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Differences Between Early and Late Readmissions Among Medical Patients, A Cohort Study

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Abstract

Background—Early and late readmissions may have different causal factors and thus require different strategies for prevention.

Objective—Determine whether predictors of readmission change within the 30-day window post-discharge.

Design—Retrospective cohort study

Setting—Academic medical center

Participants—Medicine discharges, 1/1/2009-12/31/2010

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This work has not been presented.

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Data access and security: Dr. Graham had full access to all of the data in the study and takes responsibility for the integrity of the data and accuracy of the data analysis. Dr. Elissa Wilker conducted the data analysis.

Exposures—(1) Factors related to the index hospitalization: acute illness burden, inpatient care process factors, and clinical indicators of instability at discharge; (2) Unrelated factors: chronic illness burden, and social determinants of health.

Outcomes—(1) Early readmissions, 0-7d post-discharge; (2) Late readmissions, 8-30d post-discharge.

Results—13,334 discharges, representing 8,078 patients were included in the analysis, 1,046 readmissions (7.8%) occurred in the early period and 1,586 readmissions (11.9%) occurred in the late period. Early readmissions were associated with markers of acute illness burden, including length of hospital stay (Odds Ratio(OR) 1.02, 95%CI 1.00-1.03), and whether a rapid response team assessment was called (OR1.48, 95%CI 1.15-1.89); some markers of chronic illness burden, including being on a medication that indicates organ failure (OR1.19 95%CI 1.02-1.40); and some social determinants of health, including barriers to learning (OR 1.18 95%CI 1.01-1.38); and were less likely if a patient was discharged from the hospital between 800AM-1259 PM (OR0.76, 95%CI 0.58-0.99). Late readmissions were associated with markers of chronic illness burden, including being on a medication that indicated organ failure (OR1.27, 95%CI 1.10-1.46) or hemodialysis (OR1.75, 95%CI 1.29-2.37); and social determinants of health, including barriers to learning (OR1.22, 95%CI 1.07-1.40), and having unsupplemented Medicare or Medicaid (OR1.20, 95%CI 1.04-1.38).

Limitations—Single center, only ascertains readmissions at our institution

Conclusions—The 30 days following hospital discharge may not be homogeneous. Causal factors and readmission prevention strategies may be different for the early vs. late periods.

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Introduction

One in five Medicare beneficiaries who have been discharged from a hospital will be readmitted within 30 days, costing 17.6 billion dollars to the US healthcare system annually (1). As a result, 30-day readmission rates have become a quality metric intended to gauge inpatient quality of care and unnecessary healthcare utilization, with formal public reporting beginning in 2009. Effective October 1, 2012, Section 3025 of the Affordable Care Act established the Hospital Readmissions Reduction Program (2), which requires the Centers for Medicare and Medicaid Services to reduce payments to hospitals with excess readmissions.

Despite its face validity, the readmission metric has fueled controversy. Ideally a quality metric should accurately and reliably predict outcomes, avoid unintended consequences, and represent something preventable. Recent evidence demonstrates that hospitals with the greatest adherence to evidence-based care processes do not consistently achieve the lowest readmission rates (3), and readmission rates are only weakly associated with, or even inversely related to inpatient mortality (4, 5); calling into question the metric's utility. Recent reports have also shown that since the inception of the Hospital Readmissions Reduction Program, hospitals caring for the most disadvantaged patients bear the most

penalties (6). The small literature on preventability suggests that preventable readmissions are rare events (4, 7-10); and that preventability decreases within the 30-day window after discharge (10), leading experts to propose that a more appropriate window for this quality metric would be 3-7 days (8, 11,12).

Whether the 30-day window actually represents a homogeneous period after discharge has not been studied. We therefore aimed to study correlates of readmission within an early (0-7 days post-discharge) and late period (8-30 days post-discharge) in an internal medicine population to evaluate whether risk factors for readmission are different within this timeframe. We hypothesized that early readmissions are associated with factors related to the index admission, including acute illness burden, inpatient care process factors and markers of clinical instability on discharge. Conversely, we hypothesized that late readmissions are more highly associated with chronic illness burden and social determinants of health, factors that are less related to the index admission. Our goal is to provide the data necessary to refine readmission prevention strategies for these two distinct windows.

Methods

Setting and Study Population

This is a retrospective single center cohort study, set in a large urban teaching hospital. The hospital's Institutional Review Board approved the study with a waiver of informed consent. We included all live medicine admissions (including observation status admissions) from our hospital's primary care network from 1/1/2009-12/31/2010. Notably, because the medical record number is not the unit of observation, patients can be represented more than once if they are readmitted any time during the observation period. A readmission is only counted once as a readmission, relative to the prior index admission, then re-entered the cohort as a new index admission. Admissions followed by elective readmissions within 30 days of discharge were excluded from the dataset. We also excluded patients who were discharged to long term acute care hospitals and in-house psychiatry transfers, because the nature of healthcare utilization after discharge was felt to be qualitatively different from that of patients discharged in stable condition.

Data Sources

We derived our cohort and variables of interest using the hospital's clinical and administrative data repositories; the professional fee billing repository; electronic provider order entry data; and our electronic initial nursing assessment tool, which our nurses use to collect clinical and socioeconomic data on patients at the time of admission. All of the aforementioned data is prospectively collected as part of regular hospital operations. See Appendix Table A for a listing of the source for each variable used in our model.

Outcomes

Our primary outcomes included early readmissions, defined as readmissions within 7 days post-discharge from the index hospitalization, and late readmissions, defined as readmissions between 8-30 days post-discharge. At our institution, all admissions are

categorized by type in the repository, only non-elective readmissions were included in our analysis.

Analysis

Variables of Interest—We grouped variables into two conceptual categories based on how we hypothesized they would relate to early and late readmissions. The first category contained a group of variables related to the index admission that we hypothesized would be associated with early readmissions, and included markers of acute illness burden, a set of inpatient care process factors, such as discharge timing and physician continuity, and markers of clinical instability on discharge, which is a composite variable based on treatments administered on the day of discharge (see Appendix Table B for a complete list of included treatments). To adjust for patients' physiologic instability, we used Escobar et al's methods to calculate a Laboratory-based Acute Physiology Score based on laboratory data prior to or immediately at the time of admission (14). The second category contained variables that we hypothesized would be associated with late readmissions, and included markers of chronic illness burden, and social determinants of health, including race, marital status, barriers to learning, primary language, and insurance coverage. When two variables from the repository were clinically redundant we chose to keep the variable that was felt to be more clinically relevant. See our Appendix for a complete list of our variables, their source, and how we operationalized them.

If data were missing in $\leq 5\%$ of the cohort for any variable originating from the repository, multiple imputation was employed, using a chained equation approach with 50 imputed datasets and all non-missing variables in the model. Variables where $>5\%$ of the data were missing from the repository were not used, with the following exceptions. Missing data derived from our electronic nursing assessment were treated as not conferring risk because missing data from this document indicate lack of applicability to the patient. Missing laboratory data used to calculate the laboratory-based acute physiology score were treated as being within normal physiologic parameters, which is the standard approach for this calculation (14). We made the assumption that patients who did not have echocardiographic data available in the repository were unlikely to have ejection fractions less than 35%. See our Appendix for more information on missing data for each variable.

Statistical Analysis—We used polytomous multinomial logistic regression to model the association between variables of interest and early and late readmissions simultaneously. We used generalized estimating equations to cluster at the level of the patient, as the unit of observation in our cohort was the admission, and individual patients could be admitted more than once. Our model building and variable reduction strategies were as follows: polytomous multinomial logistic regression was used to determine univariable associations between exposures of interest and early and late readmissions. All exposures with $p < 0.2$ were included in the model, along with age, gender, race, index hospital length of stay, and discharge disposition, which were included *a priori*.

Because the cut point for an early vs. a late readmission is not clear, we performed a sensitivity analysis using a 5-day cut point and did not see a substantial change in the results. Therefore, only 7-day cut point results are presented.

Data management was performed using SAS version 9.2 (Cary, NC), and data analysis was performed using R statistical programming version 3.0.1 and multgee package version 1.3 (R foundation for statistical computing, Vienna Austria). Data were imputed using the mi package (v. 0.09-19).

Role of the Funding Source

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Results

Cohort Characteristics

The cohort included 13,355 admissions, representing 8,078 patients with a mean age of 66 years (SD 18), 54% female. Figure 1 is a flow diagram depicting creation of the cohort. The overall 30-day readmission rate was 19.7%. There were a total of 1,046 early readmissions (7.8% of index admissions), and 1,586 late readmissions (11.9% of index admissions), (Table 2, Figure 1). The distribution of readmission by post-discharge day is shown in Figure 2, with 39.7% of the readmissions occurring in the early period, and 60.3% of the readmissions occurring in the late period. When all admissions were included in the analyses, the iterative process to solve the equations did not provide solutions in a reasonable length of time (i.e., the models did not converge). Therefore the final analyses were restricted to the first 20 admissions for each individual; 21 admissions from 5 patients were omitted, leaving a total of 13,334 observations in the final cohort.

Independent Correlates of Early and Late Readmissions

In adjusted analyses, we found that higher Charlson comorbidity index, the number of admissions in the prior 12 months, and needing in-home medical services upon discharge were associated with higher odds of a readmission in both periods (Table 2).

Acute vs. Chronic Illness Burden—Markers of acute illness burden, including length of index hospital stay (OR 1.02 for each day, 95%CI 1.00-1.03), and whether or not the patient experienced a rapid response during the index hospitalization (OR 1.48, 95%CI 1.15-1.89) (Table 2) were associated with early readmissions, but not late readmissions. Markers of chronic illness burden, including being on a medication indicating organ failure,

were associated with both early (OR 1.19, 95%CI 1.02-1.40) and late readmissions (OR 1.24, 95%CI 1.08-1.41) while other markers of chronic illness burden, including being on hemodialysis, were only associated with late readmissions (OR 1.61, 95%CI 1.19-2.17) (Table 2).

Inpatient Care Process Factors—Discharge from the index hospitalization between 800AM-1259PM rather than the afternoon was associated with lower odds of early readmissions (OR 0.76, 95%CI 0.58-0.99), but not late readmissions. We did not observe this pattern for our marker of inpatient attending MD continuity, which was associated with lower odds of late readmissions. Shared electronic medical record access between the hospital and primary care provider was associated with a higher odds of early readmission (OR1.28, 95%CI 1.09-1.52) (Table 2).

Markers of Clinical Instability on Discharge—Markers of clinical instability on the day of discharge were not associated with early or late readmissions (Table 2).

Social Determinants of Health—Barriers to learning were associated with both early (OR 1.18, 95% 1.01-1.38) and late (OR 1.24, 95%CI 1.09-1.42) readmissions. Having unsupplemented Medicare or Medicaid as health insurance was also associated with late readmissions (OR 1.16, 95%CI 1.01-1.33) (Table 2).

Sensitivity Analysis—A sensitivity analysis was performed using a 5-day cut point to divide early and late readmissions, which did not produce substantially different results.

Discussion

In this large retrospective cohort study, we found that risk factors of readmission differed within the 30 days following discharge. Specifically, factors related to the index hospitalization; including acute illness burden and inpatient care process factors, were only associated with early readmissions, whereas chronic illness burden and social determinants of health were associated with both early and late readmissions. These findings suggest that the 30 days following hospital discharge may not be a homogeneous timeframe with respect to their relationship to unplanned readmissions.

We present a conceptual model that divides the thirty days after hospital discharge into an early period and a late period, and present the factors that we hypothesize predict readmissions within each of these timeframes. We used data from our hospital's data repository that represent these factors.

Our findings supported our hypothesis about illness burden. We found that early readmissions were associated with markers of acute illness burden and some markers of chronic disease burden, whereas late readmissions were only associated with markers of chronic illness burden. The Charlson index, which includes markers of both acute and chronic illness burden, was associated with readmissions in both periods. Our findings suggest that early readmissions are predicted by the severity of the acute illness managed during the index hospitalization, but that a patient's chronic illness burden is more important

in predicting late readmissions. Experts have expressed concern that risk adjustment for illness severity (4,12), which limits adjustment for chronic illness burden to the presence of specific ICD-9 diagnoses on the discharge abstract, is inadequate for determining readmission penalties. Such ICD-9 coding is affected by coding trends, and fails to distinguish acute vs. chronic disease burden. We included the Charlson Score (15) in our analysis to remain consistent with prior studies; however, this score likely reflects both acute and chronic disease. To increase specificity, we also used clinical variables targeting both acute and chronic illness burden. For example, we used the presence of a rapid response team assessment during the hospitalization as a marker of acute illness burden, and markers of organ failure to represent chronic illness burden. We attempted to fill a gap in the literature by further evaluating the complex relationship between illness severity and readmissions.

Our findings highlight the current tension between minimizing length of stay and the occasionally disparate goals of providing high quality care and preventing readmissions. Discharge between 800AM-1259PM from the hospital was associated with early readmissions. This supports our hypothesis that inpatient care processes act in the early period. There is a sparse literature on the impact of discharge timing on hospital throughput and nursing workload (16, 17), however, its impact on readmissions has not been studied. Early discharge likely enables patients and their families more time to access community resources such as pharmacies and social supports during their transition home, thus reducing the likelihood of a readmission. Patients who are discharged later in the day may represent a population that could benefit from an additional hospital day with an earlier discharge the following day.

Our findings for social determinants of health supported our hypothesis that these factors persist as important predictors of readmissions in the late period. We used our nursing assessment tool to evaluate the impact of barriers to learning, as a marker of health literacy, on readmissions and found that they were associated with both early and late readmissions. Other social factors emerge during the late period, including insurance status. Patients with unsupplemented Medicare or Medicaid had higher odds of late readmissions compared to patients with private insurance, perhaps because of the difficulty accessing outpatient care, and utilization of the inpatient setting for ambulatory care sensitive conditions. It is likely that social determinants of health are integrally tied to readmissions, as they impact how patients access healthcare (18,19). The National Quality Forum has recently recommended adjustment for these factors for accountability measures, such as 30-day readmission rates, particularly when the relationship is not mediated by quality of care (20). Our findings support these recommendations.

Our findings did not support our hypotheses about physician continuity or clinical instability on discharge. We observed an unexpected relationship between our variable for physician continuity and late readmissions, rather than the expected relationship with early readmissions. This is the first study to our knowledge to evaluate the impact of continuity of care during hospitalization on readmissions, and is a topic for further investigation. Our variables for clinical instability were not associated with early or late readmissions, where we expected them to be disproportionately associated with early readmissions. Other studies

have found a link between clinical instability on discharge and readmissions, however, they used 14 days as their cut-off whereas we used 7 days therefore it is possible that the effect would have been more apparent using a different cut-off (21). It should also be noted that this variable is a composite based on physician order entry data (see appendix for a complete list) and not a true clinician-adjudicated outcome based on medical record review, indicating that perhaps our variable did not adequately represent clinical instability. This presents a limitation of the current analysis, and is an issue that requires further examination, for which we are currently conducting an embedded chart review study.

Our study has several important implications. From a health policy perspective, experts have questioned the validity of 30-day readmissions as a quality metric, and have recommended either changing the length of time after discharge to consider hospitals at fault for readmissions to 3-7 days (12) or weighing penalties based on the timing of the readmission (8). Our study showed that early readmissions were more highly associated with factors related to the index admission than late readmissions, suggesting a narrower window for which hospitals are accountable for readmissions than 30 days.

In this study we were only able to ascertain readmissions within our own healthcare system. However, our primary goal was to illustrate that correlates of readmission shift within the 30 days following hospital discharge, rather than to develop an externally valid prediction model. We favored a single center study design, with highly detailed clinical variables for this objective; larger administrative claims databases would have sacrificed this level of detail. Several prediction models using such databases have already been developed and generally perform poorly (22), indicating the need for higher quality data sources that include clinically relevant variables. Our analyses show proof of concept- that early and late readmissions differ meaningfully. However, understanding how well this concept generalizes across other centers requires additional studies, using equally detailed but uniformly available clinical variables.

In summary, we found that risk factors for readmission change during the thirty days following hospital discharge. Specifically, factors related to the index hospitalization, including acute illness severity and inpatient care processes, are associated with readmissions during the early period following discharge (days 0-7 post-discharge), but not during the late period (days 8-30 post-discharge). Factors related to chronic illness burden and social determinants of health are associated with readmissions in both periods, more substantially in the late period. These findings address an important open question in the fields of quality measurement and health policy, and suggest that the 30 days following hospital discharge are not a homogeneous timeframe. Strategies to prevent readmissions in these two timeframes are likely different.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Flow Diagram showing how we assembled our cohort.

Figure 2.
Number of readmissions by post-discharge day in the first 30 days after hospitalization for our cohort. The vertical line separates early and late readmission

Table 1
Initial Hospitalization and Patient Characteristics by Readmission Status

Variable	Early Readmissions (0-7 days) (n=1046, 7.8%)	Late Readmissions (8-30 days) (n=1586, 11.9%)	No Readmissions (within 30 days) (n=10723, 80.3%)
30-day mortality rate*	5.9%	3.6%	1.3%
Length of stay (index admission, days), median, Interquartile range (IQR)	3.2 (2.0-6.0)	3.2 (2.0-5.3)	2.8 (1.6-4.7)
Proportion of the hospitalization that a single physician attended on the patient, mean, standard deviation (SD)	0.7 (0.3)	0.7 (0.2)	0.8 (0.2)
Proportion of the hospitalization that the discharging physician attended on the patient, mean, (SD)	0.7 (0.3)	0.7 (0.3)	0.7 (0.3)
Number of Consultants, mean (SD)	0.9 (1.3)	0.9 (1.2)	0.7 (1.1)
<u>Discharge Timing (%)</u>			
0800-1259	7.1	10.2	11.1
1300-1759	70.0	69.3	68.2
1800-0759	22.9	20.5	20.7
Primary care physician access to hospital electronic medical record	72.5	70.8	65.9
Medication administered indicating clinical instability on day of discharge (%)	14.0	13.6	10.3
<u>Disposition on discharge (%)</u>			
Home, no services	41.2	42.0	54.6
Home, with services	38.2	38.5	25.5
Hospice	0.5	0.3	1.2
Skilled nursing facility	17.8	17.3	15.4
Rehabilitation hospital	2.1	1.2	1.4
Other	0.3	0.8	1.9
Number of nursing units, mean (SD)	1.4 (0.8)	1.4 (0.7)	1.4 (0.7)
<u>Age decades (%)</u>			
Less than 50 years	20.5	19.3	19.3
50-59 years	15.0	15.5	15.4
60-69 years	15.1	23.5	18.4
70-79 years	17.7	15.2	17.9
Greater than/equal to 80 years	31.7	26.5	29.0
Charlson Comorbidity Index, mean (SD)	3.0 (2.2)	3.0 (2.3)	2.2 (2.1)
<u>Chronic Illness Burden (%)</u>			
On medication indicating organ failure	30.8	30.8	21.7
Ejection fraction <= 35%	1.4	1.8	1.6
On hemodialysis	2.4	4.9	1.4
Uses supplemental oxygen at home	3.4	5.0	2.5
<u>Prior Use of Healthcare, median (IQR)</u>			
#Admissions in the last 12m	2 (1-5)	2 (1-6)	1 (0-2)
#Emergency room visits in the last 12m	2 (1-6)	3 (1-7)	1 (0-3)
<u>Acute illness burden</u>			

Variable	Early Readmissions (0-7 days) (n=1046, 7.8%)	Late Readmissions (8-30 days) (n=1586, 11.9%)	No Readmissions (within 30 days) (n=10723, 80.3%)
Rapid response during admission (%)	13.7	9.2	7.4
Intensive care unit stay during admission (%)	17.9	15.9	13.9
Laboratory- based acute physiology score, mean (SD) [†]	21.8 (15.3)	21.3 (15.2)	17.0 (14.1)
<u>Functional Status (%)</u>			
Dependent/needs assistance w/ activities of daily living	31.0	33.6	27.1
Morse Fall Risk			
No risk	47.4	42.9	43.8
Low Risk	24.1	25.6	29.6
High Risk	28.5	31.5	26.6
Gender (% Female)	53.3	53.2	54.5
<u>Race (%)</u>			
White	66.6	65.1	67.6
Black	23.8	25.6	20.2
Hispanic	6.3	6.8	6.3
Other	3.1	2.4	5.0
<u>Marital Status (%)</u>			
Married/Partnered	37.2	36.6	40.9
Single	35.0	35.6	32.4
Widowed	19.5	17.0	18.8
Divorced/Separated	8.0	10.4	7.3
<u>Education Level (%)</u>			
Highschool/GED	42.5	46.3	38.6
>Highschool	45.8	41.7	45.1
<Highschool	11.0	11.1	12.9
<u>Health literacy (%)</u>			
Barriers to learning	53.1	55.1	47.0
English speaking	88.1	87.1	86.2
<u>Insurance Payer (%)</u>			
Private/Commercial/Med Adv/Liab [‡]	29.3	27.1	36.7
Medicare/Medicaid	69.9	71.8	61.0
Free care/Self pay	0.3	0.7	1.5
Other	0.5	0.4	0.8

* Based on documented date of death by the patient's primary care physician in the electronic medical record

[†] Based on Escobar et. al's risk prediction model for inpatient and 30 day mortality using laboratory data prior to, or very early after admission.

[‡] Forms of comprehensive insurance coverage, including private, Medicare advantage, and liability insurance

Table 2
Multivariable Model for Early and Late Readmissions

Variable	Early Readmissions (0-7 days) Odds Ratio (95% CI)*	Late Readmissions (8-30 days) Odds Ratio (95% CI)
<u>Age</u>		
<=49	1.21 (0.93-1.58)	1.18 (0.95-1.46)
50-59 (reference)	--	--
60-69	0.80 (0.62-1.04)	1.16 (0.95-1.41)
70-79	1.05 (0.81-1.35)	0.84 (0.68-1.04)
>=80	1.22 (0.93-1.60)	0.93 (0.75-1.15)
Male gender	1.14 (0.98-1.34)	1.06 (0.93-1.20)
Charlson Comorbidity Index (per unit)	1.10 (1.06-1.14)	1.10 (1.07-1.13)
#Admissions in last 12m (per admission)	1.14 (1.11-1.17)	1.15 (1.13-1.17)
<u>Acute Illness Burden</u>		
Length of Stay (index admission, per day)	1.02 (1.00-1.03)	1.00 (0.98-1.02)
Total number of consulting MDs	1.04 (0.97-1.11)	1.03 (0.97-1.09)
Rapid response during admission [†]	1.48 (1.15-1.89)	0.98 (0.80-1.21)
Intensive care unit stay during admission	0.99 (0.76-1.28)	0.98 (0.78-1.22)
Laboratory-based acute physiology score [‡]	1.01 (1.00-1.01)	1.01 (1.00-1.01)
<u>Inpatient Care Process Factors</u>		
Time of day of discharge		
AM (0800-1259)	0.76 (0.58-0.99)	1.08 (0.89-1.30)
Reference (1300-1759)	--	--
PM (1800-0759)	1.05 (0.89-1.25)	0.95 (0.82-1.10)
Primary care physician access to hospital electronic medical record	1.28 (1.09-1.52)	1.08 (0.94-1.22)
Inpatient attending physician continuity	0.92 (0.66-1.29)	0.66 (0.51-0.86)
Number of nursing handoffs	1.01 (0.91-1.13)	1.00 (0.91-1.10)
<u>Premature Discharge</u>		
Medication administered indicating clinical instability on day of discharge	1.10 (0.87-1.39)	1.15 (0.96-1.38)
<u>Markers of Chronic Illness Burden</u>		
Medications indicating organ failure	1.19 (1.02-1.40)	1.24 (1.08-1.41)
Hemodialysis	0.85 (0.50-1.45)	1.61 (1.19-2.17)
Supplemental Oxygen use at home	0.92 (0.60-1.40)	1.25 (0.91-1.74)
Dependent or needs assistance for any activities of daily living	0.94 (0.79-1.12)	1.05 (0.92-1.21)
<u>Disposition</u>		
Reference (Home, no services)	--	--
Home, with services	1.29 (1.07-1.55)	1.38 (1.19-1.61)
Hospice	0.26 (0.09-0.76)	0.17 (0.05-0.52)
Skilled nursing facility	0.96 (0.74-1.25)	1.11 (0.92-1.36)
Rehabilitation hospital	1.22 (0.75-1.98)	0.85 (0.50-1.42)
Other	0.10 (0.01-1.04)	0.29 (0.14-0.61)

Variable	Early Readmissions (0-7 days)	Late Readmissions (8-30 days)
	Odds Ratio (95% CI)*	Odds Ratio (95% CI)
<u>Social Determinants of Health</u>		
Race		
Reference (white)	--	--
Black	1.01 (0.84-1.22)	1.04 (0.90-1.21)
Hispanic	0.97 (0.70-1.34)	0.92 (0.70-1.20)
Other	0.86 (0.56-1.30)	0.65 (0.46-0.92)
Marital Status		
Reference (Married/partnered)	--	--
Widowed	0.99 (0.80-1.24)	0.88 (0.74-1.06)
Divorced/separated	1.04 (0.79-1.38)	1.09 (0.88-1.35)
Single	1.04 (0.86-1.26)	1.01 (0.87-1.17)
Education Level		
Less than highschool	0.87 (0.69-1.11)	0.82 (0.68-0.99)
Ref (Highschool/GED)	--	--
Greater than highschool	1.09 (0.92-1.28)	0.97 (0.85-1.11)
Barriers to learning	1.18 (1.01-1.38)	1.24 (1.09-1.42)
Insurance Payer		
Private/Commercial/Med Adv/Liab	--	--
Medicare/Medicaid	1.07 (0.90-1.26)	1.16 (1.01-1.33)
Free care/Self pay	0.41 (0.14-1.14)	0.89 (0.48-1.65)
Other	0.96 (0.38-2.41)	0.95 (0.43-2.09)

* Odds ratios were derived using a polytomous multinomial regression model with a generalized estimating equation, using the readmission category (none within 30 days, early and late) as the independent variable, 21 observations were excluded from the analysis if they represented beyond 20 readmission events as a limitation of our statistical program. For all binary variables, the reference category is the absence of the specified variable.

† When the primary team is called to evaluate a patient based on a set of clinical variables indicating instability

‡ Based on Escobar et. al's risk prediction model for inpatient and 30 day mortality using laboratory data from the 24 hour prior to hospital admission