By Jianhui Hu, Meredith D. Gonsahn, and David R. Nerenz

DOI: 10.1377/hlthaff.2013.0816
HEALTH AFFAIRS 33,
NO. 5 (2014): 778–785

Socioeconomic Status And Readmissions: Evidence From An Urban Teaching Hospital

Jianhui Hu (jhu1@hfhs.org) is a research associate at the Center for Health Policy and Health Services Research, Henry Ford Health System, in Detroit, Michigan.

Meredith D. Gonsahn was a research associate at the Center for Health Policy and Health Services Research, Henry Ford Health System, at the time of this research. She is now a study coordinator at the Atlanta Veterans Affairs Medical Center, in Georgia.

David R. Nerenz is director of the Center for Health Policy and Health Services Research, Henry Ford Health System.

ABSTRACT The Centers for Medicare and Medicaid Services (CMS) Hospital Readmissions Reduction Program has focused attention on ways to reduce thirty-day readmissions and on factors affecting readmission risk. Using inpatient data from an urban teaching hospital, we examined how elements of individual characteristics and neighborhood socioeconomic status influenced the likelihood of readmission under a single fixed organizational and staffing structure. Patients living in high-poverty neighborhoods were 24 percent more likely than others to be readmitted, after demographic characteristics and clinical conditions were adjusted for. Married patients were at significantly reduced risk of readmission, which suggests that they had more social support than unmarried patients. These and previous findings that document socioeconomic disparities in readmission raise the question of whether CMS's readmission measures and associated financial penalties should be adjusted for the effects of factors beyond hospital influence at the individual or neighborhood level, such as poverty and lack of social support.

The Affordable Care Act established the Hospital Readmissions Reduction Program, under which the Centers for Medicare and Medicaid Services (CMS) began to reduce payments to hospitals with excess thirty-day readmissions. The penalties currently apply to three conditions: acute myocardial infarction, heart failure, and pneumonia. By 2015 they will be expanded to cover readmissions associated with acute exacerbation of chronic obstructive pulmonary disease and elective total hip arthroplasty and total knee arthroplasty.[1]

The program has received a great deal of attention and has been controversial. One key debate about the policy revolves around the absence of any adjustment for the patients' socioeconomic status when the readmission rates are calculated.[2–5]

CMS's rationale for not adjusting for patients' socioeconomic characteristics is that differences in the quality of care received by groups of patients of different socioeconomic status can contribute to readmissions. Therefore, hospitals should not be held to different standards of care based on the demographic characteristics of their patients, and specifically should not be held to lower standards for socioeconomically disadvantaged populations.[6–8] CMS has cited guidance from the National Quality Forum in support of this position.[8]

However, some stakeholder groups and scholars have expressed concern that the current CMS policy would disproportionately affect hospitals that provide care to patients of low socioeconomic status.[2,4,9] They argue that the policy assumes that readmissions are a result of poor-quality care, but instead readmissions are driven largely by patients' circumstances after discharge, such as lack of social support at home

or in the community, and are therefore outside the control of hospitals.[2]

Determinants of hospital readmission have been well studied in a variety of patient populations admitted for different conditions. Factors that have been found to influence readmissions include patients' demographic characteristics and clinical conditions,[10–18] communities' characteristics,[19–23] and practice patterns.[20,24]

The association between patients' socioeconomic status and readmission has been investigated in several studies.[25–27] A recent review[28] found that low education and low income were often associated with an increased risk for readmission among patients with heart failure or community-acquired pneumonia. In another study, Alicia Arbaje and colleagues[26] found that having limited education was associated with sixty-day readmission rates among community-dwelling Medicare beneficiaries.

Previous readmission studies have used large data sets with information from many hospitals.[11,14,19,20] However, few of them have identified and controlled for various hospital-specific factors that might be related to readmission, such as staffing, organizational structure, discharge-planning protocols, and role in an integrated system.[18] Therefore, the studies may not be able to separate the impact of such factors from the effects of patients' socioeconomic status.

In contrast, studies using a single hospital's data on readmissions can eliminate variations in practice patterns across hospitals and examine the effects of patients' socioeconomic status under a single fixed organizational and staffing structure. But many of the studies that used data from a single hospital had problems with small sample sizes.[29] Patients' readmission information that is available from a single hospital may also be incomplete because of an inability to include data on patients whose readmission was at a different hospital or hospital network.[27,30]

The current study used data from a single hospital in an integrated health system, but with a comparatively large population size and a data set containing readmissions to all hospitals within thirty days after discharge. Our aim was to better understand how various socioeconomic factors influenced the probability of readmission.

Study Data And Methods

DATA This retrospective cohort study used data from Henry Ford Hospital, an 802-bed teaching hospital in Detroit. The hospital has a closed, salaried staff model: All admitted patients are cared for by members of the Henry Ford Medical Group (which includes a strong hospitalist component) using a single electronic health record system and a standard discharge planning process.

We identified all Medicare fee-for-service beneficiaries ages sixty-five and older who were discharged from the hospital during 2010. We excluded from the study patients who died in the hospital; were discharged against medical advice; and were admitted for medical treatment of cancer, with a primary diagnosis of psychiatric disease, or for rehabilitation care such as the fitting of prostheses and adjustment devices.

Each patient's demographic information (age, sex, and race), marital status, street address, and clinical (diagnosis) data for all hospitalizations during the study period were obtained from the Corporate Data Store, Henry Ford Hospital's central repository for patient encounter data. Each patient's address was then geocoded to the Census Block Group level and mapped to data from the 2000 census to obtain the following socioeconomic characteristics of the patient's neighborhood: the percentage of families with incomes below the federal poverty level, median household income, and percentage of the population older than twenty-five without a high school diploma.

Data on readmissions were obtained from a CMS "dry run report"—that is, a data file distributed to the hospital for review that contained hospital-specific data CMS used to produce quality measures—for a hospital-wide all-cause unplanned readmission measure, which included all unplanned thirty-day readmissions to any hospital for patients discharged from Henry Ford Hospital in 2010. This readmission file was then checked and reconciled with the Corporate Data Store records.

VARIABLES The dependent variable used in this study was thirty-day readmission. This variable was analyzed at two levels: admission and patient. In the admission-level analysis, a binary variable was created indicating whether or not the index, or original, admission was followed by a thirty-day readmission. Definitions of *index admission* and *readmission* are those used in the CMS all-cause unplanned readmission measure; details are available in the online Appendix.[31]

In the patient-level analysis, we used two readmission variables. One was a binary variable indicating whether or not a patient had at least one thirty-day readmission in the year. The other was an ordered categorical variable indicating whether a patient had zero, one, or more thirty-day readmissions.

Our key independent variables were three variables related to neighborhood socioeconomic

status: poverty, education, and median household income. For each of the variables, we divided the patients into three groups of equal size and categorized them as living in neighborhoods of high, medium, or low socioeconomic status. We then created a binary variable for each socioeconomic factor to compare patients living in neighborhoods with low socioeconomic status to other patients.

For example, a patient was assigned to a high-poverty neighborhood if he or she lived in a neighborhood where the percentage of families living below poverty was high (compared to the medium- and low-poverty groups). Similarly, a patient was assigned to a low-income neighborhood if he or she lived in a neighborhood where the household income was low (compared to the medium- and high-income groups).

We also included the following independent variables: age, age squared,[32] sex, race, and marital status. Age was created as a continuous variable; sex, race, and marital status were coded as binary variables, with female, nonblack, and not currently married as the reference groups. Patients who were not currently married were those who were single, divorced, widowed, or legally separated. To account for differences in patients' clinical characteristics, in all regression models we adjusted both for patients' discharge conditions and for comorbidities identified from the index and historical admission records. Detailed risk adjustment methods are presented in the online Appendix.[31]

STATISTICAL ANALYSES We used multivariate logistic regressions to examine the associations between thirty-day readmissions and patients' and neighborhoods' characteristics. Readmission analyses are usually conducted using hospital admission as the study unit because clinical risk adjustment is done at this level. However, socioeconomic status is a relatively stable factor, at both patient and neighborhood levels. We also observed that some patients had more than one readmission (in some cases, as many as eight) in a year. We were interested in exploring the influence of socioeconomic status on a patient's having multiple readmissions in a year. Therefore, we ran multivariate logistic regressions at both the admission and patient levels.

We first examined the effects of poverty, education, and household income by adding these variables to a base model (controlling for age, age squared, sex, race, and marital status, and adjusting for clinical risk factors) one at a time. Individual socioeconomic factors were correlated with each other.[33] Therefore, to further examine the effects of different socioeconomic factors (with others' presence in the model) in explaining readmissions, we included all three in a last multivariate model.

Socioeconomic disparities in readmission risk exist even after variations in practice patterns across hospitals have been eliminated.

Finally, in our patient-level analysis, we ran multivariate models using ordered logistic regressions on a three-level outcome variable: whether the patient had zero, one, or more thirty-day readmissions.

LIMITATIONS Our study had several limitations. First, the generalizability of our results may be limited because our data came from one hospital. However, we identified all readmissions to other hospitals.

Second, our risk adjustment calculation used one year's historical inpatient diagnoses from hospitals in the Henry Ford Health System only. CMS has demonstrated that using inpatient data only (as compared to using both inpatient and outpatient data) would have minimal impact on the model's predictive ability.[7] However, we could have missed some relevant diagnosis information if the patient was admitted to one or more hospitals outside of the system during the study period. Therefore, we might have underestimated the severity of patients' illnesses. If that was the case, however, we do not expect that it would substantially change our estimates.[34]

Third, because data were not available, we were unable to include some important factors related to postdischarge clinical care and community support. Previous studies[26,35] have suggested that patients who lack access to important resources—such as transportation, primary care, and caregivers to help with activities of daily living—after discharge are more likely to have early hospital readmissions. However, we included patients' marital status as a proxy for social support.

Study Results

There were 7,845 hospitalizations among Medicare fee-for-service patients ages sixty-five and

older in 2010. We excluded patients who died in the hospital, were discharged against medical advice, and were hospitalized for certain special treatments, leaving us with 6,762 hospitalizations. After adjustments for minor discrepancies between the CMS and Henry Ford data, our final study cohort consisted of 6,832 eligible index admissions for 4,646 unique patients (details about our inclusion and exclusion criteria and the study population are available in the online Appendix).[31] We successfully matched 98.5 percent of patients' street addresses to Census Block Groups. Rates of missing data for poverty, education, and household income variables were 1.55 percent, 1.53 percent, and 1.49 percent, respectively.

We analyzed patients' characteristics at both the individual and the neighborhood levels, using patient's residence (Exhibit 1). Eighty percent of the 4,646 patients had no thirty-day readmissions during the year, and 5 percent had multiple readmissions. The mean age of all patients was seventy-seven, and black patients made up the majority of the cohort. On average, patients lived in neighborhoods where nearly 30 percent of people ages twenty-five and older lacked a high school diploma, 17 percent of households had incomes below poverty, and the median household income was about $38,000.

The most common discharge condition was nonhypertensive congestive heart failure (7 percent). Common comorbidities included coronary atherosclerosis or angina, cerebrovascular disease (48 percent), diabetes (37 percent), specified arrhythmias (24 percent), coronary obstructive pulmonary disease (15 percent), and acute renal failure (14 percent). Details of the prevalence of clinical conditions are available in the online Appendix.[31]

Male, black, and currently unmarried patients were more likely to have at least one readmission than female, nonblack, and currently married patients (Exhibit 1). A larger proportion of patients residing in neighborhoods with low education had at least one readmission, compared to those living in other neighborhoods. The same was true for patients residing in neighborhoods with high poverty and low household income. The prevalence of all common comorbidities was higher among patients who had a readmission than among those who did not (data not shown).

INDIVIDUAL SOCIOECONOMIC VARIABLE EFFECTS The results of the multivariate logistic regression analysis on readmissions are presented in Exhibit 2. Results for all discharge conditions and comorbid risk factors are available in the online Appendix.[31] Across the three socioeconomic factors, older and male patients were significantly more likely to be readmitted within thirty days after discharge than younger and female patients, while currently married patients were significantly less likely to be readmitted than patients who were not married.

The presence or a history of some diseases was significantly associated with readmission (data not shown). Patients discharged with congestive heart failure and acute myocardial infarction and those with certain comorbidities—including cancers, end-stage liver disease, acute renal failure, and malnutrition—were at significantly higher risk of being readmitted than patients without those conditions or comorbidities.

The three socioeconomic variables were all significantly associated with patients' having at least one thirty-day readmission (Exhibit 2). For example, patients living in a high-poverty neighborhood were 28 percent more likely to be readmitted than those living elsewhere.

COMBINED SOCIOECONOMIC VARIABLE EFFECTS The result of the final model, using all three socioeconomic factors, shows which one was most predictive of thirty-day readmission risk (Exhibit 2): Patients living in high-poverty

EXHIBIT 1

Characteristics Of Medicare Fee-For-Service Patients Ages Sixty-Five And Older Discharged From The Henry Ford Hospital In 2010, By Number Of Thirty-Day Readmissions

		Number of readmissions		
Characteristic	**All**	**0**	**1**	**>1**
Number	4,646	3,708	697	241
PATIENT-LEVEL CHARACTERISTICS				
Mean age (years)	77.1	77.0	77.7	76.7
Sex (%)***				
Male	44.0	77.4	17.0	5.6
Female	56.0	81.7	13.5	4.8
Race (%)***				
White	35.4	82.5	13.7	3.8
Black	60.6	78.1	15.8	6.1
Other	4.0	81.2	14.5	4.3
Marital status (%)***				
Married	43.6	81.9	14.1	4.0
Other[a]	56.4	78.2	15.7	6.1
COMMUNITY-LEVEL CHARACTERISTICS				
Education (% of population ages >25)				
Less than high school****	28.5	28.0	29.6	31.6
Bachelor's degree or above****	13.0	13.4	11.5	11.6
Households with income below poverty level (%)****	17.2	16.7	19.2	20.3
Median household income ($)****	37,683	38,417	35,359	33,062

SOURCE Authors' analysis of inpatient data extracted from Henry Ford Hospital's electronic health record systems and a CMS dry run report for the hospital-wide all-cause unplanned readmission measure, 2010. **NOTES** Overall differences between readmission groups were tested by chi-square tests (categorical variables) and one-way analysis of variation (continuous variables). Community is Census Block Group. [a]Single, divorced, widowed, or separated. ***$p < 0.01$ ****$p < 0.001$

EXHIBIT 2

Multivariate Associations Of Patients' Characteristics With Thirty-Day Readmissions, Analyzed By Admission

	Model									
	Base (*n*=6,832)		Poverty (*n*=6,732)		Education (*n*=6,733)		Household income (*n*=6,735)		Poverty, education, and income (*n*=6,732)	
Characteristic	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age (in years)	1.28**	1.11, 1.48	1.30**	1.13, 1.51	1.29**	1.12, 1.49	1.30**	1.12, 1.50	1.30**	1.13, 1.50
Male	1.35**	1.18, 1.54	1.34**	1.18, 1.53	1.34**	1.18, 1.53	1.34**	1.18, 1.53	1.34**	1.17, 1.53
Black	1.07	0.93, 1.23	1.00	0.87, 1.16	1.05	0.91, 1.21	1.03	0.89, 1.19	1.00	0.86, 1.16
Married	0.77**	0.67, 0.87	0.79**	0.69, 0.91	0.78**	0.68, 0.89	0.78**	0.69, 0.90	0.80**	0.70, 0.91
Living in a neighborhood with:										
High poverty	—[a]	—[a]	1.28**	1.11, 1.47	—[a]	—[a]	—[a]	—[a]	1.24**	1.05, 1.47
Low education	—[a]	—[a]	—[a]	—[a]	1.15**	1.00, 1.31	—[a]	—[a]	1.05	0.90, 1.22
Low household income	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	1.18**	1.03, 1.35	1.02	0.85, 1.21

SOURCE Authors' analysis of inpatient data extracted from Henry Ford Hospital's electronic health record system and a CMS dry run report for the hospital-wide all-cause unplanned readmission measure, 2010. **NOTES** An odds ratio (OR) of less than 1 means a negative relationship, and an odds ratio of greater than 1 means a positive relationship, between the predictor and the readmission risk. For each of the neighborhood socioeconomic factors, we split the patients into three equal groups (for details, see the text) and compared patients living in the neighborhoods with low socioeconomic status to patients living in the other neighborhoods. We controlled for age, age squared, sex, race, and marital status, and adjusted for clinical risk factors. In all models, odds ratios for age squared were 0.99 and were significant ($p < 0.05$). CI is confidence interval. [a]Not applicable. **$p < 0.05$

neighborhoods were 24 percent more likely than other patients to be readmitted.

Exhibit 3 presents the results of patient-level regressions, using both a binary variable and a three-level categorical outcome readmission variable. Results based on patients were almost identical to those based on admissions. For example, patients living in neighborhoods with higher poverty rates had greater odds of being readmitted within thirty days.

EXHIBIT 3

Multivariate Associations Of Patients' Characteristics With Thirty-Day Readmissions, Analyzed By Patient

	Number of readmissions			
	0 versus >0		0, 1, or >1	
Characteristic	OR	95% CI	OR	95% CI
Age (in years)**	1.24	1.04, 1.48	1.23	1.03, 1.47
Male**	1.32	1.12, 1.57	1.29	1.09, 1.52
Black	0.96	0.80, 1.16	0.96	0.80, 1.15
Married**	0.79	0.67, 0.94	0.77	0.65, 0.91
Living in a neighborhood with:				
High poverty**	1.34	1.07, 1.67	1.32	1.07, 1.64
Low education	0.96	0.78, 1.17	1.00	0.82, 1.22
Low household income	1.03	0.82, 1.30	1.01	0.81, 1.26

SOURCE Authors' analysis of inpatient data extracted from Henry Ford Hospital's electronic health record system and a CMS dry run report for the hospital-wide all-cause unplanned readmission measure, 2010. **NOTES** An odds ratio (OR) of less than 1 means a negative relationship, and an odds ratio of greater than 1 means a positive relationship, between the predictor and the readmission risk. For an explanation of the neighborhood socioeconomic factors, see the notes to Exhibit 2. In all models, odds ratios for age squared were 0.99 and were significant ($p < 0.05$). CI is confidence interval. **$p < 0.05$

Discussion

Using inpatient data from an urban teaching hospital, this study showed significant associations between socioeconomic variables and thirty-day readmissions for patients discharged from the hospital. After we controlled for patients' demographics and clinical conditions, we found that patients living in neighborhoods with high poverty, low education, and low household incomes were at greater risk of being readmitted when we analyzed the effects of the three socioeconomic factors individually. When we combined the three factors, we found that patients living in high-poverty neighborhoods were more likely to be readmitted than those living in lower-poverty neighborhoods.

Our finding was similar to that of another single-hospital study that also had data on readmissions to other hospitals. Ruben Amarasingham and colleagues developed prediction models using 1,372 admissions to Parkland Memorial Hospital in Dallas, Texas.[13] They were able to identify readmissions to any of the 136 hospitals in the Dallas–Fort Worth region. They found that residence in a census tract in the lowest socioeconomic quintile was related to increased risk of thirty-day readmission.

Findings from a single hospital are not necessarily generalizable to other settings. However, our findings are informative and add to the sparse empirical evidence that socioeconomic disparities in readmission risk exist even after variations in practice patterns across hospitals have been eliminated.

Our socioeconomic variables were measured

The mechanism by which residing in a poor neighborhood increases the risk of readmission is complex.

at the neighborhood level rather than individual level. The effects of these variables, then, may reflect neighborhood-level phenomena including the availability of public transportation; availability of resources such as grocery stores and pharmacies; the presence of social support, including connections among neighbors; and health-related features of the built environment such as the age of the housing stock. The distinction between individual-level and neighborhood-level socioeconomic effects is an important one[36,37] that deserves additional exploration in the context of hospital readmissions and other health care quality metrics.

The mechanism by which residing in a poor neighborhood increases the risk of readmission is complex. One explanation may be that living in a poor neighborhood makes it more difficult to access community resources and primary or postdischarge care services.

Studies have suggested that poor patients often use emergency departments (EDs) as a place to access primary care.[38,39] An additional examination of inpatient admission source in our data set showed that 84 percent of patients were admitted through the ED (as opposed to elective or urgent admissions through the admitting office). In addition, consistent with previous studies,[40] we found that patients from poor neighborhoods were more likely than other patients to be admitted through the ED.

However, including the source of admission did not affect the results or conclusions in any of our regression models. Source of admission was not an independent predictor of readmission, and the same variables that were identified as significant predictors emerged from regression models with and without source of admission as a potential predictor.

Another noteworthy finding of our study was the association between patients' marital status and readmission: Across all models, patients who were currently married were less likely to be readmitted than patients who were not married. Previous studies have reported mixed results regarding the effect of marital status on readmission.[17,27,28] This is especially true when potentially confounding factors such as living arrangement (for example, living alone) and socioeconomic status were also considered.[26,30]

Our final combined model showed that being married and level of neighborhood poverty were both significantly associated with thirty-day readmission. This suggests that marital status might reflect social and emotional support factors that are independent determinants of readmission not fully explained by neighborhood characteristics.

The use of readmission rate as a quality metric and a basis for financial penalties to hospitals assumes that readmissions are a result of poor-quality care. Whether this and similar quality measures should be adjusted for social, as well as clinical, factors is still being debated.[2–8]

Resolution of the debate would seem to require that consensus be reached on three separate points. First, are a set of demographic and socioeconomic factors empirically associated with risk of readmission at the level of the patient? Second, do some hospitals treat a disproportionate share of patients who are at higher risk for readmission? Third, should hospitals be responsible for taking actions to address socioeconomic disparities in risk of readmission—and if they should be, is there a limit on what they should do? The first two questions can be answered empirically; the third is a matter of social policy.

The present study adds to the empirical foundation for this discussion. Socioeconomic factors at the patient and community levels were related to the probability of readmission, even in a data set in which potentially relevant factors such as hospital medical staff structure, health record system, nurse staffing, and discharge planning resources were controlled for.

At Henry Ford Hospital, evidence-based and standardized clinical protocols have been adopted or developed by medical staff, and systems are in place to monitor compliance with the adopted protocols on both an inpatient and outpatient basis. Patients with the same clinical conditions but varying demographic and socioeconomic characteristics would have been treated in the same inpatient units, by the same physicians and nursing staff, with the same health record system and discharge planning processes. The effects of demographic and socioeconomic variables were not confounded with variations in hospital resources.

At the same time, though, the hospital has programs and services designed to address special needs related to sociodemographic charac-

teristics. Over the years, special programs such as medication assistance and language services have been developed. The hospital has offered these programs to low-income patients or patients with limited English proficiency to improve their medication adherence and foster self-care in disease management, which may decrease their readmission risk. Expanded use of community health workers has been part of a strategy to reduce readmissions, admissions in general, and ED visits. In 2009 the hospital initiated a three-year Healthcare Equity campaign, with the goals of increasing knowledge and awareness of health care disparities and opportunities to improve health care equity; and ensuring that the quality of care provided does not vary by personal characteristics such as race, sex, geographic location, and socioeconomic status. The associations reported here occurred in spite of efforts to prevent readmissions in general and to reduce disparities in readmission rates.

Conclusion

Current risk adjustment models used for measures such as hospital readmission include clinical variables such as comorbidity and disease severity. This reflects the belief that hospitals and other providers should not be held accountable for the effects of those factors on quality measures such as readmission. The question of whether hospitals should be held accountable for the effects of factors such as poverty, illiteracy, lack of proficiency in English, or lack of social support in the patients and communities they serve has not yet been resolved. The present findings underscore the importance of reaching consensus on this issue and, if appropriate, modifying the risk-adjustment models, associated penalties, or both. ■

The authors thank Brian Ahmedani for very helpful comments on an early version of this article.

NOTES

1 Centers for Medicare and Medicaid Services. Medicare program; hospital inpatient prospective payment systems for acute care hospitals and the long term care; hospital prospective payment system and fiscal year 2014 rates; quality reporting requirements for specific providers; hospital conditions of participation; payment policies related to patient status: final rule. Federal Register [serial on the Internet]. 2013 Aug 19 [cited 2014 Mar 20]. Available from: http://www.gpo.gov/fdsys/pkg/FR-2013-08-19/pdf/2013-18956.pdf

2 Joynt KE, Jha AK. A path forward on Medicare readmissions. N Engl J Med. 2013;368(13):1175–7.

3 Krumholz H. Harlan Krumholz on hospital readmissions. Incidental Economist [blog on the Internet]. 2013 Feb 5 [cited 2014 Mar 14]. Available from: http://theincidentaleconomist.com/wordpress/harlan-krumholz-on-hospital-readmissions/

4 Frakt A. Hospital readmissions summary comments. Incidental Economist [blog on the Internet]. 2013 Jan 26 [cited 2014 Mar 14]. Available from: http://theincidentaleconomist.com/wordpress/hospital-readmissions-summary-comments/

5 Flansbaum B. "Readmits are not a quality measure": Q&A with Harvard's Ashish Jha MD, MPH. Doctor Weighs In [blog on the Internet]. 2013 Mar 18 [cited 2014 Mar 14]. Available from: http://www.thedoctorweighsin.com/readmits-are-not-a-quality-measure-qa-with-harvards-ashish-jha-md-mph/

6 Suter LG, Vellanky S, Li S-X, Strait K, Eddy E, Okai M, et al. Medicare hospital quality chartbook 2012: performance report on outcome measures. Baltimore (MD): Centers for Medicare and Medicaid Services; 2012 Sep.

7 Horwitz L, Partovian C, Lin Z, Herrin J, Grady J, Conover M, et al. Hospital-wide all-cause unplanned readmission measure: final technical report. Baltimore (MD): Centers for Medicare and Medicaid Services; 2012 Jul.

8 Bernheim SM, Grady JN, Spivack S, Bartczak K, Bhat KR, Desai MM, et al. 2012 measures maintenance technical report: acute myocardial infarction, heart failure, and pneumonia 30-day risk-standardized readmission measure. Baltimore (MD): Centers for Medicare and Medicaid Services; 2012 Apr 12.

9 National Association of Urban Hospitals. The potential impact of the Affordable Care Act on urban safety-net hospitals. Sterling (VA): The Association; 2012.

10 McAdams-Demarco MA, Grams ME, Hall EC, Coresh J, Segev DL. Early hospital readmission after kidney transplantation: patient and center-level associations. Am J Transplant. 2012;12(12):3283–8.

11 Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. N Engl J Med. 2009; 360(14):1418–28.

12 Shulan M, Gao K, Moore CD. Predicting 30-day all-cause hospital readmissions. Health Care Manag Sci. 2013;16(2):167–75.

13 Amarasingham R, Moore BJ, Tabak YP, Drazner MH, Clark CA, Zhang S, et al. An automated model to identify heart failure patients at risk for 30-day readmission or death using electronic medical record data. Med Care. 2010;48(11):981–8.

14 Joynt KE, Orav EJ, Jha AK. Thirty-day readmission rates for Medicare beneficiaries by race and site of care. JAMA. 2011;305(7):675–81.

15 Hannan EL, Racz MJ, Walford G, Ryan TJ, Isom OW, Bennett E, et al. Predictors of readmission for complications of coronary artery bypass graft surgery. JAMA. 2003;290(6): 773–80.

16 Allaudeen N, Vidyarthi A, Maselli J, Auerbach A. Redefining readmission risk factors for general medicine patients. J Hosp Med. 2011;6(2): 54–60.

17 Garrison GM, Mansukhani MP, Bohn B. Predictors of thirty-day readmission among hospitalized family medicine patients. J Am Board Fam Med. 2013;26(1):71–7.

18 Vest JR, Gamm LD, Oxford BA, Gonzalez MI, Slawson KM. Determinants of preventable readmissions in the United States: a systematic review. Implementation Sci. 2010; 5:88.

19 Aranda JM Jr, Johnson JW, Conti JB.

Current trends in heart failure readmission rates: analysis of Medicare data. Clin Cardiol. 2009;32(1): 47–52.
20 Lindenauer PK, Lagu T, Rothberg MB, Avrunin J, Pekow PS, Wang Y, et al. Income inequality and 30 day outcomes after acute myocardial infarction, heart failure, and pneumonia: retrospective cohort study. BMJ. 2013;346:f521.
21 Shier G, Ginsburg M, Howell J, Volland P, Golden R. Strong social support services, such as transportation and help for caregivers, can lead to lower health care use and costs. Health Aff (Millwood). 2013; 32(3):544–51.
22 Weaver C, Schiech L, Held-Warmkessel J, Kedziera P, Haney E, DiLullo G, et al. Risk for unplanned hospital readmission of patients with cancer: results of a retrospective medical record review. Oncol Nurs Forum. 2006;33(3):E44–52.
23 Schwarz KA. Predictors of early hospital readmissions of older adults who are functionally impaired. J Gerontol Nurs. 2000;26(6):29–36.
24 Epstein AM, Jha AK, Orav EJ. The relationship between hospital admission rates and rehospitalizations. N Engl J Med. 2011;365(24): 2287–95.
25 Weissman JS, Stern RS, Epstein AM. The impact of patient socioeconomic status and other social factors on readmission: a prospective study in four Massachusetts hospitals. Inquiry. 1994;31(2):163–72.
26 Arbaje AI, Wolff JL, Yu Q, Powe NR, Anderson GF, Boult C. Postdischarge environmental and socioeconomic factors and the likelihood of early hospital readmission among community-dwelling Medicare beneficiaries. Gerontologist. 2008; 48(4):495–504.
27 Moore CD, Gao K, Shulan M. Racial, income, and marital status disparities in hospital readmissions within a veterans-integrated health care network. Eval Health Prof. 2013 Jun 27. [Epub ahead of print].
28 Calvillo-King L, Arnold D, Eubank KJ, Lo M, Yunyongying P, Stieglitz H, et al. Impact of social factors on risk of readmission or mortality in pneumonia and heart failure: systematic review. J Gen Intern Med. 2013;28(2):269–82.
29 For example, the fifteen single-hospital studies reviewed by Calvillo-King and colleagues (see Note 28) had sample sizes ranging from 54 to 1,372 patients, with a mean sample size of 379.
30 Donzé J, Aujesky D, Williams D, Schnipper JL. Potentially avoidable 30-day hospital readmissions in medical patients: derivation and validation of a prediction model. JAMA Intern Med. 2013;173(8): 632–8.
31 To access the Appendix, click on the Appendix link in the box to the right of the article online.
32 The effect of age is often nonlinear. For instance, the risk of readmission can increase at an accelerated rate until, say, age seventy-five and then increase at a decelerated rate after that. Therefore, we included an age squared variable. A significant age squared variable indicated that the effect of age was nonlinear.
33 The correlation coefficients between socioeconomic measures were 0.58 between poverty and education, −0.66 between poverty and income, and −0.65 between income and education; all were significant ($p < 0.001$). We checked collinearity diagnostics, including variance inflation factor and eigensystem analysis of correlation matrix. No multicollinearity problem was detected.
34 As a sensitivity check, we used discharge codes for diagnosis-related groups of index admissions only as our clinical risk adjuster. The results were similar.
35 Kangovi S, Grande D. Hospital readmissions—not just a measure of quality. JAMA. 2011;306(16):1796–7.
36 Winkleby MA, Cubbin C. Influence of individual and neighbourhood socioeconomic status on mortality among black, Mexican-American, and white women and men in the United States. J Epidemiol Community Health. 2003;57(6):444–52.
37 Diez Roux AV, Merkin SS, Arnett D, Chambless L, Massing M, Nieto FJ, et al. Neighborhood of residence and incidence of coronary heart disease. N Engl J Med. 2001;345(2):99–106.
38 Cheung PT, Wiler JL, Lowe RA, Ginde AA. National study of barriers to timely primary care and emergency department utilization among Medicaid beneficiaries. Ann Emerg Med. 2012;60(1):4–10.
39 O'Brien GM, Stein MD, Zierler S, Shapiro M, O'Sullivan P, Woolard R. Use of the ED as a regular source of care: associated factors beyond lack of health insurance. Ann Emerg Med. 1997;30(3):286–91.
40 Stern RS, Weissman JS, Epstein AM. The emergency department as a pathway to admission for poor and high-cost patients. JAMA. 1991; 266(16):2238–43.