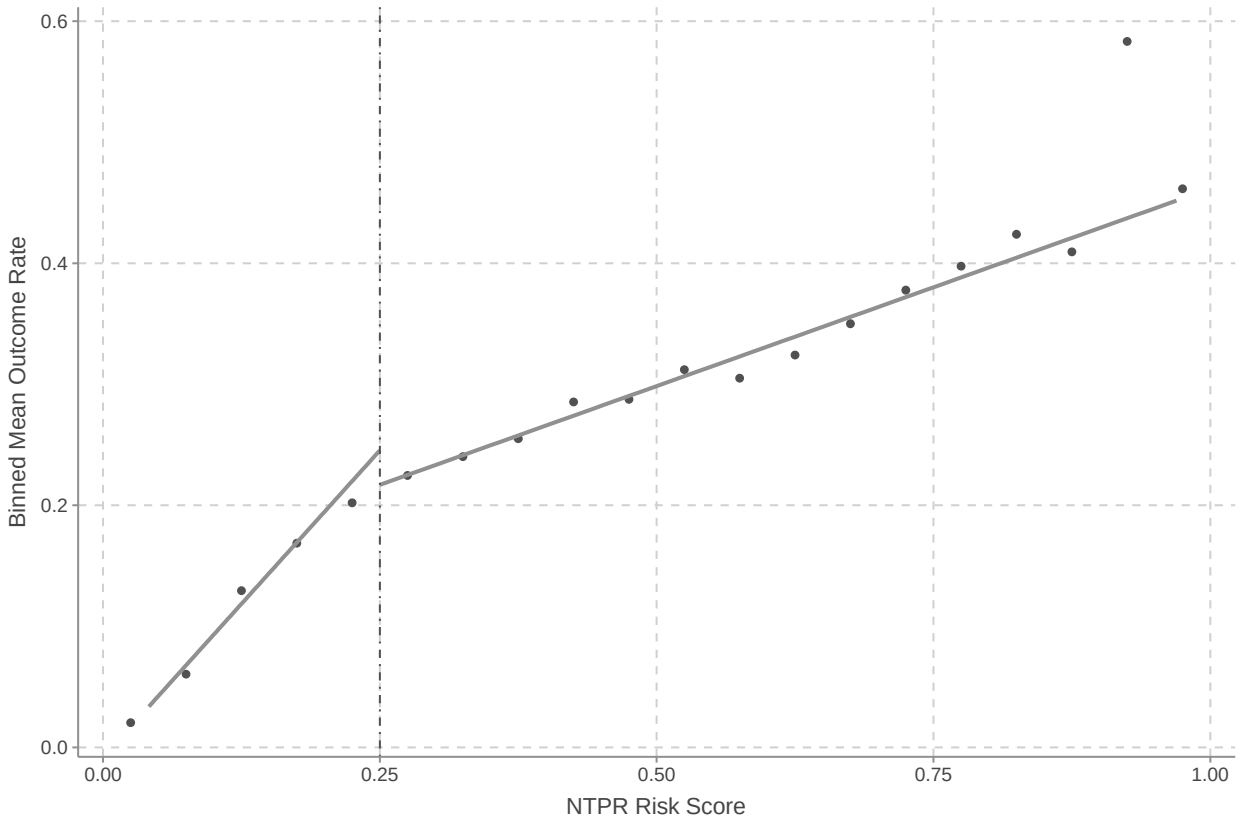


Figure C2d: 30-day non-elective re-hospitalization, inpatient index discharges only

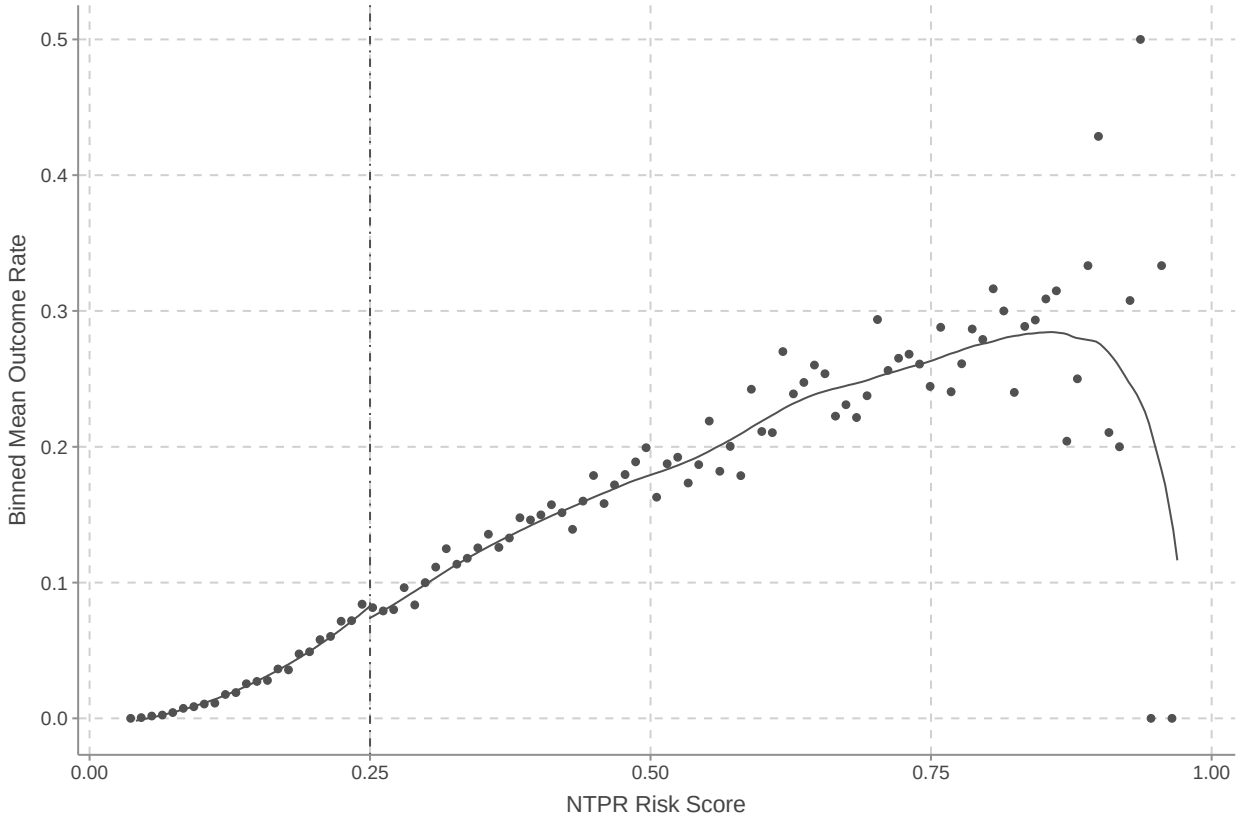


Figure C2e: 30-day post-discharge mortality, inpatient index discharges only

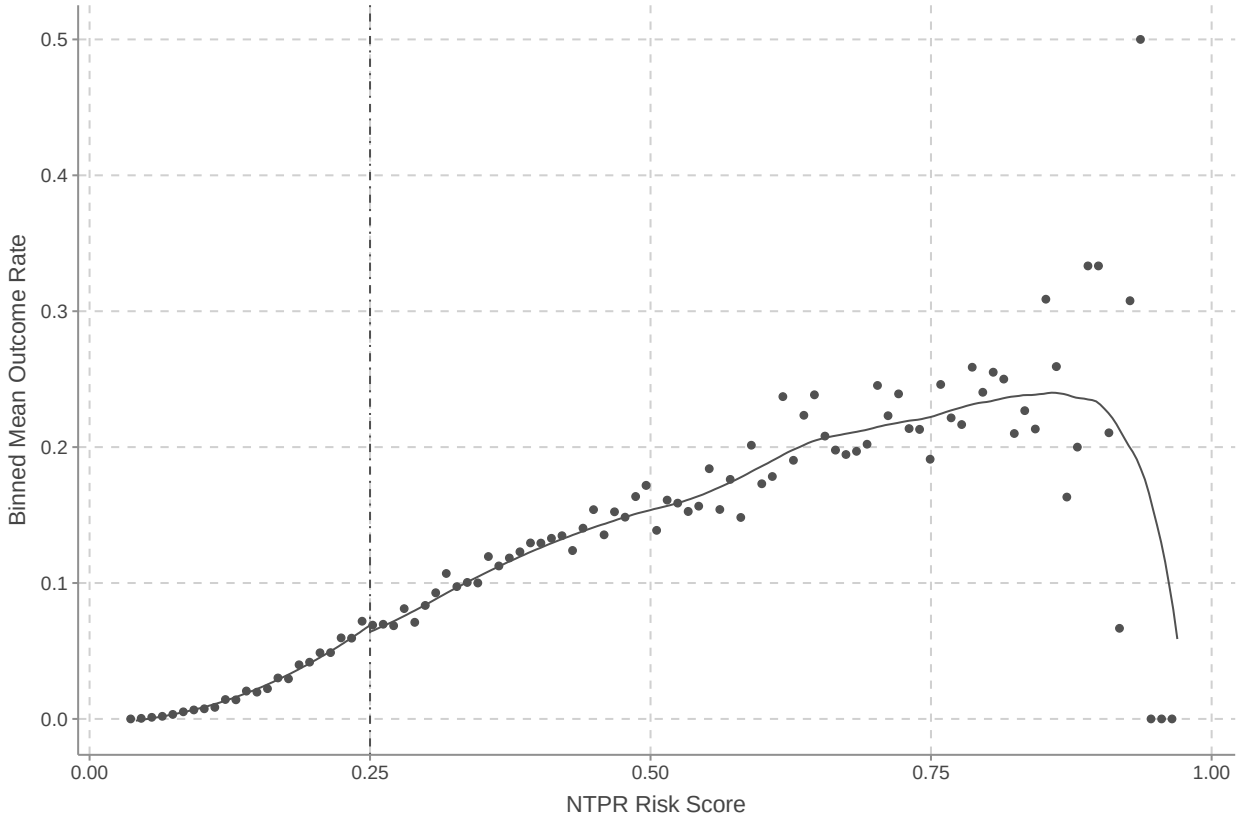


Figure C2f: 30-day out-of-hospital post-discharge mortality, inpatient index discharges only

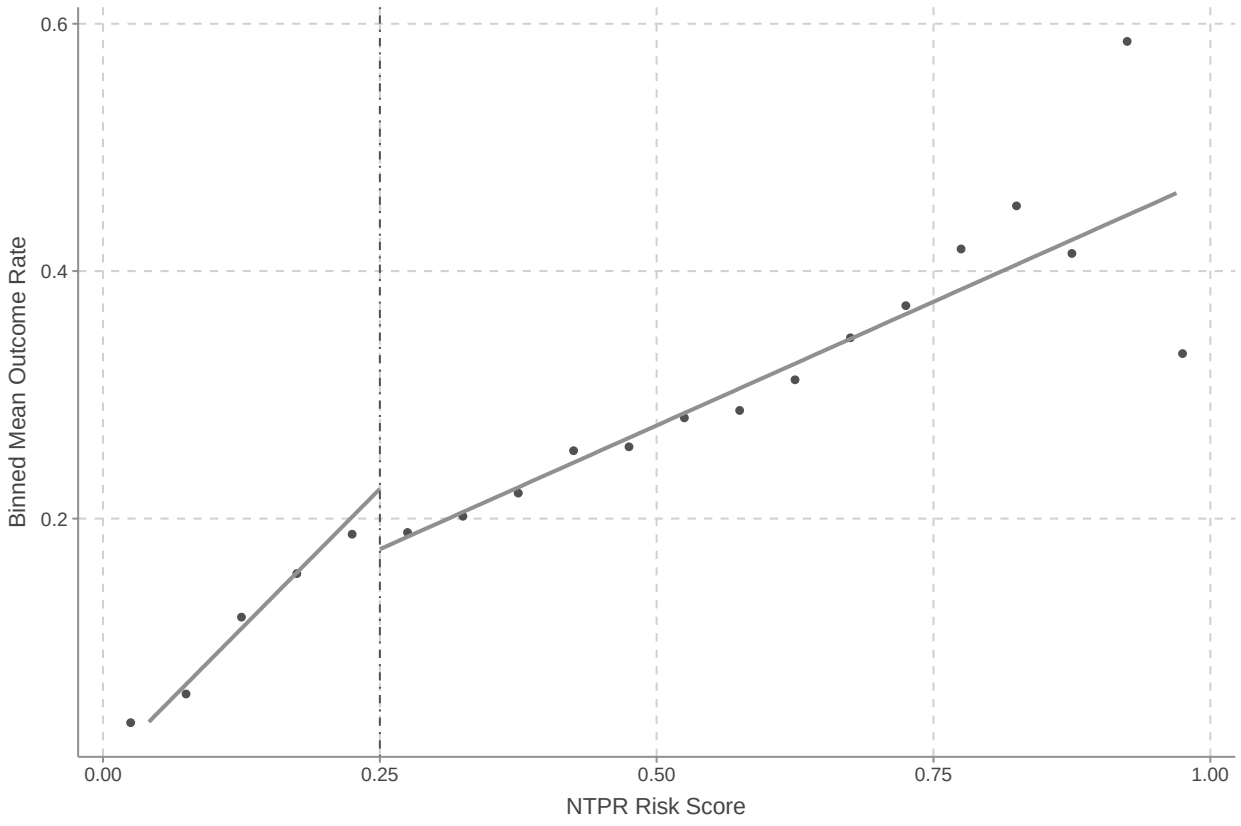


Figure C2g: 30-day non-elective re-hospitalizations, index discharges meeting HEDIS criteria only

C3: Placebo plots for the RD estimates

Here, we also present seven “placebo plots”, each of which corresponds to a RD estimate from Table 4 in the manuscript. A placebo plot is generated by successively re-fitting the RDD across a span of “dummy” cut-off values (between the 5th and 95th percentiles of the risk score) that were not used to assign treatment. The blue point and error bars correspond to the point estimates and 95% confidence intervals (CIs) presented in Table 4; the lines on either side of the blue point correspond to the RD estimates and 95% CIs at each of the “dummy” cut-off values.

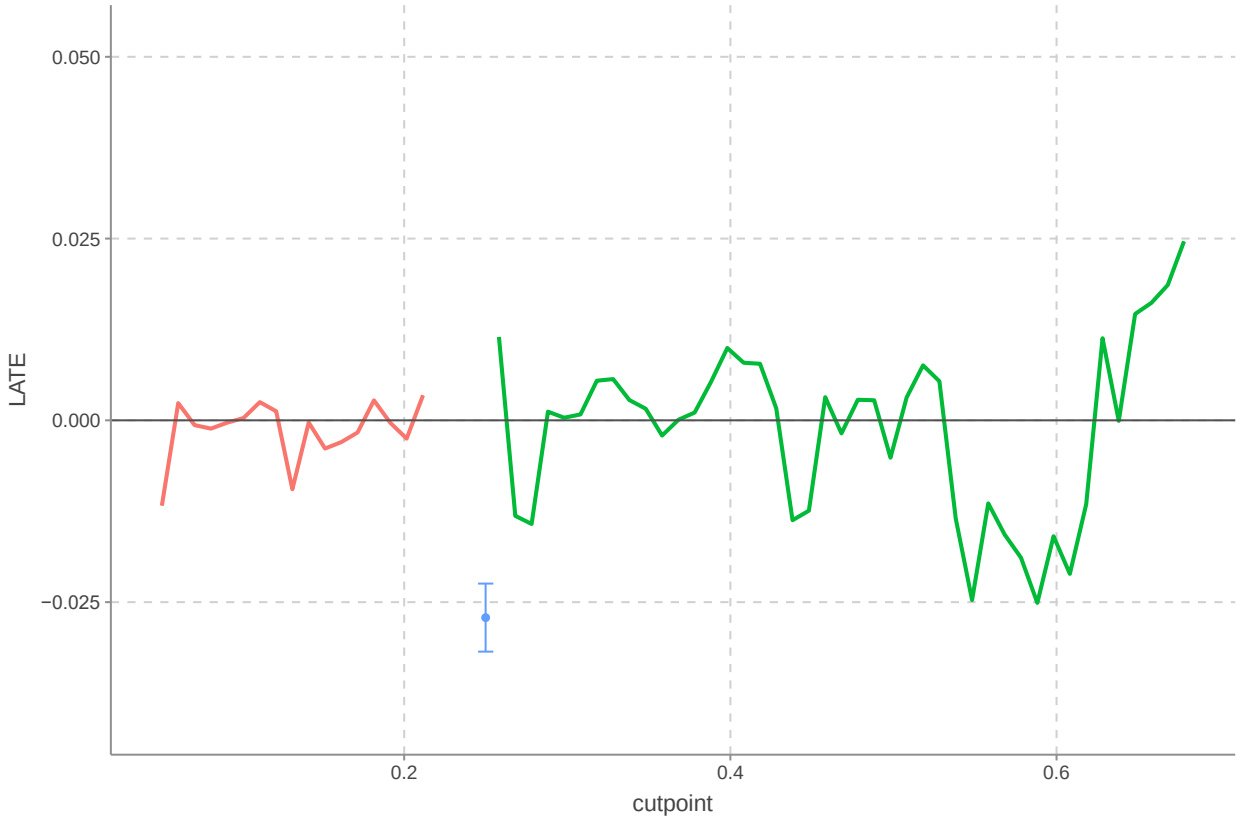


Figure C3a: 30-day non-elective re-hospitalization, all index discharges (inpatient and observation)

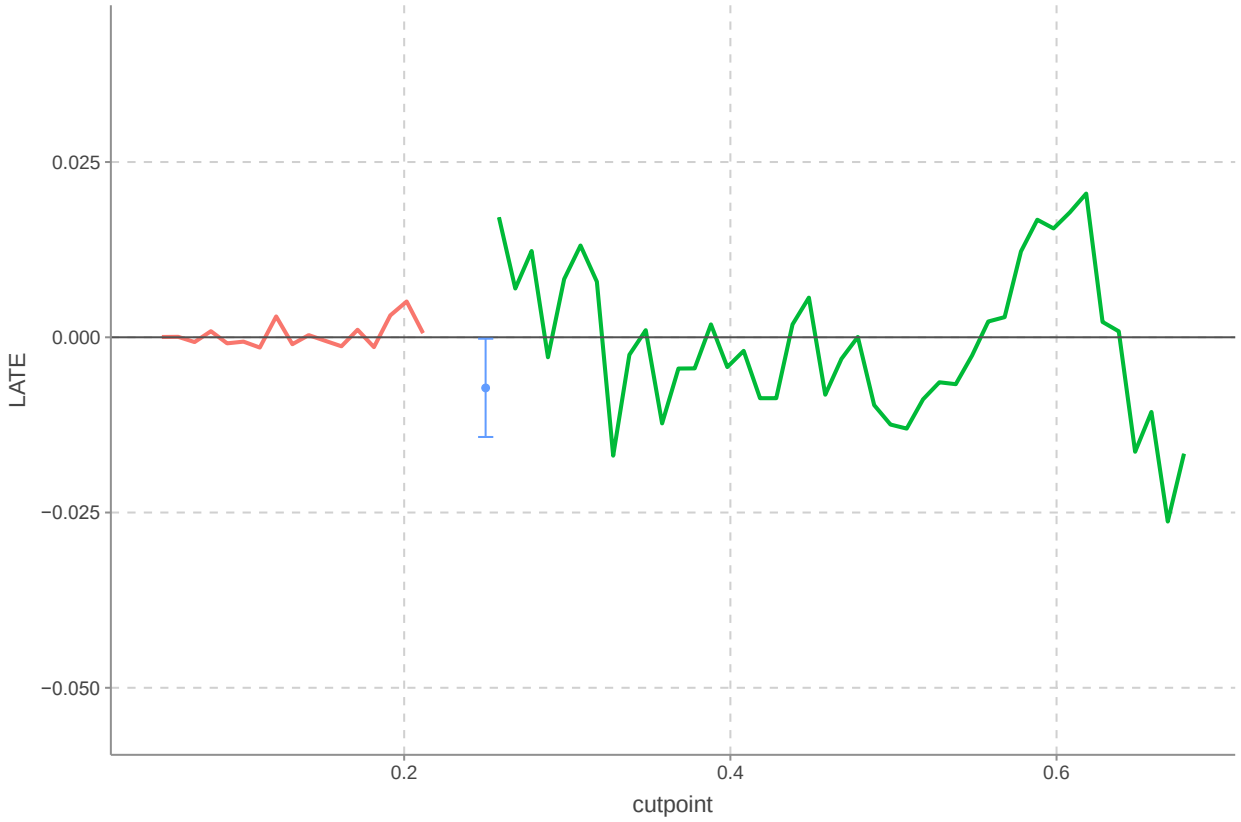


Figure C3b: 30-day post-discharge mortality, all index discharges (inpatient and observation)

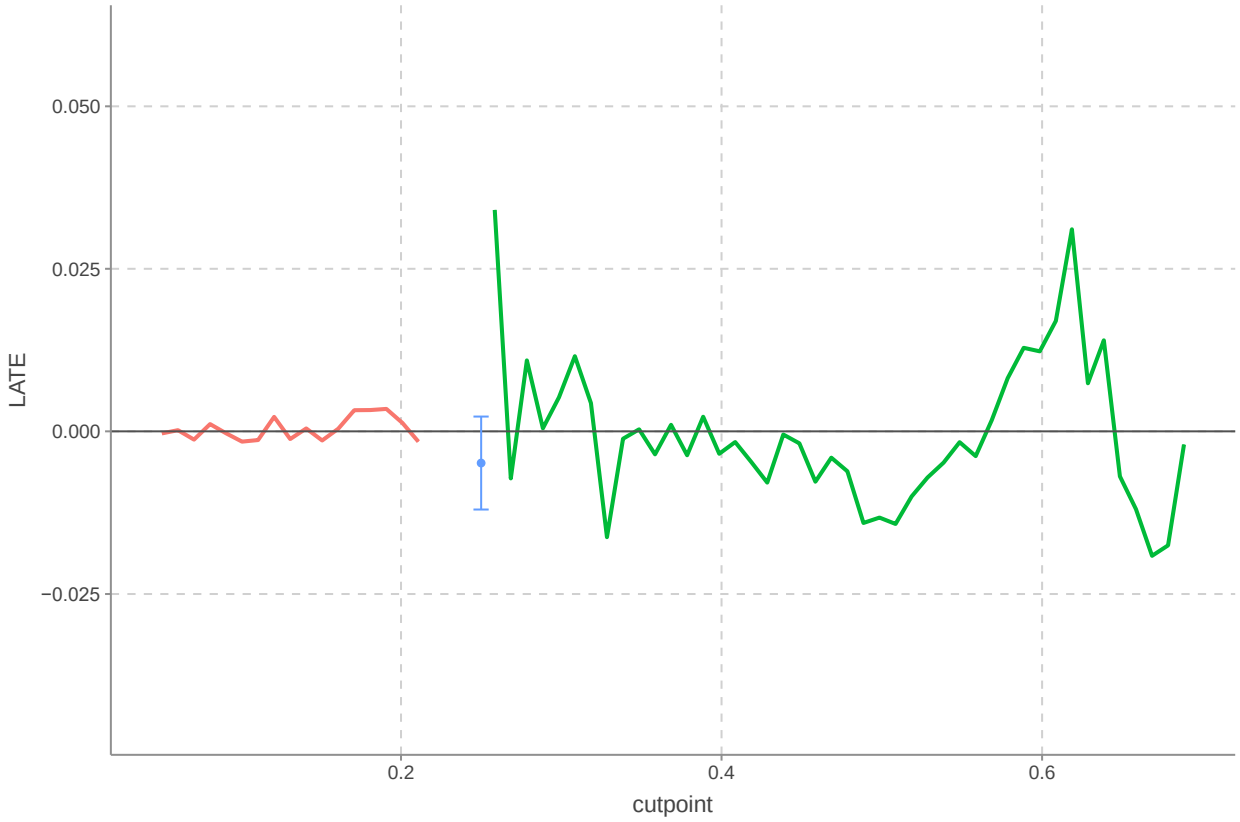


Figure C3c: 30-day out-of-hospital post-discharge mortality, all index discharges (inpatient and observation)

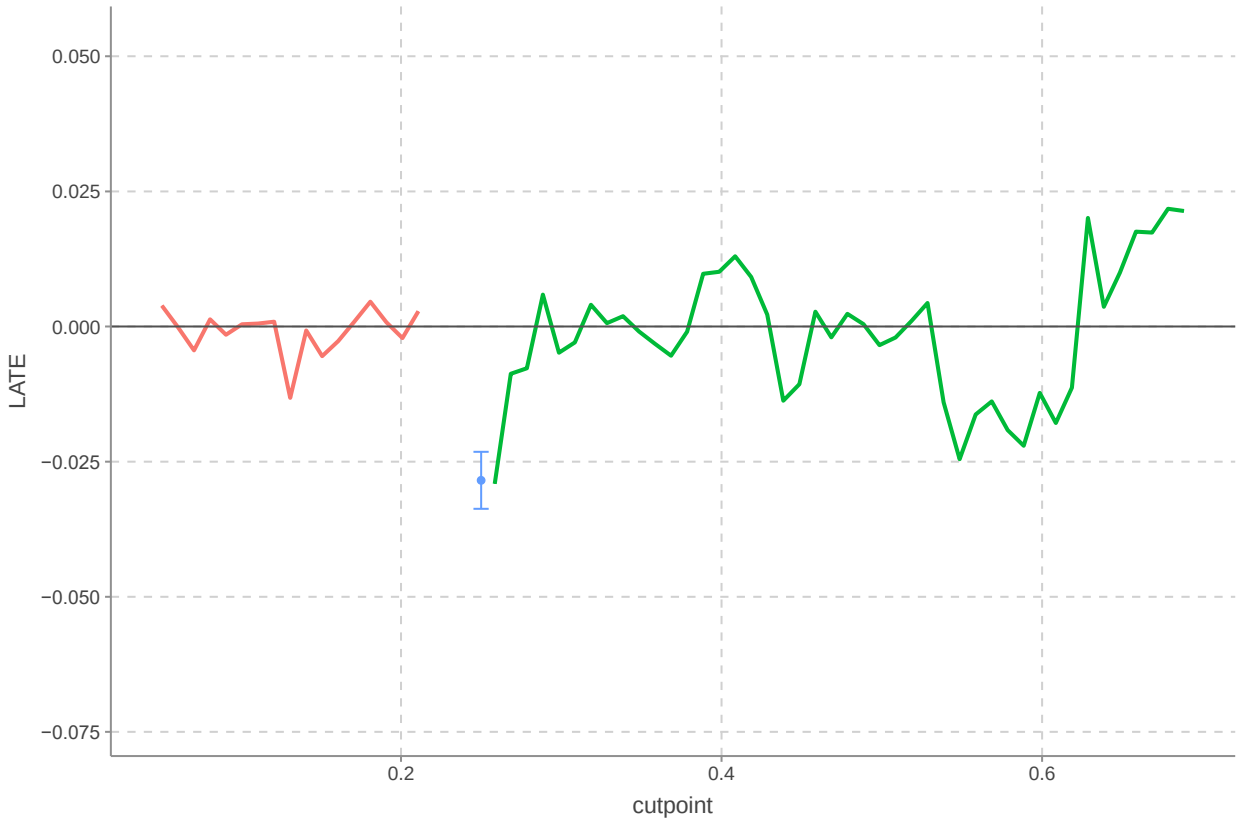


Figure C3d: 30-day non-elective re-hospitalization, inpatient index discharges only

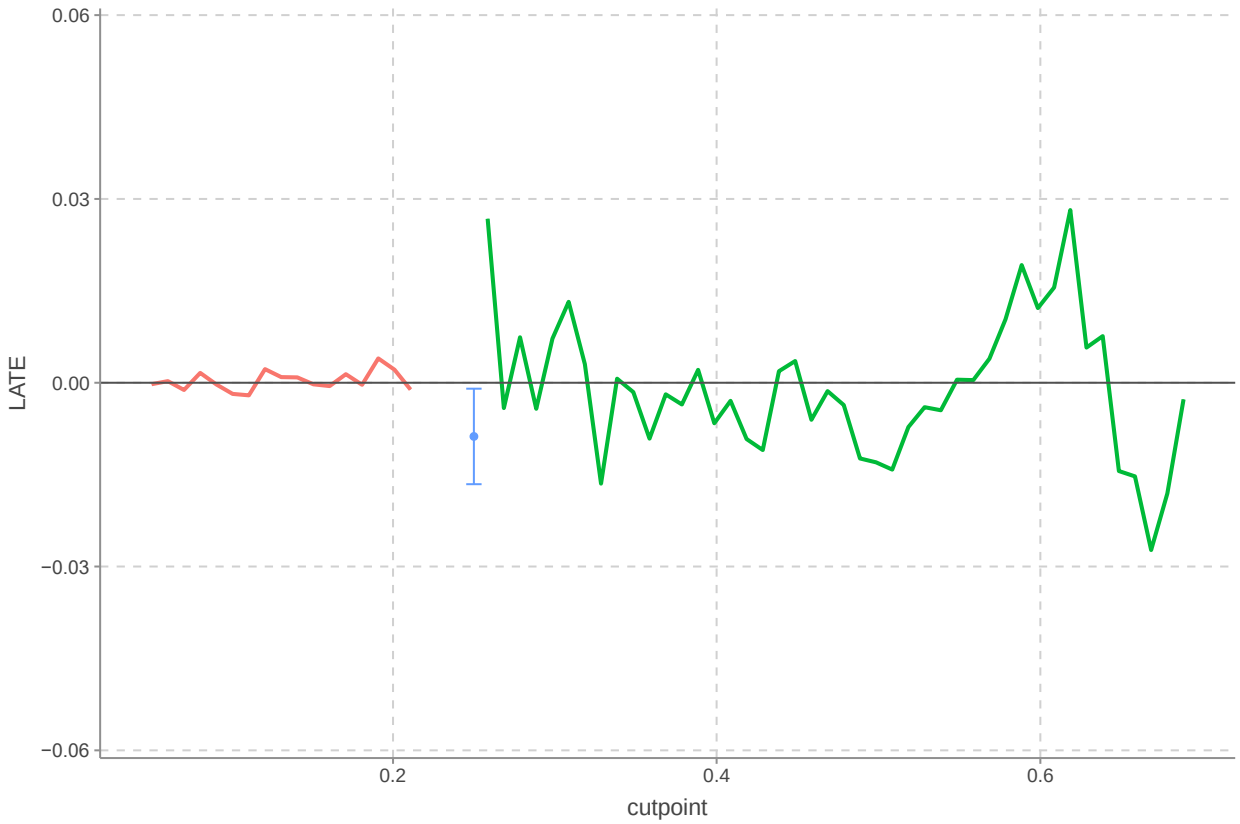


Figure C3e: 30-day post-discharge mortality, inpatient index discharges only

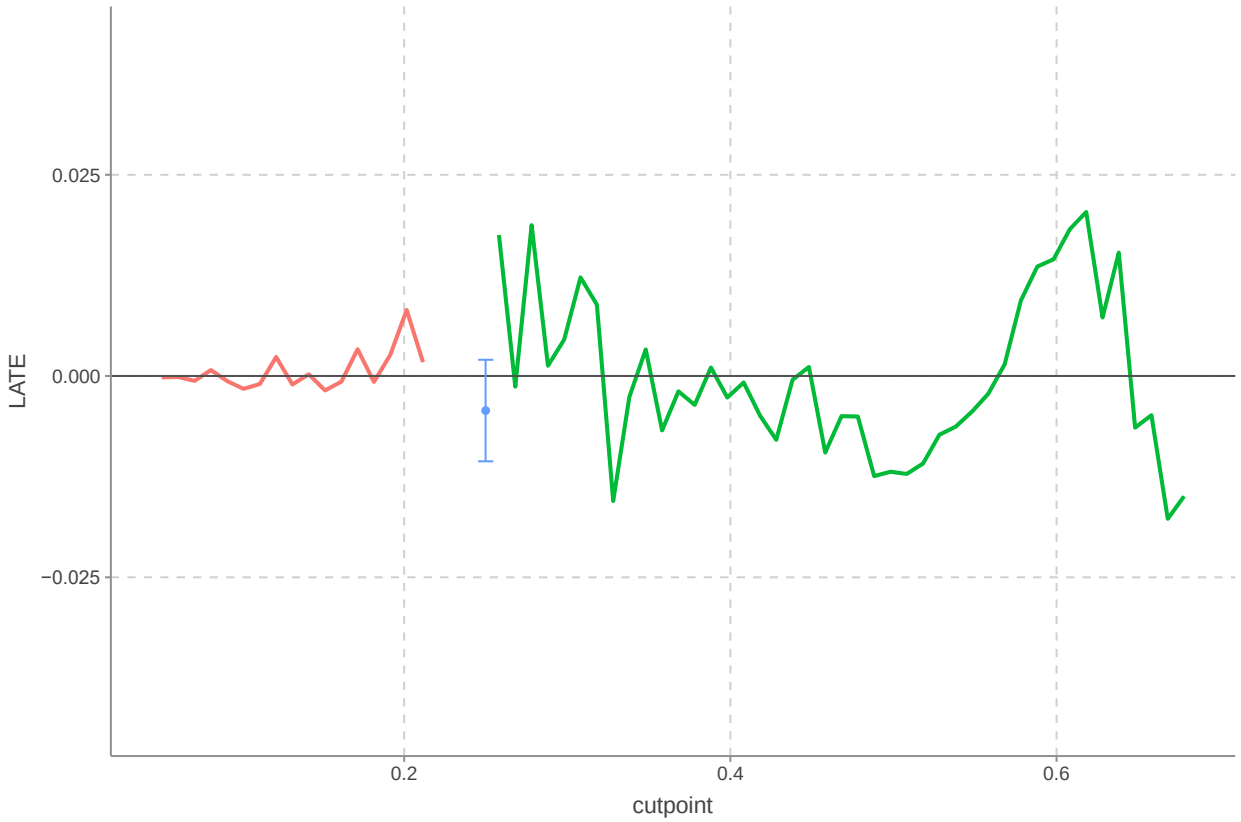


Figure C3f: 30-day out-of-hospital post-discharge mortality, inpatient index discharges only

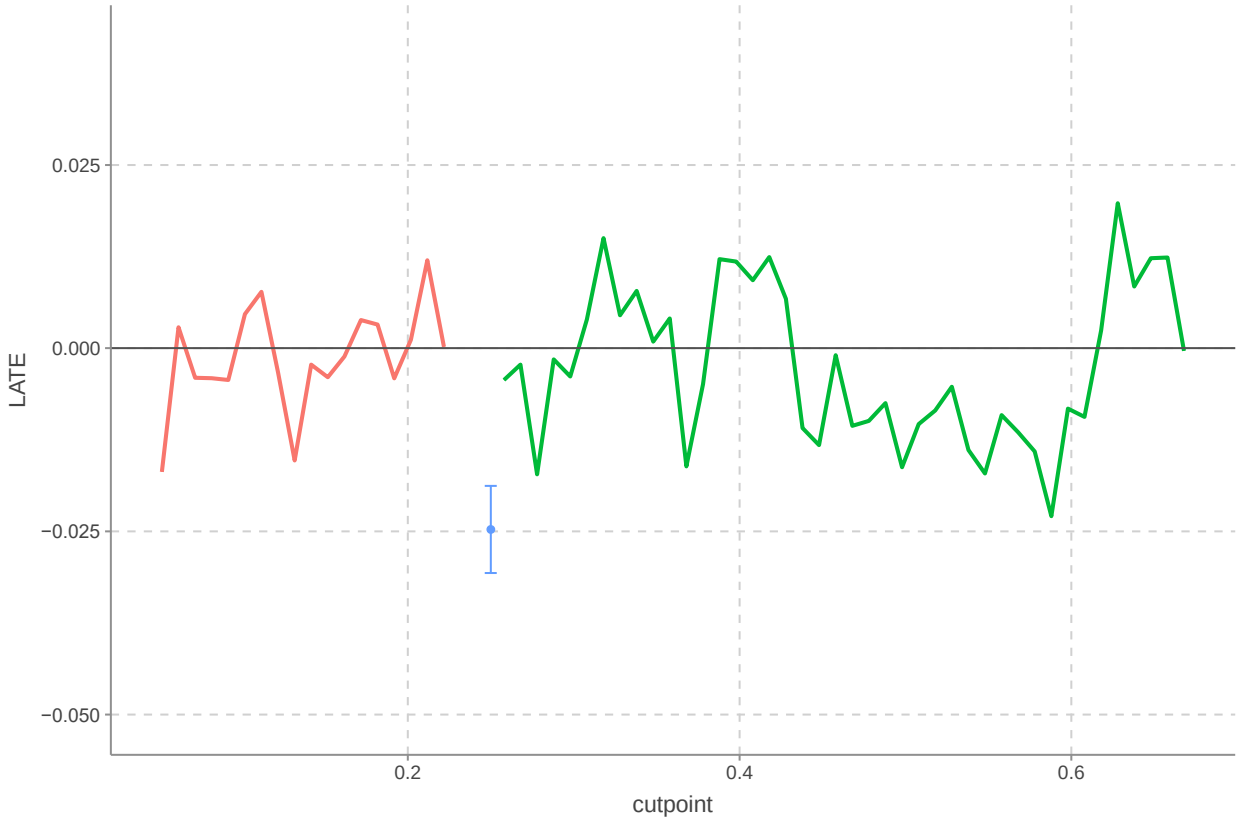


Figure C3g: 30-day non-elective re-hospitalization, index discharges meeting HEDIS criteria only

Appendix D: Definitions of Primary Condition Supergroups

Health Care Utilization Project (HCUP) single-level diagnosis clinical classification software (CCS) categories were combined in order to cluster ICD discharge diagnosis codes into 30 groups, which are referred to as *Primary Conditions*.[1] These were assigned to all index discharges and used to adjust for baseline covariates in the difference-in-differences analysis (see Appendix B). The table below shows our 30 groupings with their corresponding CCS category numbers. The listing and definition of the CCS categories below can be found at www.ahrq.gov/data/hcup.

Primary Condition Name	HCUP single-level diagnosis clinical classification software (CCS) category number(s)
Sepsis	2
Fluid and electrolyte disorders	55
Coma; stupor; and brain damage	85
AMI	100
Cardiac arrest	107
CHF	108
Acute CVD	109
CAP	122
GI bleed	153
UTI	159
Hip fracture	226
Residual codes	259
Renal failure (all)	156, 157, 158
Less severe cancer	11-16, 18, 20-26, 28-32, 34, 36, 37, 44-47, 207
Endocrine & related conditions	48-51, 53, 54, 56, 57, 200, 202, 210, 211
Miscellaneous GI conditions	137-140, 155, 214
Other cardiac conditions	96-99, 103-105, 114, 116, 117, 213, 217
HCUP Hyper Group 1	101, 102, 106
HCUP Hyper Group 2	0, 10, 141, 144-146, 147, 154, 160-166, 168-196, 201, 215, 218-224, 241-243, 255, 256, 258, 650-652, 654-663, 670, 999, 2601-2621
HCUP Hyper Group 3	115, 129, 131, 249
HCUP Hyper Group 4	127, 128, 130, 132, 133

Hematologic conditions	59-64
Ill-defined signs and symptoms	250-253
Liver and pancreatic disorders	151, 152
Highly malignant cancer	17, 19, 27, 33, 35, 38-43
Miscellaneous neurological conditions	79-84, 93-95, 110-113, 216, 245, 653
Problems with nutrition	52, 58
Other infectious conditions	1, 3-9, 76-78, 90, 92, 123-126, 134, 135, 148, 197-199, 201, 246-248
Miscellaneous surgical conditions	86-89, 91, 118-121, 136, 142, 143, 167, 203, 204, 206, 208, 209, 212, 237, 238, 254, 257
Trauma	205, 225, 227-236, 239, 240, 244

Appendix E: TSL Risk Score Implementation Details

This appendix details how the Transitions Support Level (TSL) score was implemented, including coefficient estimates for the TSL predictive model itself, as well as the predictive model used in the computation of the Laboratory-based Acute Physiology Score, version 2 (LAPS2) which is used as an input to the TSL predictive model. Coefficients are also given for the COmorbidity Point Score, version 2 (COPS2) which comprises another input to the TSL predictive model. The following tables and descriptions have been adapted from Escobar *et al.*[5] as well as Escobar *et al.*[1]

The TSL model coefficients and standard errors are given below. The column "Compared Level" represents the non-reference levels; i.e., for the covariate DCO the reference level is "Full Code".

Table E1. TSL Model Coefficients

				95% Confidence Interval	
Covariate	**Compared Level**	**Point Estimate**	**Standard Error**	**Lower**	**Upper**
(Intercept)		-2.347	0.019	-2.384	-2.311
COPS2 (per point)		0.009	0.000	0.009	0.009
LAPS2 (per point)		0.009	0.000	0.009	0.009
LOS_30 (per day)		0.041	0.001	0.039	0.043
DCO	*Not Full Code*	0.305	0.007	0.292	0.318
PCAT	1	-0.581	0.013	-0.606	-0.557
PCAT	2	0.005	0.019	-0.032	0.042
PCAT	3	0.058	0.016	0.027	0.088

COPS2. COmorbidity Point Score, version 2. The COPS2 shares similarities with other comorbidity indices, including the Charlson and Elixhauser indices, but was developed and validated in a KPNC population. Each month, for each KPNC member, their ICD diagnosis codes from all outpatient and inpatient encounters in the previous 12 months are captured and used to tabulate a COPS2 score. Patients without a history of ICD codes belonging to the 42 comorbidity groupings are assigned a COPS2 score of 14. These groupings and point assignments are given in Table E5 below.

LAPS2. Laboratory-based Acute Physiology Score, version 2, computed at admission. The LAPS2 is similar to many existing acute severity of illness scores, but it has an important difference with respect to imputation, where it employs two stages for point assignment. In the first stages, a simple model, detailed below, is used to subdivide the population into two risk groups. Patients with a predicted mortality risk of <6% as well as those of ≥6%. Among patients with a predicted risk of mortality of <6% using the first-stage predictive model, if missing data exist, then they are imputed to normal. However, for patients with a predicted risk of mortality of ≥6%, points are assigned if data for the following score components are missing:

- Arterial pH
- Lactate
- White blood cell count
- Troponin I
- Neurological status

A notable feature of LAPS2 scoring takes into account the dependence between lactate values and arterial pH, which are scored using a grid (Table E4a). This comprises the first scoring step of the second stage. In the next step of the second stage, the remaining categories of laboratory tests are scored independently (Table E4b). In those situations where multiple values for a score component were available in the 72-hour time frame, the worst (showing the greatest

physiologic derangement) value was employed. The LAPS2 score can be computed at discharge; this is performed in a manner similar to that of LAPS2 except that:

a) the T_0 was set to 0800 hours on the day of discharge,
b) the “look back” time frame was set to 24 hours instead of 72,
c) and all patients were assumed to be “low risk” for the purposes of imputing missing data.

LOS_30. Denotes the patient length of stay in days, with stays over 30 days truncated to 30 days. The T_0 (start time) was the time a patient was roomed-in, and the T_{END} was the date/time stamp from the last linked hospital stay.

DCO. An indicator for the care level order (full or not full code) in effect at discharge. At KPNC hospitals, when a physician enters admission orders, end-of-life care directives are mandatory (with a corresponding “hard stop” in KP HealthConnect, the KP electronic medical record system) or the physician’s admission orders will not be processed. The computerized order system gives 4 options: full code, partial code, do not resuscitate, and comfort care only. As patients’ care directives may change, we elected to capture the care directive in effect when a patient first entered a hospital unit other than the ED. The reference level assumed in the TSL model was “Full Code”.

PCAT. Prior hospitalization category, which characterizes the pattern of any prior hospitalizations with the four levels in Table E2 below. The reference level assumed in the TSL model was “4”.

Table E2. PCAT Variable Categories.

PCAT Level	Meaning
1	No prior admissions in up to 30 days preceding admission date of index discharge
2	≥1 prior admissions up to 7 days ago, and none 8 to 30 days ago
3	No prior admissions up to 7 days ago, and ≥1 8 to 30 days ago
4	≥1 prior admissions up to 7 days ago, and ≥1 8 to 30 days ago

Table E3. Coefficient Estimates for First-Stage LAPS2 Mortality Risk Model.

Risk Factor	Range	Coefficient Estimate
(Intercept)		-4.31678
Age at Admission	18 to 39 years	(Reference)
	40 to 64	-0.25234
	65 to 74	0.25894
	75 to 84	0.48826
	≥85	0.87647
Sex	Female	(Reference)
	Male	0.27430
Emergency Room Visit	No	(Reference)
	Yes	1.39670
BUN/Creatinine Ratio	<8	0.26988
	8 to 15.9	(Reference)
	16 to 23.9	-0.22465
	≥24	0.39858
Sodium	<129 mEq/L	0.11980
	129 to 131	-0.06801
	132 to 134	-0.30494
	135 to 145	(Reference)
	146 to 148	-0.02560
	149 to 154	0.42071
	≥155	0.58891
Anion Gap/Serum Bicarbonate Ratio	<200	-0.20038
	200 to 399	(Reference)
	400 to 599	-0.11174
	≥600	0.70227

Table E4a. LAPS2 Point Assignment, Part I: Lactate-Arterial pH Scoring Grid.

Lactate (mM/L)	Arterial pH			
	<7.20	**7.20 to 7.34**	**7.35 to 7.44**	**≥7.45 or missing *and* patient high risk from first stage**
<2.00	13	5	0	12
2.00 to 3.99 or missing *and* patient high risk from first stage	19	15	12	15
≥4.00	34	25	26	30

Table E4b: LAPS2 Point Assignment, Part II.

Laboratory Test or Vital Sign	Range	Points Assigned to LAPS2
Sodium	<129 mEq/L	14
	129 to 134	7
	135 to 145	0
	≥145	4
Total Serum Bilirubin	<2.0 mg/dL	0
	2.0 to 2.9	11
	3.0 to 4.9	18
	5.0 to 7.9	25
	≥8.0	41
Blood Urea Nitrogen	<18 mg/dL	0
	18 to 19	11
	20 to 39	12
	40 to 79	20
	≥80	25
Creatinine	<1.00 mg/dL	0
	1.00 to 1.99	6
	2.00 to 3.99	11
	≥4.00	5
BUN/Creatinine Ratio	<25	0
	≥25	10
Albumin	<2.0 g/dL	31
	2.0 to 2.4	15
	≥2.5	0
Serum Glucose	<40 mg/dL	10
	40 to 59	10
	60 to 199	0
	≥200	3
Hematocrit	<20.0%	7
	20.0% to 39.9%	8
	40.0% to 49.9%	0
	≥50.0%	3
White Blood Cell Count	$<5.0 \times 10^9$/L	8

	5.0 to 12.9	0
	≥13.0	11
	Missing *and* in high risk group	32
Arterial $PaCO_2$	<35 mmHg	7
	35 to 44	0
	45 to 54	11
	55 to 64	13
	≥65	12
Arterial PaO_2	<50 mmHg	8
	50 to 119	0
	≥120	12
Troponin I	0 pg/mL	0
	0.01 to 0.19	8
	0.20 to 0.99	17
	1.00 to 2.99	19
	≥3.00	25
	Missing *and* in high risk group	9
Temperature	<96.0 deg. F	20
	96.0 to 100.4	0
	≥100.5	3
Heart Rate	<60 bpm	7
	60 to 109	0
	110 to 139	7
	≥140	10
Respiratory Rate	<20/min	0
	20 to 29	11
	≥30	21
Systolic Blood Pressure	<75 mmHg	22
	75 to 89	13
	90 to 119	5
	120 to 139	0
	140 to 159	8
	≥160	14
Shock Index (HR/SBP)	<0.65	0
	0.65 to 0.84	8
	≥0.85	17
Oxygen Saturation	<90%	22
	90 to 93%	12
	≥94%	0
Neurological Score (based on Glasgow Coma Score [GCS] and status checks)	Normal (GCS ≥13)	0
	Abnormal (GCS 9 to 12) or missing *and* not in high-risk group	16
	Abnormal (GCS 9 to 12) or missing *and* in high-risk group	21
	Very abnormal (GCS <9)	36

Table E5. COPS2 Scoring: Hierarchical Condition Category (HCC)-Defined Comorbidity Groups and Point Assignments.

Comorbidity Group Name	Description	CMS HCCs	Pts.	Comorbidity Group Name	Description	CMS HCCs	Pts.
AMPUT	Amputation	176, 177	***18***	LUNG	Lung Diseases	107, 111, 112	***22***
ARRHYTHMIA	Specified Heart Arrhythmias	92	***19***	LYMPH	Lymphoma	9	***31***
ARTH	Rheumatoid Arthritis	38	***9***	MALNUT	Malnutrition	21	***35***
CAD	Coronary Artery Disease	81, 82, 83	***4***	METCA	Metastatic Cancer	7	***69***
CHF	Congestive Heart Failure	80	***28***	NEPHRITIS	Nephritis	132	***15***
CIRRHOSIS	Cirrhosis of Liver	26	***54***	NEURO	Neurological Diseases	70, 71, 72, 73, 74, 75	***9***
COPD	Chronic Obstructive Pulmonary Disease	108	***19***	OPPINFEC	Opportunistic Infections	5	***30***
CRFAIL	Cardio-Respiratory Failure and Shock	79	***40***	OTHCA	Other Cancer	10	***0***
CVD	Cardiovascular Disease	95, 96	***19***	OTHINFEC	Bone, Joint, Muscle Infections/Necrosis	37	***12***
DECUB	Decubitus Ulcer of Skin	148	***38***	PARALYSIS	Paralysis	67, 68, 69, 100, 101	***21***
DIALYSIS	Dialysis Status	130	***29***	PSYCH	Psychiatric Disorders	54, 55	***9***
DM	Diabetes	15, 16, 17, 18, 19	***11***	RESP	Respiratory Diseases	77, 78	***37***
EYE	Proliferative Diabetic Retinopathy and Vitreous Hemorrhage	119	***19***	RF	Renal Failure	131	***18***
GI	Gastrointestinal Diseases	31, 32, 33	***11***	SEPSIS	Septicemia/Shock	2	***18***
HEADINJ	Head Injury	154, 155	***10***	SEVCA	Severe Cancer	8	***41***
HEMAT	Severe Hematological Disorders	44	***32***	SKIN	Skin Diseases	149, 150	***28***
HEP	Chronic Hepatitis	27	***27***	SUBST	Substance Abuse	51, 52	***20***
HIPFX	Hip Fracture / Dislocation	158	***19***	TRANSPLANT	Major Organ Transplant	174	***28***
HIV	HIV/AIDS	1	***33***	TRAUMA	Trauma	161, 164	***7***
IMMUNE	Disorders of Immunity	45	***25***	VD	Vascular Disease	104, 105	***19***
LIVER_END	End-Stage Liver Disease	25	***61***	VERTB	Vertebral Fractures without SCI	157	***20***

Appendix F. Internal Transitions Program Documentation

The following pages include information on the Transitions Program that have been presented internally at KPNC, and were used to guide implementation, as well as for training purposes. They include:

- high-level information on the purpose and scope of the Transitions Program
- standard work checklists
- several workflows (in “swimlane” format) used at various stages of the Transitions referral process
- Epic electronic health record DotPhrase and SmartList examples
- example scripts for Transitions encounters, specifically the initial bedside visit and follow-up assessments

NCAL Transitions Program

KAISER PERMANENTE® thrive

OVERVIEW

Vision: Excellent Transitions

We aim to be industry leaders in patients successfully transitioning from acute settings to home, providing a seamless, high-quality experience for every patient, at every interaction, at every medical center – right care, right time, right place.

Goal Optimization:

- Transitions Program – a continuum extension of Excellent Transitions in the hospital.
- Focused program goals on readmission reduction for 30-60 days post discharge.
- Leveraged KP knowledge of re-hospitalization risk to prioritize outreach.
- Implemented a robust measurement strategy to evaluate program effectiveness.
- Standardized programs to provide consistent levels of care across NCAL.
- Provide team education to build staff knowledge and skill.
- Develop tools for staff efficiency.

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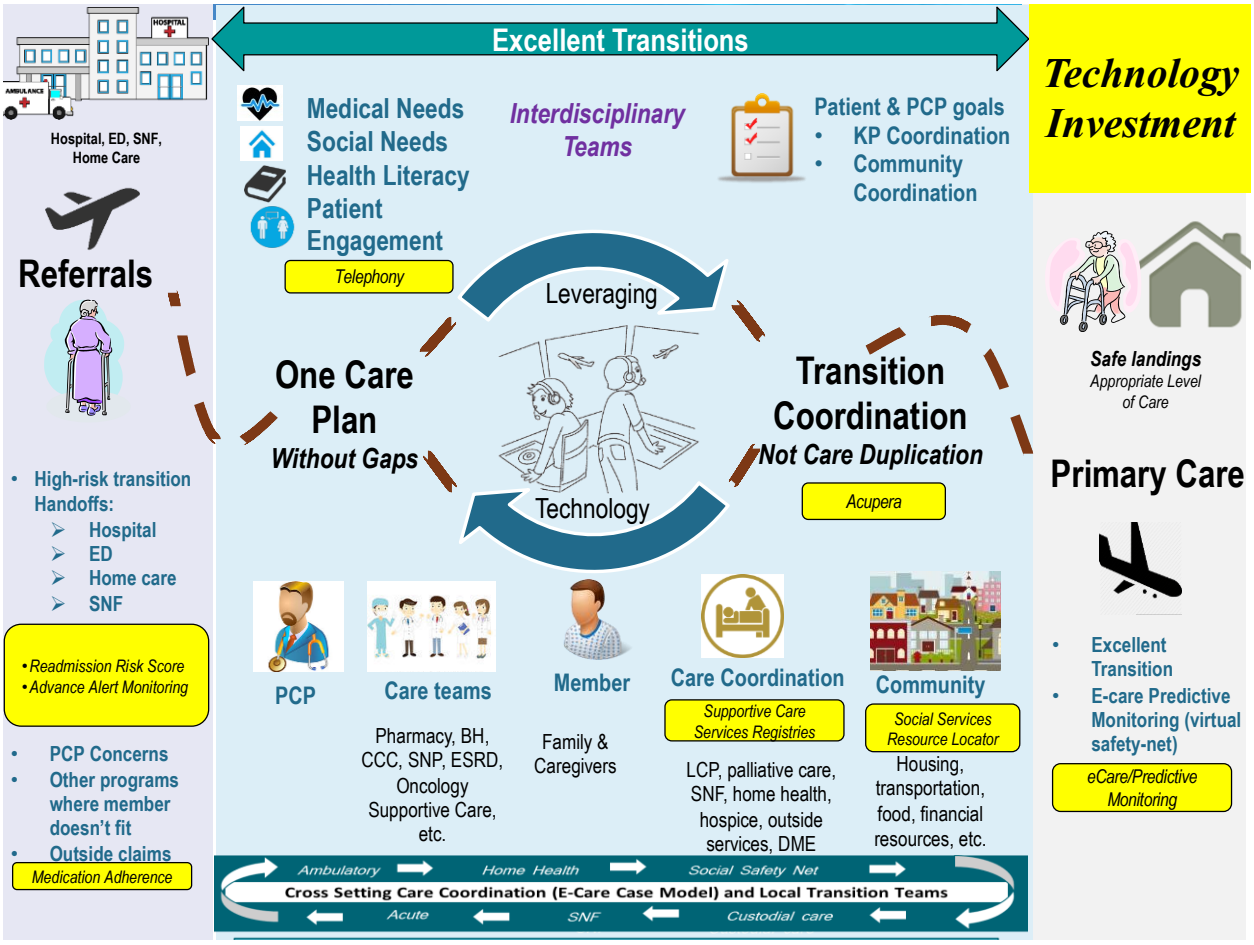
Excellent Transitions
Technology Investment
Hospital, ED, SNF, Home Care
Referrals
High-risk transition Handoffs:
Hospital
ED
Home care
SNF
Readmission Risk Score
Advance Alert Monitoring
PCP Concerns
Other programs where member doesn't fit
Outside claims
Medication Adherence
Medical Needs
Social Needs
Health Literacy
Patient Engagement
Telephony
Interdisciplinary Teams
Patient & PCP goals
KP Coordination
Community Coordination
Leveraging
One Care Plan
Without Gaps
Transition Coordination
Not Care Duplication
Acupera
Technology
PCP
Care teams
Pharmacy, BH, CCC, SNP, ESRD, Oncology Supportive Care, etc.
Member
Family & Caregivers
Care Coordination
Supportive Care Services Registries
LCP, palliative care, SNF, home health, hospice, outside services, DME
Community
Social Services Resource Locator
Housing, transportation, food, financial resources, etc.
Ambulatory
Home Health
Social Safety Net
Cross Setting Care Coordination (E-Care Case Model) and Local Transition Teams
Acute
SNF
Custodial care
Safe landings
Appropriate Level of Care
Primary Care
Excellent Transition
E-care Predictive Monitoring (virtual safety-net)
eCare/Predictive Monitoring

Transitions Program

- Provides a short-term (30 days) mainly telephonic care coordination intervention for patient's at risk for readmission post hospital discharge.
- Uses a predictive algorithm created by the KP Division of Research known as the Readmission Risk Score (Transition Support Level)
- A patient, once admitted, generate a score for readmission / mortality and stratifies the patient's score into HIGH (=> 45.1), MEDIUM (25.1-45), or LOW TSL (=<25) based on:
  - LAPS2DC score, COPS2 score, LOS, Hospital/ED visits, and care directive
- Transitions Program is currently serving approximately 3,000 members / month across 14 programs across 21 facilities / sites
- Outreach mainly telephonic coordination 24-48 hours after discharged from hospital to home with no skilled services based on HIGH, MEDIUM TSL and by promotion by PCC from LOW TSL elevated based on social issues:
  - (a) Home insecurity, (b) transportation issues, (c) food insecurity
- Team / Clinicians comprised of RN, SW, and Pharmacist (in some areas only)
- Based on risk score levels – the intensity of assessment, interventions and follow up is determined
- If patients are discharged to SNF or Home Health – their risk score is transposed into the referral so appropriate interventions are followed

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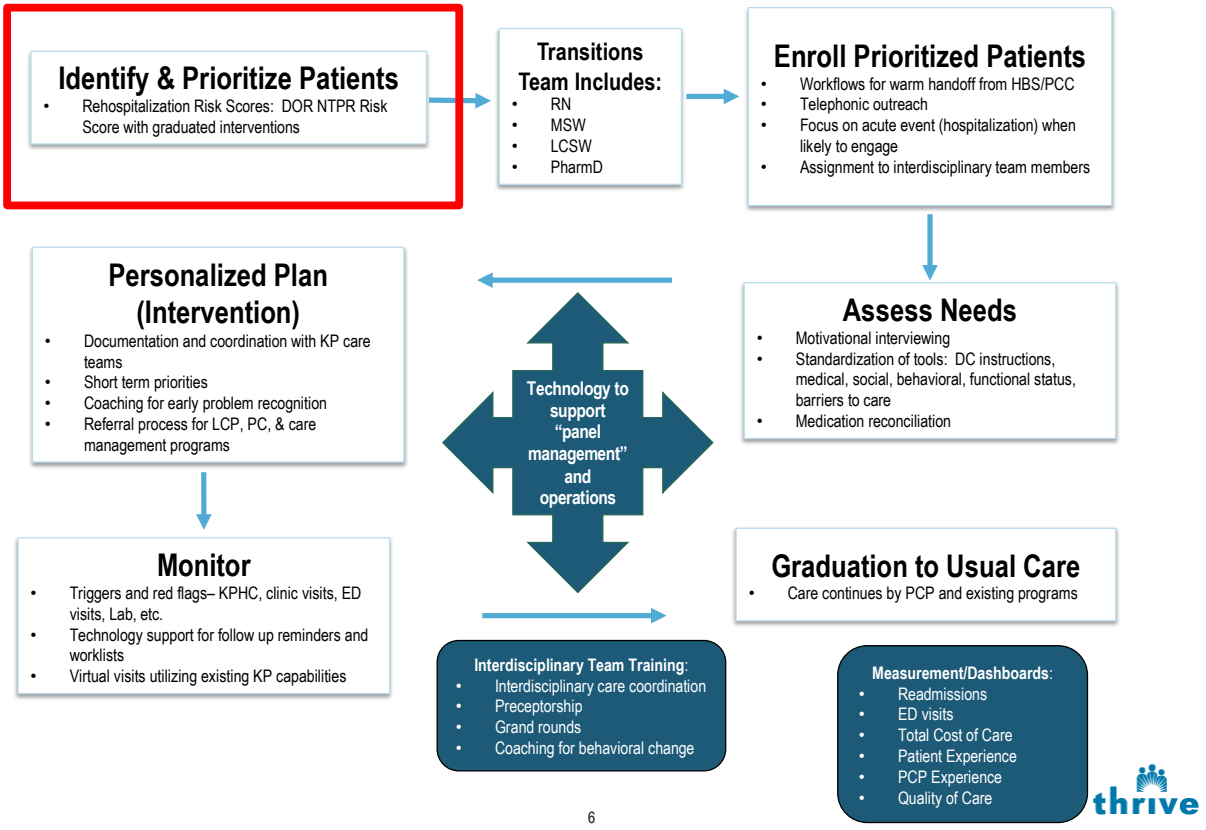
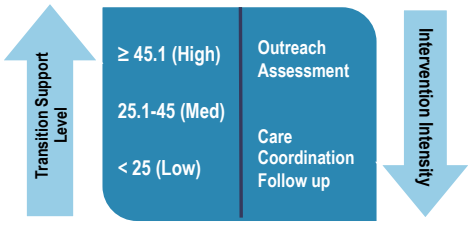
Transitions Program Optimization Opportunities



CHECKLIST AND OPERATIONAL WORKFLOWS

Care Coordination: Transitions Program *Tier Based* Interventions

by Transition Support Level



Transition Support Level	Initial Outreach	30-day Care Coordination Assessment and Follow up
High: ≥ 45.1	1. PCC informs patient that the Transitions Program will be working with them; Transitions Program RN or SW meets patient in the hospital prior to discharge (if TP on site).	1. Complete phone follow up within 24-48 hours 2. MD f/u visit within 5-7 days 3. Contact patient every other day for 1st week 4. At least twice a week or more as needed for week 2 5. At least weekly for weeks 3-4 + as needed contact 6. Graduation at 30 days
Medium: 25.1 - 45	1. PCC informs patient that Transitions Program will be working with them; Transitions Program outreaches by phone within 24-48 hours of discharge (24 hours is the goal, except weekends) 2. If the patient is LOW risk *and* has any of the following identified via KPHC Transitions Concerns flowsheet, *treat* as medium risk: • No Transportation • No Access to Meals • Housing Insecurity • Homeless	1. Complete phone follow up within 24-48 hours (goal is 24, except weekends) 2. MD f/u visit within 5-7 days 3. Contact patient at least weekly + as needed contact 4. Graduation at 30 days
Low: < 25	Usual care	Usual care

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Care Coordination: Transitions Program 2018 Standard Work Checklist

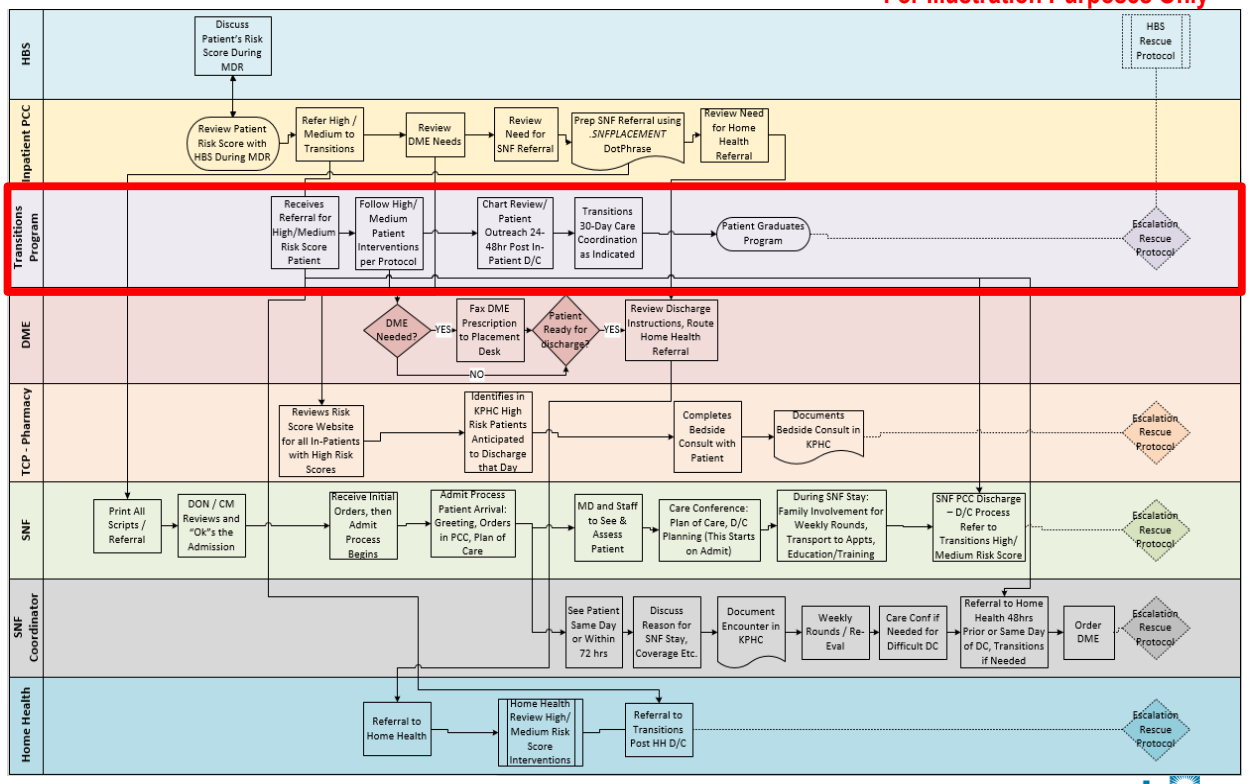
High Level Process	Steps
1. Intake: Monitor CareLinx for New Referrals	❒ Logon to CareLinx Daily ❒ Check for Readmission Risk Database and eConsult new referrals ❒ Enter any other workflow referrals not captured via automatic data feeds using 'Add Referral' form
2. Intake: Assign New Referrals	❒ Intake staff assigns any new referrals to the appropriate team member / discipline for initial review
3. Clinician: Conduct Chart Review – Collect Screening Information	❒ Verify if referral is a Readmission Risk referral, and if so obtain the following information to enter into CareLinx Screening: ❒ Patient's hospitalization registration status: ED, Observation (ED or Hospital), or Inpatient ❒ Any elevation of patient's Readmission Risk Level from Low or Med with reasons(s) as documented by the PCC within Discharge Planner note(s) with the reason(s) for elevation - which the PCC documents using DotPhrase: **.TCPRISKELEVATED** ❒ Check to see if patient has an appointment within 5-7 days of discharge ❒ Verify patient was discharged to Home without other services ***If patient discharged to HH, SNF, or HO open case details, answer screening questions presented as appropriate, select the patient's current location and services, then close referral as 'Unable to Enroll' and select appropriate 'Unable Reason' related to location and services selected.
4. Clinician: Conduct Initial Outreach Call to Patient / Designee	❒ Review ED / Inpatient Utilization ❒ Review HBS, PCC, Social Work Notes, etc. ❒ Review ambulatory chart for other current outpatient case / care management program enrollment or eligibility to coordinate care ❒ Check patients living location for any potential transfer needs to other TP location ❒ Consider PharmD referral for medication assessment
5. Clinician: Conduct Initial Outreach	❒ Document outreach in KPHC ambulatory chart using a Telephone Encounter and enter **Post Discharge Follow-up Call (or 3278)** as the Reason for Call. ❒ Document Initial Outreach and Assessment note listed within DotPhrase: either **.TCPRN or .TCPSW** as appropriate. ❒ Add assigned Transitions Clinician information into the Patient Care Team in the Outpatient Chart selecting "CM – Transitions Program" in the 'Relationship' field, enter date of patient's discharge home in the 'Start' date field, enter "t+30" into the 'End' date field, and enter the respective Transitions Program contact information into the comments section. ▪ ***If unable to reach patient, document a Telephone Encounter in KPHC chart using Unable to Reach note type listed within appropriate discipline DotPhrases above. After 3 unsuccessful initial outreach attempts have been made on 3 different days, the referral may be closed with status being 'unable to enroll', and reason being 'unable to reach'. ▪ ***If able to reach patient and patient declines participation at time of initial outreach call, document a Telephone Encounter in KPHC chart using Initial Outreach and Assessment note listed within DotPhrases above – selecting declined, and referral may be closed with status being 'unable to enroll', and reason being 'declines participation'.

Care Coordination: Transitions Program 2018 Standard Work Checklist

High Level Process	Steps
6. Enter Encounter Details in CareLinx	❒ Documentation completed in KPHC ❒ Coordination, resource linkage, education / counseling, and referral interventions provided / completed ❒ Enrollment outcome ❒ Other Case / Care Management involvement / contact made ❒ Any handoff made to another TP if applicable
7. Enter Reminder(s) for Next Coordination/Follow-up Task	❒ Enter next follow-up outreach / coordination reminder task into CareLinx for on going follow-up as indicated / needed during 30 day enrollment period. ❒ If primary driver identified is social vs. medical, recommend assignment of additional follow-up outreach / coordination task to either Social Work or RN accordingly.
8. Conduct Follow-up Call(s), Enter Encounter(s) and Next Coordination / Follow-up Task Reminder(s) in CareLinx	❒ Document Telephone Encounter(s) in KPHC chart using **Transition Management (3084)** as the Reason for Call and use the respective Follow-up or Coordination note type listed within DotPhrases as appropriate. ❒ Enter Encounter details in CareLinx. ❒ If patient graduates prior to 30 days, is disenrolled from Transitions, or needs continued care management through the Transitions Program past 30 days post-discharge, update the Patient Care Team 'End' date field as appropriate (note: do not delete Patient Care Team entries unless entered in error). ❒ Connect and coordination with other case management / care continuum programs as needed and document the coordination either within the Initial Outreach and Assessment or Follow-up note if patient / designee contact also made same day or document using the Coordination note type listed within DotPhrases above.
9. Case Closure or Graduation at 30 Days and Update CareLinx	❑ Document final follow-up encounter in KPHC chart using Follow-up note listed within DotPhrases above, complete relevant portions, and in 'Follow-up Needed' section towards bottom of note select no follow-up needed and specify reason for closure as appropriate (i.e., patient graduated / met goals, of readmission after TP enrollment, declines further participation, etc.) ▪ *** If patient readmitted prior to graduation / goals being met document the case closure in a follow-up telephone encounter using the Follow-up note listed within the DotPhrases above, complete the top portion, delete middle portion as needed, freehand additional comments if needed, and complete 'Follow-up Needed' section at bottom of note with selection of no follow-up needed due to patient being readmitted. ▪ *** If patient declines further participation during follow-up calls, prior to graduation / goals being met, document in a follow-up telephone encounter using the Follow-up note listed within the DotPhrases above, complete relevant portions, and in 'Follow-up Needed' section towards bottom of note select no follow-up needed due to patient declining further participation. ❒ Close case in CareLinx specifying reason for closure as per reason identified in KPHC documentation

Care Coordination: Risk Score Transitions Multidisciplinary Workflow

For Illustration Purposes Only



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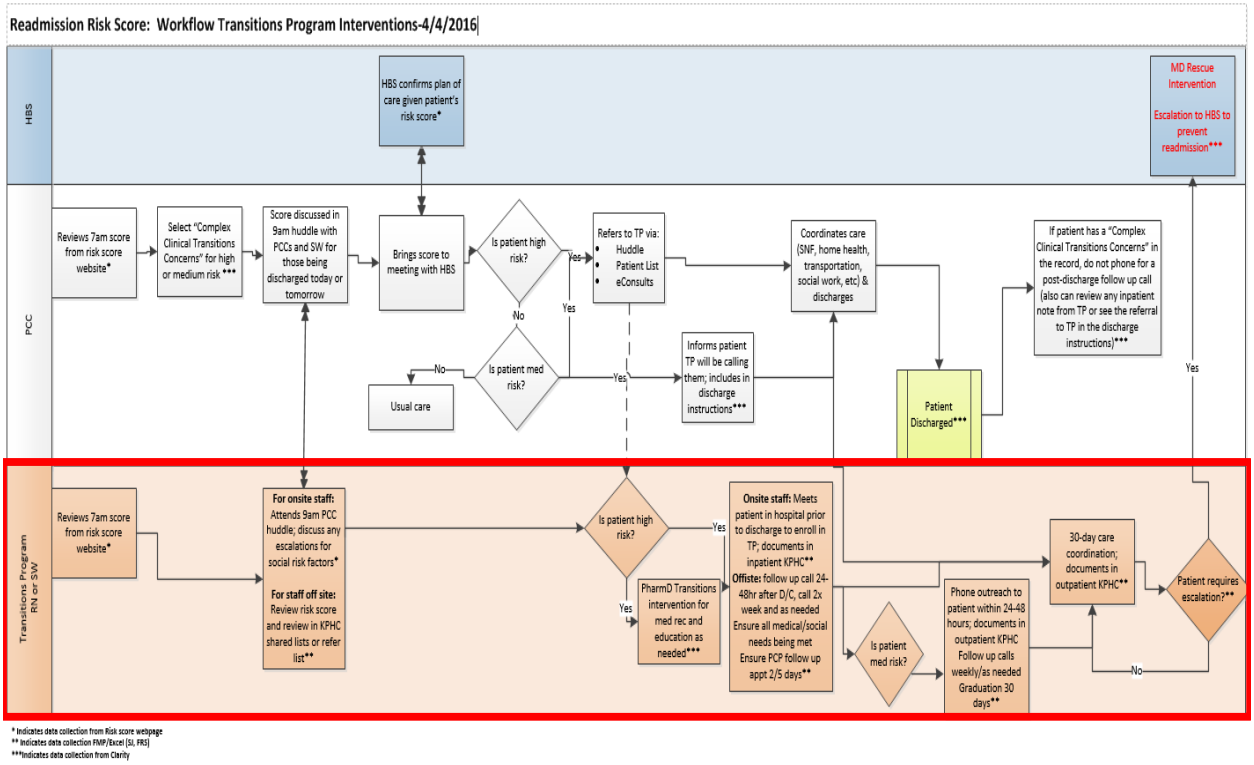
11

*HBS: Refers to Hospital-Based Specialist, i.e., a hospitalist or hospital medicine physician

Care Coordination: Transitions Program Discharge to Home Workflow



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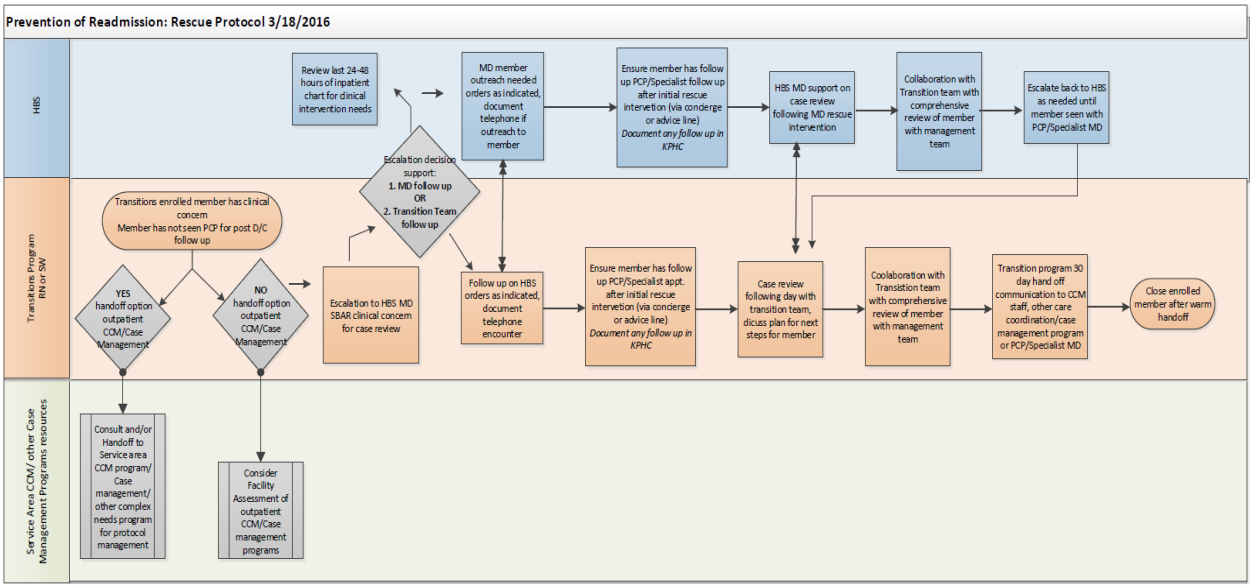
Care Coordination: Transitions Program Readmission Risk Score MD Rescue Workflow



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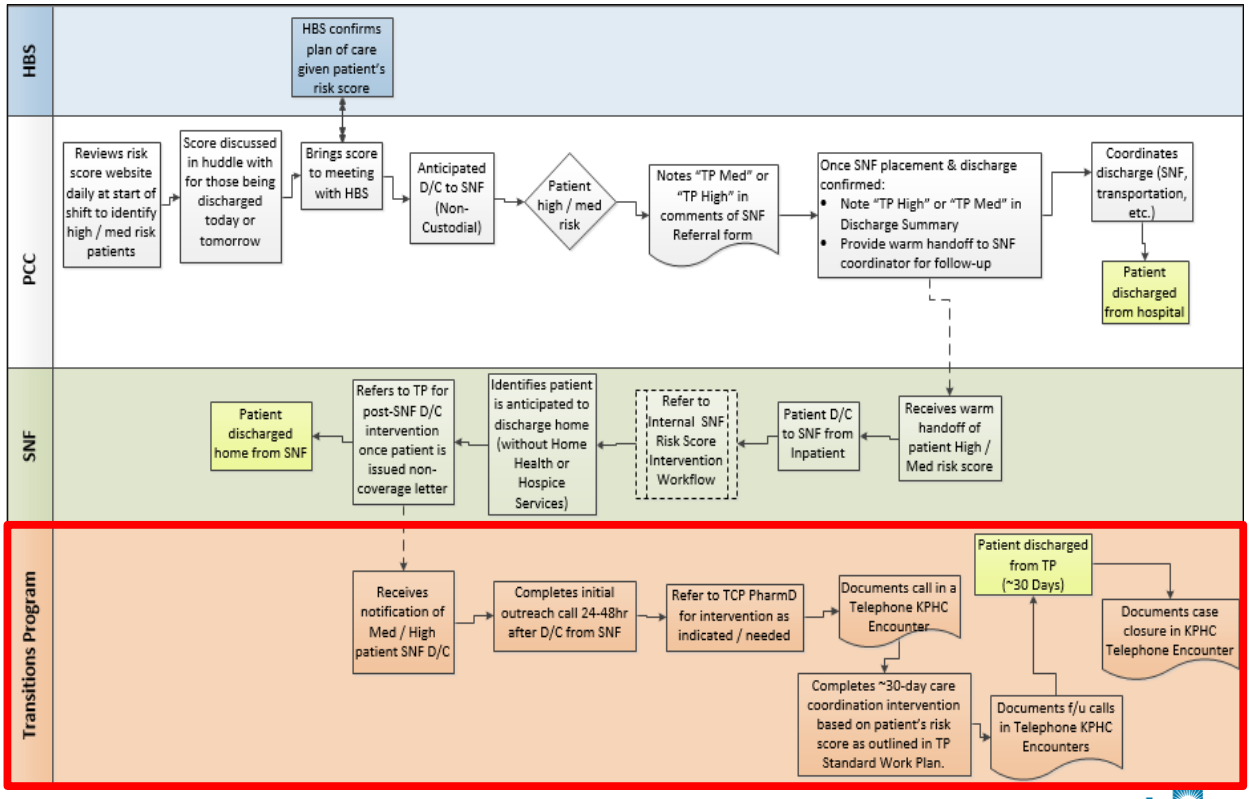
SNF Transitions Program Referral Process



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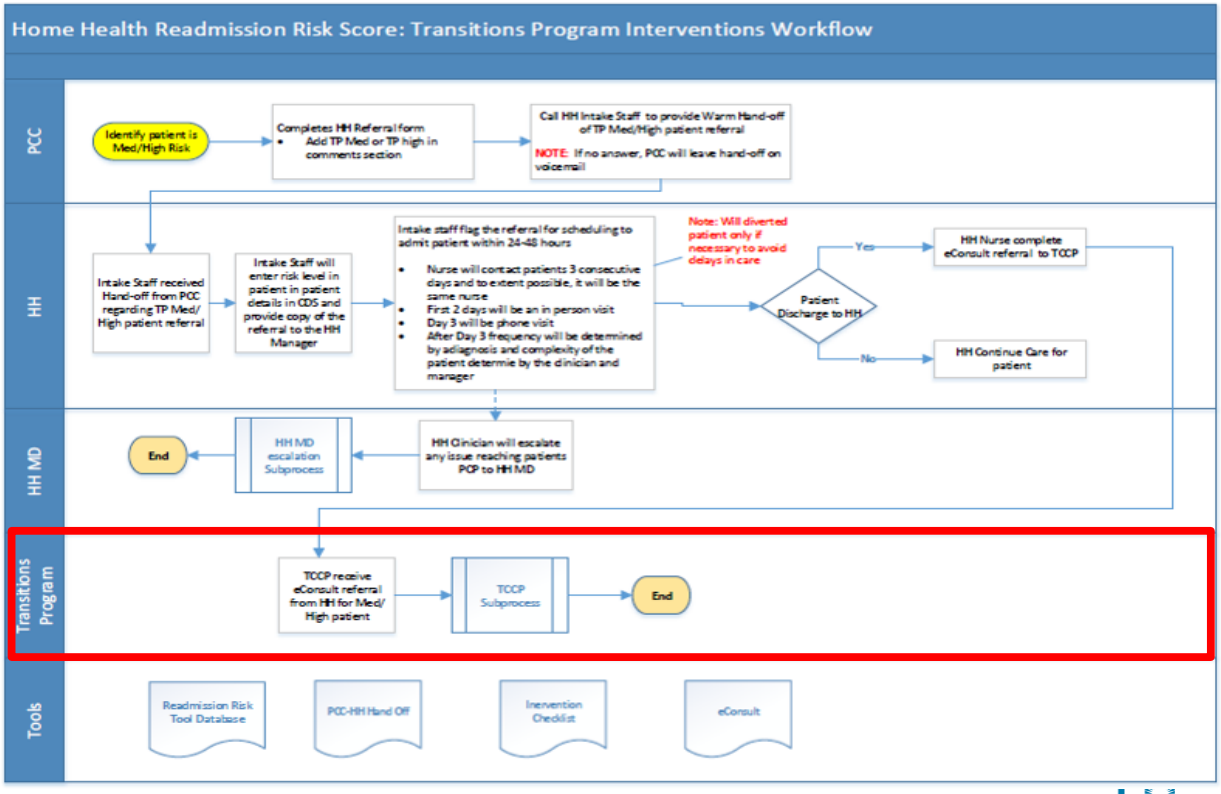
Readmission Risk Score: Home Health Referral, Intervention and TP Referral



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Transitions Program KPHC Standard DotPhrases and SmartLists

DotPhrase	User	Description	KPHC Encounter Types
.TCPSW	TP Social Services Clinicians	Transitions Program SW DotPhrases	Care Coordination
.TCPRN	TP Nursing Clinicians	Transitions Program RN DotPhrases	Care Coordination
.TCPRISKELEVATED	Hospital Providers / Clinicians	Transitions Program Readmission Risk Elevation Note	Inpatient Hospital Chart Notes

Name of Documentation in .TCPRN and .TCPSW SmartLists	Documentation Description and Use Case
Initial Outreach and Assessment with Accept / Decline	Initial Outreach Assessment with patient/designee, including if accepts / declines enrollment
Follow Up Note	Follow-up(s) with patient/designee
Coordination Note	Coordination with other KP or community services, programs, or providers
Hospital Intro Note	Transitions Program Clinician Hospital Introduction
Referral Reviewed and Case Close Note	Transitions Program referral received, chart reviewed, patient / designee not contacted, & case not opened with reason why
Unable to Reach Note	Unable to reach patient x___ for either initial outreach assessment or follow-up with plan / outcome

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PATIENT COMMUNICATION WORKFLOWS

Transitions Program: Hospital Bedside Visit Example

The PCC Introduces Anticipated Transitions Program Bedside Visit or Post-discharge Telephone Follow-up:

- **PCC Script for Transitions Bedside Visit:**

  "A nurse from the Transitions Program will come to meet you here at the hospital, a day or 2 before you are discharged. Once you are home, the nurse will call you within 1-2 days, to help you with any questions you have about your transition from the hospital to managing your care at home. You can reach the Transitions Nurse during your first month home at 555-555-5555, between 8:30 and 4:30, Monday through Friday."

- **PCC Script for Transitions Post-discharge Telephone Follow-up:**

  "A nurse from the Transitions Program will call you 1-2 days after you are discharged from the hospital, to help you with any questions you have about your transition from the hospital to managing your care at home. You can reach the Transitions Nurse during your first month home, at 555-555-5555, between 8:30 and 4:30, Monday through Friday."

Transitions Team Conducts a Bedside Visit:

Transitions Program Bedside Visit Example Introduction:
"Hello Betty, my name is Janice Smith and I am a RN for Kaiser Permanente's Transitions Program." "Would it be alright if I took about 5 minutes to tell you about the Transitions Program?" "The Transitions Program is a short-term (about 30 day) case management program that coordinates and promotes continuity of your care within Kaiser Permanente and the community. Our focus is to ensure you are continuing to be healthy at home. We will outreach to you after your discharge from the hospital to assess for any medical or other challenges you may experience so that we may assist you with finding the appropriate solutions, services, and resources to meet your needs."

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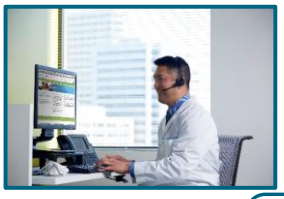
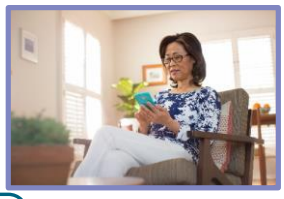
18

Transitions RN Initial Outreach Call Example – Post Discharge Follow-up Assessment



24-48 Hours from D/C Transitions RN Contacts Patient by Phone for Initial Assessment



START→

"Hello Betty- My name is John, I'm a Registered Nurse with Kaiser Permanente's Transitions Team calling to follow-up to see how you are doing after your hospital stay. Is this an okay time to talk for about 15 minutes?"

"How have you been feeling since you arrived at home?"

"Can you tell me why you were in the hospital?" "Do you know what symptoms to watch out for?"

"Did you receive a copy of your hospital discharge instructions?" "What questions do you have about the discharge instructions that I can help you with?"

"Can you tell me your understanding of which medications are new and which were changed? How you are taking them?"

""Can you tell me what type of equipment we ordered for you? Have they been delivered? To ensure the safe use of your new equipment, can you tell me how you will use it?"

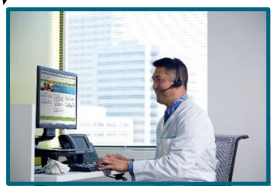
"Tell me how you are doing with: -Moving around….as usual or are you needing more help? Are you getting all the help you need? -Eating/drinking? - Voiding or having bowel movements? -Hygiene? -Pain? Is it relieved?"

"We want to make sure that you are able to get help immediately if you feel worse. Are you able to tell me what symptoms to watch for and who you would call for help? What phone number do you have for the doctor or advice nurse?"

"Do you have a follow-up appointment scheduled with your primary care physician or any other provider?" "When is that?" "How will you get to this appointment?"

"I will follow up with other team members (SW/PharmD) and your provider to make sure we support your through your recovery. I'd like to check in to see how you are doing [next week], would that be alright?" or "I will ask [name SW/PharmD] to follow up with you regarding….."

"Thank you so much for your time. Before we finish up, do you have any questions for me or anything else I can help you with?"



19

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Transitions RN Initial Outreach Call Example – Post Discharge Follow-up Assessment

24-48 Hours from D/C Transitions RN Contacts Patient by Phone for Initial Assessment

START→
"Hello John." "Yes, this is a good time to talk."

"I'm doing better but still feeling tired, a little dizzy, and I'm not very hungry."

"I was in the hospital for CHF. I think I am supposed to watch for weight gain and eat right… Is that correct? I'm not that worried about the changes though because I eat pretty healthy, I'm of average body size, and I can always judge my weight by how my clothes fit. I don't even use my scale because I can just tell if I'm gaining weight."

"I received a lot of papers while in the hospital but I'm sure they are around here somewhere." "What does my weight even have to do with my condition?"

"I have a lot of new medicines and they gave me a pill box to keep them organized. I wasn't sure if I should keep taking my blood pressure medicine and my baby aspirin that I had from before the hospital so I've been taking them just in case. Should I be taking those still?"

"No medical equipment was ordered for me."

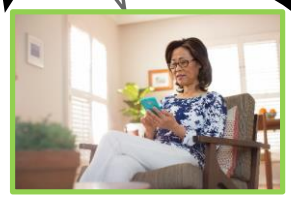
"I'm still needing a little help getting around because I've been pretty tired and dizzy. My husband helps when he can, and when he is at work, I make do on my own. All my plumbing is working as usual and I haven't had any pain."

"I'm supposed to get help if I have chest pains or trouble breathing. I would call my husband or 911 if that happened. I have my local Kaiser Appointment Line number 555-555-5555 if I wanted to reach my doctor or the advice nurse."

"Yes - I believe I have a follow-up appointment with my heart doctor on Tuesday at 1 and my primary care doctor on Wednesday at 2." "My husband works both days so I plan to drive myself."

"Yes it is fine with me if you call again next week." "I appreciate your help with all this and for requesting SW and the Pharmacist to follow-up."

"No, no other questions I can think of at this time. Thank you John."



20

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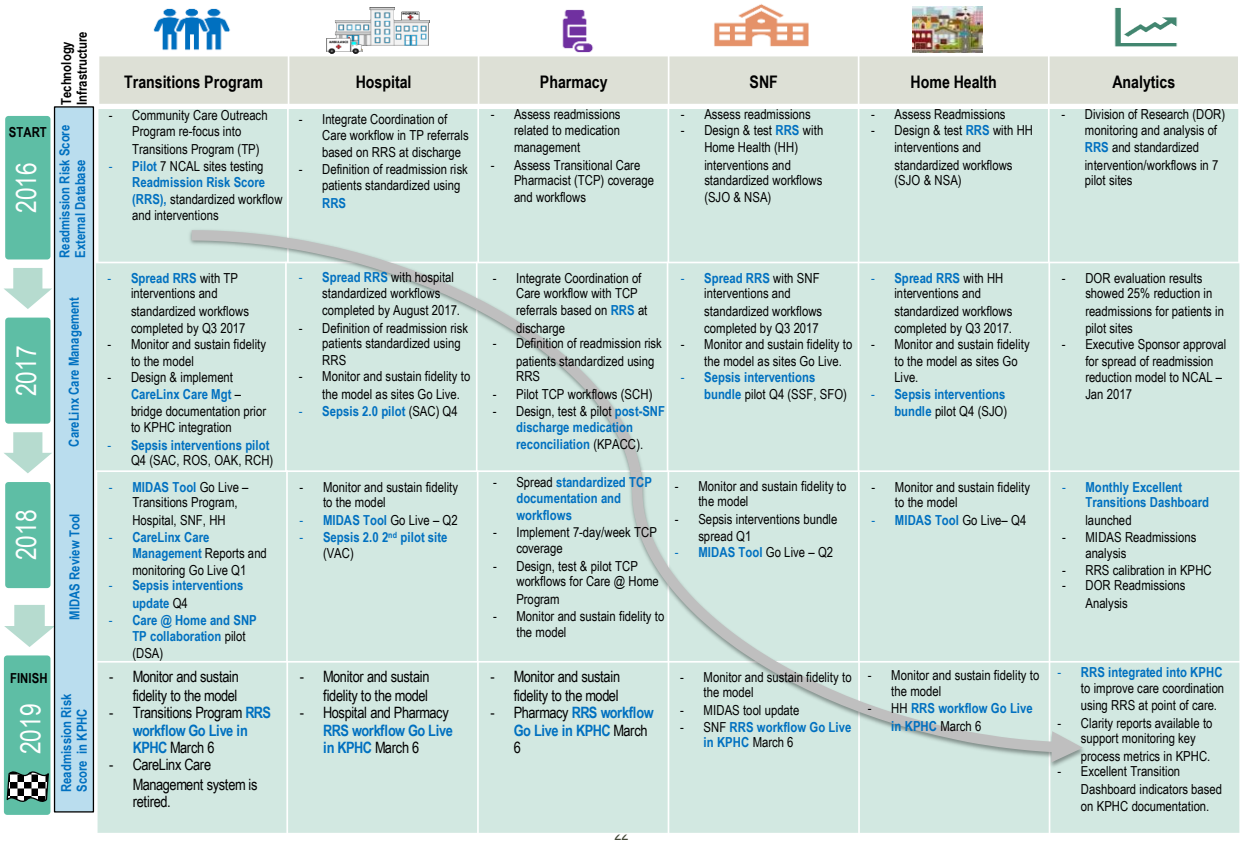
DEPLOYMENT AND STAFFING PLANNING

NCAL Readmissions Actions: Excellent Transitions Refocus Timeline



Transitions Program Teams

Service Area (some with more than 1 hospital)	CA	DIR	MGR	TEAM
A	1	1	1	3 RN; 4 SW
B	1	1	1	1 Ops Specialist 1 SW 3 RN
C	1	-	1	3 RN 1 LVN
D	1	1	2	3 RN 2 SW
E	1	1	1	1- Admin 1- SW 7 RN
F	1	1	-	2- SW 6 RN
G	1	1	1	1 SW 1 Dept Sec 1 LVN 2 RN
H	1	1	Vacant	2 Pharmacists 1 RN 4- SW 1 Affairs Rep
I	1	1	-	3 RN 1 LVN 1 Social Worker
J	1	1	1	5 RN 3 Social Workers 1 Patient Coordinator
K	1	-	1	2 SW 4 RN
L	1	1	-	1 Quality Specialist 3 RN 1 SW
M	1	1	1	2 RN 3 SW 2 Case Manager

References

1. Escobar GJ, Gardner MN, Greene JD, Draper D, Kipnis P. Risk-adjusting hospital mortality using a comprehensive electronic record in an integrated health care delivery system. *Med Care*. May 2013;51(5):446-53. doi:10.1097/MLR.0b013e3182881c8e
2. Escobar GJ, Dellinger RP. Early detection, prevention, and mitigation of critical illness outside intensive care settings. *J Hosp Med*. Nov 2016;11 Suppl 1:S5-S10. doi:10.1002/jhm.2653
3. Escobar GJ, Turk BJ, Ragins A, et al. Piloting electronic medical record-based early detection of inpatient deterioration in community hospitals. *J Hosp Med*. Nov 2016;11 Suppl 1:S18-S24. doi:10.1002/jhm.2652
4. Kipnis P, Turk BJ, Wulf DA, et al. Development and Validation of an Electronic Medical Record-Based Alert Score for Detection of Inpatient Deterioration Outside the Icu. *J Biomed Inform*. Sep 19 2016;64:10-19. doi:10.1016/j.jbi.2016.09.013
5. Escobar GJ, Ragins A, Scheirer P, Liu V, Robles J, Kipnis P. Nonelective Rehospitalizations and Postdischarge Mortality: Predictive Models Suitable for Use in Real Time. *Med Care*. Nov 2015;53(11):916-23. doi:10.1097/MLR.0000000000000435
6. Moscoe E, Bor J, Baernighausen T. Regression discontinuity designs are underutilized in medicine, epidemiology, and public health: a review of current and best practice. *Journal of Clinical Epidemiology*. Feb 2015;68(2):132-143. doi:10.1016/j.jclinepi.2014.06.021
7. Hansen BB. The prognostic analogue of the propensity score. *Biometrika*. 2008;95(2):481-488. doi:10.1093/biomet/asn004
8. Walkey AJ, Bor J, Cordella NJ. Novel tools for a learning health system: a combined difference-in-difference/regression discontinuity approach to evaluate effectiveness of a readmission reduction initiative. *BMJ Quality & Safety*. 2019:bmjqs-2019-009734. doi:10.1136/bmjqs-2019-009734
9. Imbens G, Kalyanaraman K. Optimal Bandwidth Choice for the Regression Discontinuity Estimator. *Review of Economic Studies*. Jul 2012;79(3):933-959. doi:10.1093/restud/rdr043