Original Article

How Effective Are Rehab Programs in Lowering Rehospitalization Rates?

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Abstract
Aim: The main aim of this paper is to estimate the likelihood of a patient being readmitted to the hospital within thirty days of discharge. Short-term rehab programs in Skilled Nursing Facilities face pressures to transition patients to their homes and minimize rehospitalization rates. While the goal of reducing rehospitalization is evident, it is unclear what the likelihood of rehospitalization is after completing a rehabilitation process.
Methodology: Electronic Medical Record (EMR) is used to retrieve the data, and a logistic regression estimation technique is employed.
Results: This study estimates the likelihood of 30-day hospital readmissions following discharge to home using 343 short-term rehab cases. It finds that the likelihood of rehospitalization is reduced by 2.868 percent for every additional daily therapy minute provided. In terms of monetary value, there is a cost savings of $18.15 (at 2021 price level) per unit of additional daily therapy minute when measuring the cost of labor against healthcare expenditures of Medicare hospital readmissions. Therefore, a policy action is recommended that increases therapy participation and reduces healthcare expenditures.
Conclusions: Short-term rehab programs in Skilled Nursing Facilities experience pressures to reduce rehospitalization rates through daily patient therapy. This study estimates that the likelihood of rehospitalization is reduced by 2.868 percent for every additional daily therapy minute provided. This reduction in rehospitalization will also help to lower healthcare expenditures.

Key Words: Medicare, Healthcare Cost, Skilled Nursing Facility, Therapy, Rehospitalization

Introduction

Within the context of the United States healthcare system, the role of the Skilled Nursing Facility (SNF) is to provide chronic condition management and rehabilitative services to the elderly outside of the hospital. This overarching principle has been consistent from the post-World War II era through the current COVID-19 pandemic. The persistent public healthcare need for an alternative care setting for the high utilization group of those primarily 65 years of age and older has been a root influence on many governmental policy structures and changes. These efforts seek to address two core issues: providing lower cost alternatives to expensive in-patient hospitalizations and maintaining hospital bed availability for those services that cannot be provided elsewhere (Hawes & Phillips, 1986; CMS 2021c).

The Skilled Nursing Facility market is quite large. Grand View Research (2021) estimated that it was $173.8 billion in 2020. It is where about 20% of all hospitalized Medicare

beneficiaries are discharged, usually for short-term rehabilitation (Yurkofsky and Ouslander, 2021). In 2018, Medicare patients accounted for over 60% of the 3.8 million 30-day all-cause adult hospital readmissions. Their readmission rate was 16.9% at an average cost of $15,500 per episode (Weiss and Jiang, 2021). With the costs of hospitalizations and SNF stays increasing at an alarming rate of 7.4% of national health expenditures (Stewart et al., 2004), it is not surprising that this industry has become a primary focus in determining how to control healthcare costs.

Investigating how to lessen preventable and costly hospital readmissions has been a core focus for the better part of the last decade. As reported by the U.S. Centers for Medicare and Medicaid Services (CMS, 2021b) financial penalties were initiated in 2013 for hospitals based on their individual 30-day unplanned readmission rates. From that time, there has been considerable attention to this metric for the hospital. Consequently, hospitals favor referrals to SNFs and home health agencies that help them keep this metric below penalty level. Therefore, SNF companies need to demonstrate lower rehospitalization rates to compete for these referrals.

While the goal of reducing rehospitalizations is evident, it is unclear what factors indicate if a patient is at higher risk when planning discharges to home. It is routine for rehab patients discharging from the SNF to receive referrals to home health agencies, follow up primary care appointments, and caregiver education, but specific indicators are not identified in the industry. Towards this end, the objective of this study is to utilize the SNF perspective to estimate the likelihood of a patient to readmit to the hospital within 30 days of discharge to home. This study estimates the effect of daily therapy minutes on the probability of rehospitalizations after discharging. Identifying specific risk indicators could guide additional research and lead to impactful interventions that better target reductions in rehospitalization rates than the current industry norms in any region.

Prior studies

Published articles related to hospital readmissions after rehabilitation are very rare, especially from the Skilled Nursing Facility perspective. Of the few relevant studies, none discuss the factors affecting the readmission nor provide an estimation about its likelihood. This has created a gap in the literature of this area.

Some of the current literature focuses on identifying unnecessary rehospitalizations. Middleton et al., (2018) looked at a cohort of 371,846 Medicare Part A patients that discharged from skilled nursing rehabilitation in 2013 and 2014. The 30-day readmission referenced in this study was 30 days after SNF discharge. The overall readmission rate was 12.4% and 5.7% were classified as preventable based on their analysis of functional outcome measures.

Similarly, Mendu et al., (2018) introduced a readmission review process conducted between a referring hospital and its partnered SNF rehabilitation providers. They point out that there was no reduction in readmission rates within 30 days of hospital discharge during the limited period of the study. However, they did find inefficiencies of coordination of care including the lack of access to medical records of each party to the other's system and medication irregularities. Also, areas in need of quality improvement of the SNFs included competing staff responsibilities and inadequacies in communication and technology. It was notable that the review process showed that the hospital was more likely to label a readmission as preventable than the SNF. The hospital reported that 79.7% of readmits were preventable versus only 58.6% by the SNF.

In another study that used the SNF perspective, Weerahandi et. al. (2019) followed 67,333 Medicare beneficiaries with heart failure for 30 days after completing SNF rehabilitation and

subsequent discharge to home from 2012 to 2015. They reported that 24.2% were readmitted to the hospital within 30 days. Patients were categorized by SNF length of stay (LOS) in the following groups: 1 – 6 days, 7 – 13 days, 14 – 30 days. Also, days since SNF discharge were recorded for all readmissions.

The results showed that the highest risk for rehospitalization was in the first two days following SNF discharge. The authors identify that most research focuses on transition from the hospital and that more research is needed for the specified transition from the SNF to home.

Indeed, hospitals are better represented than SNFs in the literature. Gadre et al., (2019) investigated the 30-day readmission rates of 898,257 patients discharged from hospitals across the United States from 2013 to 2014 and reported 17.5% had a 30-day readmission. Their study focused on prevalence of incident by diagnosis.

Another interesting study by Hudali, Robinson and Bhattarai, (2017) found that the 30-day readmission rate was 3.8% for those participating with a transition of care clinic versus 11.7% for those that were not a part of that group. Their work contains details on the resources available to the transition team including office space in the same location as the participants' primary care physician office, staffing of medical personnel at the clinic, and personnel with responsibilities to the program at the hospital.

Key operations were the patient education about the program prior to discharge, the confirmation of appointment following discharge, and the one week in office follow up visit. While the transition program was the dominant indicator. It was a factor that was introduced by design to influence the 30-day readmission rate.

In another recent hospital-based study, Freburger et al., (2020) investigated outcomes after rehab services provided at the hospital for 30,746 patients with a primary or secondary diagnosis related to pneumonia or influenza. They measured the number of physical and occupational therapy visits against 30-day hospital readmission or mortality. Their findings indicate that increasing the number of therapy visits was statistically significant for reducing these negative outcomes for patients with lower initial mobility scores and for those discharged from the hospital to the community.

The reviewed studies associated with 30-day readmissions show a research gap in the literature pertaining to Skilled Nursing Facility short-term rehab. This calls for an empirical study to identify indicators that estimate the likelihood of hospital readmission after SNF discharge.

Methodology

Data Collection: A significant challenge to this type of research exists in acquiring a relevant data set. Raw data was collected using the Electronic Medical Record (EMR) software used by the facility called Casamba. Because no single report existed within the EMR that would provide all data desired for the independent variables in this investigation, three individual Casamba reports were used: Med A LOS Excel, Rehab LOS by Diagnosis Excel, and Demographics Excel. The base list of cases to review were derived by using the Med A LOS Excel report to isolate patients that had a short-term rehab primary payer and discharged to home from January 1, 2019, through September 30, 2020. Much time and attention were given to cross-referencing reports and cleaning of the inconvenient pattern for the reports to combine information, such as total therapy minutes, one to one case if the patient had multiple stays at the SNF. After using the Casamba EMR to retrieve several variables, a separate data base system called PatientPing was used to track patients' admissions to hospitals, SNFs, and home health agencies for care coordination. A total of 343 discharges were looked up in PatientPing to find if the patient had a hospital readmission within 30 days of discharge to home from the SNF.

Empirical Estimation: Given the binary nature of the response of hospital readmission (if True

= 1 and if False = 0), this study employs a logistic regression estimation technique. This is exactly the case with the dependent variable of rehospitalization within 30 days. Also, it can manage multiple independent variables of different types. These potential predictors of the dependent variable can be categorical variables that are either multilevel or binary, as well as numeric variables (Java, 2018). Indeed, logistic regression has the capability of performing well for the diverse data set use in this study. The logistic regression model can be written as follows:

$$P_i = F(\boldsymbol{x_i'\beta}) \quad (1)$$

where F(.) is a cumulative distribution of a logistic random variable. And it can be further expressed as

$$P_i = \frac{1}{1+e^{-x_i'\beta}} \quad (2)$$

expected probability that the outcome and $\boldsymbol{x}$ is the vector of independent variables; and $\boldsymbol{\beta}$ is a vector of corresponding coefficients of independent variables.

Definition of Variables: The estimation of likelihood of readmission to the hospital within 30 days of discharge to home is a binary dependent variable and is defined as: If the patient readmitted to the hospital within 30 days of SNF discharge (Rehosp-in-30) (if True = 1 and if False = 0). It has the mean 0.111 with a standard deviation 0.314. The observed data shows that about 11% of discharged patients to home will return to hospital after short-term rehabilitation; however, it has a large standard deviation of about 31.4%.

This study has utilized nine independent variables based on the availability of the variables in the observed data set. They were used to assess their influence on the patient readmission to the hospital within 30 days of SNF discharge (DC). Out of those nine independent variables, three are binary. The primary funding for the rehab stays were either traditional Medicare Part A or the private insurance alternative of Medicare Advantage. Insurance companies give the SNF less control over length of stay and provide less reimbursement which drives therapy minutes lower. So, paying through Medicare Part A has been defined (Payer) (if True = 1 and if False = 0), which has mean 0.676 and SD of 0.469. Another important binary independent variable is if the patient received speech therapy (ST-Provided) (if True = 1 and if False = 0) with the mean 0.192 and SD of 0.395. It was selected because speech therapy is the most specialized of the rehab services. The other binary variable is gender of the patient, if the patient was male (Male) (if True = 1 and if False = 0), which has the mean 0.356 and SD 0.479. To account for the day of the week the patient discharged to home, a variable defined as day of week of SNF discharge to home (DC-Day-of-Week) was included. Friday was the most common day of the week for discharge in the study, 24.5%. On one hand, some argue that weekends allow for more family support for the transition. On the other hand, others are more concerned about delayed home health start of care on weekends. Similarly, to capture the diagnosis that caused the patient to need rehabilitation, this study has controlled a medical diagnosis category (Dx-Group) with eight diagnostic groups. Each are defined as: Medical diagnosis category which is identified as the primary cause of rehabilitation admission. They are as follows: (Cancer) (if True = 1 and if False = 0) with a mean of 0.029 and SD 0.168; (Cardiac) (if True = 1 and if False = 0) with a mean of 0.216 and SD 0.412, (CVA) (if True = 1 and if False = 0) with a mean of 0.061 and SD 0.240, (Gastrointestinal) (if True = 1 and if False = 0) with a mean of 0.067 and SD 0.251, (Metabolic) (if True = 1 and if False = 0) with a mean of 0.032 and SD 0.176, (Ortho) (if True = 1 and if False = 0) with a mean of 0.353 and SD 0.479, (Respiratory) (if True = 1 and if False = 0) with a mean of 0.120 and SD 0.325, and (Sepsis) (if True = 1 and if False = 0) with a mean of 0.122 and SD 0.328.

This study has also considered three numerical independent variables. Age of the patient upon date of admission to SNF (AGE) had a mean of 78.175 and of standard deviation 8.9. Length of stay in days at the SNF (LOSTAY) is driven by a combination of clinical and financial factors. The mean of 23.974 and SD of 13.716 is highly

influenced by the fact that Medicare Part A and most Medicare Advantage plans pay for the first 20 days at 100%. Starting on day 21, there is a co-pay. According to Medicare.gov, this amount is up to $195.50 per day for 2022. Not surprisingly, the most common LOSTAY in the study was 20 days. To quantify the amount of physical therapy, occupational therapy, and speech therapy the patient received, this study has considered average therapy minutes provided per day (Mins-Per-Day) with mean 65.595 and SD 23.649. This is the most important variable of this study to explain the likelihood of hospital readmission. Interestingly, a major Medicare policy change occurred during the time frame of this research. As of October 1, 2019, Medicare Part A changed to the Patient Driven Payment Model (PDPM). The previous system, Resource Utilization Groups (RUGs), favored higher therapy minutes. The two most reimbursed groups for RUGs had seven-day thresholds to total 720 and 500 therapy minutes respectively. Those targets average to respective totals of approximately 103 and 71 minutes per day. Furthermore, each case had a record of year and month of discharge spanning from January 2019 through September 2020. Dummy variables were created from variations of discharge date—Month and year of SNF—discharge to home (DC-Date).

To capture the significance of the Medicare change to PDPM, the binary variable (PDPM) was added. It is defined as: If the DC to home occurred after October 2019 (if True = 1 and if False = 0) with mean .501 and SD of .501 as well. Similarly, the (COVID) variable uses the time reference of March 2020. It is defined as: If the DC to home occurred after March 2020 (if True = 1 and if False = 0) with the mean .254 and SD of .436. Moreover, (Quarter) was added to consolidate the 21 months into 7 quarters. It is defined as: In what quarter the DC to home occurred. Likewise, (Season) is defined as: In what season, regardless of year, the DC to home occurred and (Month) is defined as: In what month, regardless of year, the DC to home occurred. Table 1 summarizes the variable definitions and descriptive statistics. It includes the mean and standard deviation of the respective categories under (Quarter), (Season), and (Month).

Results

This investigation employed a logit regression model [equation (2)] to estimate the likelihood of hospital readmission after rehabilitation in a Skilled Nursing Facility. To find the best fitting model, Akaike's Information Criterion (AIC) score was used. Results of the best fitting logit estimation are presented in Table 2. The estimated results show that average therapy minutes provided per day (Mins-Per-Day) appears highly significant (p = 0.00154) with a negative sign coefficient of -0.0291. This finding suggests that the log odds of readmission to the hospital will decrease by 0.0291 units for every additional therapy minute per day provided, keeping all else constant. This equals a reduction in likelihood of rehospitalization by 2.868% for every additional daily therapy minute as shown in Table 3. Similarly, the variable (Age) is highly significant (p = 0.00908) with a negative coefficient of -0.0591. This finding implies that for every year a patient is older, the log odds of readmission to the hospital will be reduced by 0.0591 units. This is likely due to the youngest patients of the cohort being in special poor health circumstances that qualify them for Medicare before age 65.

The remaining independent variables that meet the significance level of p – value less than 0.05 are Q4-Winter, Male, Wednesday, Tuesday, and Ortho. Having a discharge date in the fourth quarter of the year (Q4-Winter) (p = 0.01280) has a coefficient of positive 1.49. This suggests that a discharge date in Q4-Winter, regardless of year, increases the log odds of readmission to the hospital by 1.49 units. As highlighted in recent years with COVID-19, winter is a difficult time for those with fragile health. Also, male patients (Male) demonstrate increased log odds of rehospitalization with a positive coefficient of 0.821.

As mentioned in the descriptive statistic section, some do argue that mid-week discharges are preferred to facilitate a timely home health start. This notion is somewhat validated here with the negative coefficients of Wednesday (p = 0.01930) at -1.64 and Tuesday (p = 0.03609) at -1.49. These results imply that the log odds of rehospitalization will decrease by 1.64 units for discharges that occur on Wednesdays and decrease by 1.49 units for discharges on Tuesdays.

Further, this study looked at the effects of diagnostic groups in hospital readmission after the rehabilitation. Results show that if an individual is under the primary diagnostic group of Orthopedic (p = 0.03208), the log odds of rehospitalization decreases by 2.14 units. Similarly, the diagnostic group of Respiratory (p = 0.07201) shows a decrease in log odds of readmission by 2.01 units as compared to the reference group Cancer. The rest of the independent variables do not individually meet the standard of significance accounting to their respective p – values, they are as follows: Cardiac, CVA, Gastrointestinal, Metabolic, Sepsis, Monday, Saturday, Sunday, Q2-Summer, and Q3-Fall.

Table 1. Variable definitions and descriptive statistics (n=343)

Variable	Definitions	Mean	Std Dev
Dependent			
Rehosp-in-30	If the patient readmitted to the hospital within 30 days of SNF discharge, binary	0.111	0.314
Independent			
Payer	If the primary payer was Medicare, binary	0.676	0.469
ST-Provided	If the patient received speech therapy, binary	0.192	0.395
Male	If the patient was male, binary	0.356	0.479
DC-Day-of-week	Day of week of SNF discharge to home		
	Sunday	0.047	0.211
	Monday	0.085	0.279
	Tuesday	0.143	0.350
	Wednesday	0.195	0.397
	Thursday	0.198	0.399
	Friday	0.245	0.431
	Saturday	0.087	0.283
Dx-Group	Medical diagnosis category which is identified as the primary cause of rehabilitation admission.		
	Cancer	0.029	0.168
	Cardiac	0.216	0.412
	CVA	0.061	0.240
	Gastrointestinal	0.067	0.251
	Metabolic	0.032	0.176
	Ortho	0.353	0.479
	Respiratory	0.120	0.325
	Sepsis	0.122	0.328
DC-Date	Month and year of SNF discharge to home		
	2019-01	0.055	0.229

	2019-02	0.070	0.255
	2019-03	0.055	0.229
	2019-04	0.061	0.240
	2019-05	0.067	0.250
	2019-06	0.052	0.223
	2019-07	0.035	0.184
	2019-08	0.055	0.229
	2019-09	0.047	0.211
	2019-10	0.047	0.211
	2019-11	0.047	0.211
	2019-12	0.035	0.184
	2020-01	0.079	0.270
	2020-02	0.041	0.198
	2020-03	0.058	0.235
Variable	**Definitions**	**Mean**	**Std Dev**
	2020-04	0.023	0.235
	2020-05	0.017	0.131
	2020-06	0.035	0.184
	2020-07	0.041	0.198
	2020-08	0.041	0.198
	2020-09	0.038	0.191
Age	Age of the patient upon date of admission to SNF	78.175	8.900
LOSTAY	Length of stay in days at the SNF	23.974	13.716
Mins-Per-Day	Average therapy minutes provided per day	65.595	23.649
PDPM	If the DC to home occurred after October 2019, binary	0.501	0.501
COVID	If the DC to home occurred after March 2020, binary	0.254	0.436
Quarter	In what quarter the DC to home occurred		
	2019-Q1	0.181	0.385
	2019-Q2	0.181	0.385
	2019-Q3	0.137	0.344
	2019-Q4	0.128	0.335
	2020-Q1	0.178	0.383
	2020-Q2	0.076	0.265
	2020-Q3	0.120	0.325
Season	In what season, regardless of year, the DC to home occurred		
	Q1-Spring	0.359	0.480
	Q2-Summer	0.257	0.437
	Q3-Fall	0.257	0.437
	Q4-Winter	0.128	0.335
Month	In what month, regardless of year, the DC to home occurred		
	January	0.134	0.341

February	0.111	0.314
March	0.114	0.318
April	0.085	0.279
May	0.085	0.279
June	0.087	0.283
July	0.076	0.265
August	0.096	0.295
September	0.085	0.279
October	0.047	0.211
November	0.047	0.211
December	0.035	0.184

Table 2. Results of logistic regression

Variables	Coefficients	Std. Error	z value	Pr(>|z|)	
Intercept	5.45E+00	2.12E+00	2.569	0.01019	***
Gender					
Male	8.21E-01	4.02E-01	2.041	0.04126	**
Dx-Group					
Cardiac	-5.92E-01	9.66E-01	-0.613	0.53991	
CVA	-1.52E+00	1.21E+00	-1.262	0.20709	
Gastrointestinal	-2.56E-01	1.06E+00	-0.241	0.80940	
Metabolic	-1.79E+01	1.73E+03	-0.010	0.99177	
Ortho	-2.14E+00	1.00E+00	-2.143	0.03208	**
Respiratory	-2.01E+00	1.12E+00	-1.799	0.07201	*
Sepsis	-1.42E+00	1.05E+00	-1.343	0.17939	
DC-Day-of-week					
Monday	-6.11E-02	6.38E-01	-0.096	0.92366	
Saturday	-6.04E-01	7.04E-01	-0.858	0.39071	
Sunday	-1.77E+01	1.45E+03	-0.012	0.99026	
Thursday	-8.22E-01	5.73E-01	-1.434	0.15154	
Tuesday	-1.49E+00	7.11E-01	-2.096	0.03609	**
Wednesday	-1.64E+00	7.01E-01	-2.34	0.01930	**
Season					
Q2-Summer	6.96E-01	5.52E-01	1.261	0.20738	
Q3-Fall	2.37E-01	5.28E-01	0.449	0.65315	
Q4-Winter	1.49E+00	5.99E-01	2.489	0.01280	***
Age	-5.91E-02	2.27E-02	-2.609	0.00908	***
Mins-Per-Day	-2.91E-02	9.17E-03	-3.166	0.00154	***

Notes: Significant if. codes: 0.001 '***' 0.005 '**' 0.01 '*. n: 343

Table 3. Net Cost saving calculation

Net Cost Savings Per Additional Average Daily Therapy Minute	
Coefficient of (Mins-Per-Day)	-0.0291
Cost per rehospitalization	$15,500
Rehospitalization risk of the cohort	11.100%
Reduction in rehospitalization risk per average daily minute	
1 - (e^ -0.0291)	2.868%
Reduction in rehospitalization cost per average daily minute	$ 49.35
Labor cost per minute per day	$ 1.30
Rounded average length of stay days of the cohort	24
	$ 31.20
Net Cost Savings (2021 price level)	**$ 18.15**

Discussion

The empirical estimation conducted in this study finds average daily therapy minutes (Mins-Per-Day) to be the most important predictor of rehospitalization likelihood as expected. We believe therapy minutes represent unobserved factors of the Skilled Nursing Facility (SNF) short-term rehabilitation patient such as motivation, medical stability, and a patient's compliance with their treatment plan. These factors combine to influence the outcome and are quantified in the average daily therapy minutes.

There was no other study that uses the relative level of participation in SNF rehabilitation interventions to predict the outcome of 30-day rehospitalizations after discharge to home. However, two relevant studies, Middleton et al., (2018) and Freburger et al. (2020), contain supportive information for our findings. Middleton et al., (2018) found that higher functional outcome measures of mobility, selfcare, and cognition at the end of SNF rehab stays were associated with decreased incidences of preventable readmissions. These functional outcomes are primary targets of rehab interventions; therefore, are facilitated by increased therapy minutes. In addition, Freburger et al., (2020), demonstrated that increased number of therapy visits in the acute hospital setting were associated with reducing 30-day readmissions and mortality for patients discharged to the community. Both studies make the case for participation in rehabilitative services to decrease the likelihood of rehospitalizations.

As demonstrated in Table 3, there is a probability of net cost savings of $18.15 for every additional therapy minute provided per day. The estimated $49.35 reduction in rehospitalization cost is found by multiplying three factors: the cost of $15,500 per Medicare hospital readmission found by Weiss and Jiang, (2021), the mean rehospitalization rate of 11.1% of this cohort, and the 2.868% reduction in rehospitalization risk found in this study. The labor cost per therapy minute ranges from $0.97 to $1.30 (Mastrangelo, 2019). Using the top of this range multiplied by the rounded average length of stay of 24 days in this study, the estimated increased labor cost per additional daily therapy minute provided is $31.20. The difference of $18.15 (estimated at 2021 price level) per daily minute demonstrates a higher provision of therapy does contribute to the more efficient utilization of Medicare funds in the SNF setting.

Conclusion: The long-standing role of the Skilled Nursing Facility of promoting hospital bed availability and lowering healthcare cost has been brought to the forefront in recent years. The Affordable Care Act pursued the more efficient use of the United States healthcare dollar by

enacting penalties for 30-day hospital readmissions. This led to increased accountability for Skilled Nursing Facilities because so many of the high healthcare expenditure Medicare beneficiaries are discharged to them for short-term rehabilitation. Recently, Medicare changed its reimbursement for short-term rehab patients in Skilled Nursing Facilities due to concerns of over-incentivizing the provision of physical, occupational, and speech therapy services. This study demonstrates the importance of daily therapy minutes to reduce the likelihood of rehospitalization after the hospital discharge. Further, this study finds a probable net cost savings of $18.15 for each additional therapy minute provided. If increasing therapy minutes reduces healthcare expenditures and lower therapy participation indicates increased rehospitalization risk, a policy action must be taken.

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