Medical Care Research and Review
69(5) 602–616

DOI: 10.1177/1077558712448467
http://mcr.sagepub.com
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Congestive Heart Failure: Who Is Likely to Be Readmitted?

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Abstract

Readmission for congestive heart failure (CHF) is the most common reason for readmission among Medicare fee-for-service patients. Yet CHF readmissions are not just a Medicare problem. This study examined who is likely to be readmitted for CHF, using all-payer hospital discharges from 14 of the states participating in the Healthcare Cost and Utilization Project. Patients with the strongest positive association with readmission were discharged against medical advice, covered by Medicaid, and had more severe loss of function and certain comorbidities such as drug abuse, renal failure, or psychoses. Weak negative relationship between readmission and cost of index admission provides some evidence that hospitals with higher readmission rates do not systematically use fewer resources in treating patients in initial encounters. High readmission rate for Medicaid patients suggests that state and federal governments should target Medicaid populations and drug abuse treatment for better care coordination to reduce readmissions and health care costs.

Keywords

congestive heart failure, readmissions, all payers, Medicaid, Medicare, against medical advice, cost of index admission

This article, submitted to *Medical Care Research and Review* on October 19, 2011, was revised and accepted for publication on April 12, 2012.

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Hospital readmissions are a drain on the health care system. Although some hospital readmissions are unavoidable because of the natural course of disease and treatment, many may be avoidable (Chin & Goldman, 1997; Krumholz et al., 1997; Medicare Payment Advisory Commission, 2010; Vinson, Rich, Sperry, Shah, & McNamara, 1990). Multiple factors may contribute to the return of the patient to the hospital: patient comorbidities, patient noncompliance with medication therapy, inadequate treatment at initial hospitalization, failures in discharge planning, or severe progressive illness. Other factors include access to quality outpatient care and social support systems. Hospital readmissions may adversely affect payer and provider costs and patient morale.

Congestive heart failure (CHF) is the leading cause of hospital readmission among patients covered by fee-for-service Medicare (Jencks, Williams, & Coleman, 2009), and it is the third most common cause of any hospitalization among all patients (Agency for Healthcare Research and Quality, 2010). The nation's inpatient hospital bill for CHF was $10.7 billion in 2008 (HCUPnet, 2011). Thus, reducing CHF hospital readmissions represents an opportunity to reduce health care costs while increasing the quality of patient care.

Payers are increasingly focused on how to reduce hospital admissions (Jencks et al., 2009; Ross et al., 2010). A proposed change in Medicare policy would penalize hospitals with high rates of readmissions (Medicare Payment Advisory Commission, 2010); however, the issue of readmissions for CHF patients is not limited to Medicare. Because of the impending Medicare policy change and expected similar actions by other payers, we want to understand which types of patients across payers are likely to be readmitted for CHF. A relevant question for payers relates to efficiency of care. Do hospitals with more readmissions spend less on initial care? If the answer is yes, a change in policy to restrain readmissions might be offset by increased cost of admissions after the policy change.

New Contribution

Despite a growing interest in CHF readmission rates, little information is available on readmission rates for all patients, regardless of payer. The Healthcare Cost and Utilization Project (HCUP) is a family of all-payer databases from across the nation that can be used to study hospital issues, patient characteristics, and the cost of inpatient care. Because of the ability to link patients across time within some states, HCUP is ideal for studying readmissions. No studies have analyzed CHF readmissions across all payers; studies on Medicare readmissions have been limited to fee-for-service Medicare, and few studies have focused on the association between cost of index admission and the likelihood of CHF readmission. We undertook this study to fill these gaps in the existing literature.

Method

Data Sources

This is a cross-sectional analysis that tracks readmissions across the calendar year 2006 using data from two HCUP databases: the State Inpatient Databases (SID) for 14 states with reliable synthetic person identifiers (Arizona, Arkansas, California, Florida, Massachusetts, Missouri, Nebraska, Nevada, New Hampshire, North Carolina, South Carolina, Tennessee, Utah, and Washington) and a special file for determining readmissions for 2006, as explained below (HCUP Supplemental Variables for Revisit Analyses, 2011).

Patients in this analysis were aged 18 years or older and had a CHF index admission between January 1 and November 30, 2006; they may or may not have had a readmission within the 30 days following the discharge day of their index admission (between January 2 and December 31, 2006). CHF was identified by principal diagnoses using ICD-9-CM codes: 398.91, 428.0, 428.1, 428.20, 428.21, 428.22, 428.23, 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42, 428.43, and 428.9. The analysis excluded patients for whom the index event involved a heart transplant procedure, a transfer in or out of the hospital, a surgical treatment (identified by an All-Patient-Refined Diagnosis Related Groups [APR-DRG]), or a death in the hospital.

Analysis

Multilevel hierarchical logistic models (HLMs; Houchens, Chu, & Steiner, 2007) were used to assess groups of factors associated with the odds of readmission: patient, hospital, and community characteristics and the cost of an index admission. The HLM controlled for the clustering of patients within hospitals. Community descriptors served as proxies for personal attributes that could not be measured directly (e.g., income and education).

The dependent variable in the model distinguished patients with a readmission for a principal diagnosis of CHF within 30 days of index CHF discharge (coded as 1) and patients without such a readmission (coded as 0). Because of confidentiality restrictions that removed dates from HCUP files, special variables were used to track patients across time and hospital settings. These included (a) a synthetic person identifier that was consistent statewide and examined for reliability and completeness, (b) a random start number assigned to each patient to enable counts of days for readmission analyses, and (c) a discharge-specific days-to-event timing variable assigned to each discharge record to enable day calculations within the stay, such as length of stay. Using these variables, days between hospitalizations were calculated for each patient to assign them to the 30-day readmission or non-readmission group (HCUP Supplemental Variables for Revisit Analyses, 2011).

Patient characteristics included patient sociodemographics (age, sex, and expected primary payer)[1] and patient clinical factors (discharge disposition, a list of comorbidities unrelated to CHF; Elixhauser, Steiner, Harris, & Coffey, 1998), and APR-DRG Severity of Illness subclasses. APR-DRGs are an extension of the basic DRG structure applicable to all patients, not just Medicare patients. Within individual APR-DRGs, patients are classified into one of four severity-of-illness subclasses reflecting loss of function (minor, moderate, major, or extreme) according to clinical logic that includes interactions of multiple comorbidities, age, procedure, and principal diagnosis (Averill et al., 2003). For the models of this study population, the APR-DRG severity classes relate to the principal diagnosis of CHF.

Hospital characteristics included number of inpatient beds (less than 100, 100-199, 200-499, 500 or more), hospital ownership/control (private investor owned, government nonfederal, and private not for profit), teaching status (teaching[2] or nonteaching), and hospital location (state of location and metropolitan, micropolitan, or other area in which hospital was located).

Community characteristics differentiated patients by likely wealth and education based on their communities (quartile of median household income of patient's ZIP code, and quartile of percentage of community with high school degree (U.S. Census Bureau, 2012)).

To measure cost of index admission, we converted charges for each stay to estimated costs using cost-to-charge ratios at the hospital level for the year 2006 (Agency for Healthcare Research and Quality, 2011). This was necessary because the SID contains data on total charges for each hospitalization, which is the amount that a hospital billed for care, not the actual cost of those services. The cost-to-charge ratios enable this conversion. Costs in this study reflect the hospital's expenses incurred in the production of services, but do not include professional fees separately billed by physicians. Average cost per stay was categorized by hospital quartile (less than $3,542 for the lowest 25% of hospitals; $3,542-$5,294; $5,295-$8,131; and $8,131 and more for the most costly 25% of hospitals).

To understand the sensitivity of patient traits to controls for other factors (hospital and community), we tested four HLMs with successive blocks of variables that represented patient traits (Model 1); patient and hospital attributes (Model 2); patient, hospital, and community characteristics (Model 3); and patient, hospital, community, plus cost of index admission factors (Model 4). The Model 4 addition of the cost of index admission was done to determine whether or not hospitals with high readmissions were associated with low cost of index admissions. Cost of index admission also could reflect the severity of index admission, because complicated cases should stay longer and cost more. We did not include both cost and length of stay because they are highly correlated.

Results

Descriptive Statistics

Simple descriptive comparisons of CHF readmission rates by patient characteristics (Table 1) reveal that readmission rates were notably higher for CHF patients discharged against medical advice (double the rate for routine discharges), for Medicaid CHF patients (nearly double the rate for privately insured patients and 50% higher than Medicare), and for CHF patients with specific comorbidities (drug abuse, AIDS, and psychoses). Readmission rates were higher for CHF patients who are younger than 65 years of age compared with older patients. However, readmission rates were not very different across the quartiles of cost at index admission.

Table 1. Congestive Heart Failure Patient Readmission Rates at 30 Days After Index Discharge by Patient, Hospital, and Community Characteristics and Cost at Index Admission

	Rates	Standard Deviation
Patient characteristics		
Age group		
<65 years	11.58	31.99
65-85 years	9.44	29.24
>85 years	8.47	27.85
Gender		
Male	10.49	30.64
Female	8.79	28.32
Expected primary payer		
Medicare	9.34	29.10
Medicaid	14.22	34.92
Private	7.61	26.52
Self-pay/uninsured	10.66	30.86
Other	10.29	30.39
Discharge status		
Routine and destination unknown	9.55	29.39
Transfer to other type of facility	8.27	27.55
Home health care	10.32	30.43
Against medical advice	20.03	40.03
APR DRG: Severity of illness		
Minor	8.51	27.90
Moderate	9.56	29.40
Major	10.07	30.10
Extreme	9.87	29.83
Comorbidities		
Paralysis	7.88	26.94
Other neurological disorder	8.23	27.49
Diabetes without chronic complications	10.43	30.56
Diabetes with chronic complications	10.40	30.53
Hypothyroidism	9.25	28.98
Renal failure	11.41	31.80
Liver failure	11.28	31.64
Peptic ulcer disease	5.05	22.01
AIDS	14.71	35.46
Lymphoma	10.37	30.50
Metastatic cancer	6.93	25.40
Solid tumor withoht metastasis	8.88	28.45
Rheumatoid arthritis	7.68	26.62
Coagulopathy	9.53	29.37
Obesity	8.67	28.14
Weight loss	8.93	28.52
Fluid and electrolyte disorder	9.98	29.97
Chronic blood loss anemia	7.75	26.75
Alcohol disorder	11.35	31.72
Deficiency anemia	10.13	30.17
Drug abuse	17.85	38.30
Psychoses	11.98	32.47
Depression	9.45	29.25
Hospital characteristics		
Bed size		
1-199	8.94	28.53

(continued)

Table 1. (continued)

	Rates	Standard Deviation
200-299	9.43	29.22
300-499	9.70	29.60
500+	10.39	30.51
Ownership		
Private, investor owned (proprietary)	9.88	29.84
Government, nonfederal (public)	9.46	29.26
Private, not-for-profit (voluntary)	9.81	29.74
Teaching status		
Nonteaching	9.29	29.04
Teaching	10.15	30.2
State of hospital location		
California	10.08	30.11
Arkansas	10.39	30.52
Arizona	7.45	26.27
Florida	10.14	30.18
Massachusetts	9.97	29.96
Missouri	9.55	29.39
North Carolina	8.37	27.70
Nebraska	7.43	26.23
New Hampshire	9.07	28.72
Nevada	9.01	28.63
South Carolina	9.59	29.44
Tennessee	10.18	30.23
Utah	4.00	19.59
Washington	7.80	26.82
Area of hospital location		
Not micropolitan or metropolitan area	9.78	29.71
Micropolitan statistical area	8.94	28.53
Metropolitan statistical area	9.66	29.54
Community characteristics		
Percentage of community with high school degree (quartiles)		
Quartile 1, <79	10.56	30.74
Quartile 2, 79-85	9.24	28.95
Quartile 3, 85-88	9.64	29.52
Quartile 4, >88	8.79	28.32
Median Income of patient's ZIP code		
Lowest, <$37,000	10.03	30.04
Low, $37,000-$45,900	9.35	29.11
Moderate, $46,000-$60,900	9.45	29.25
Highest, >$61,000	9.16	28.84
Cost		
Cost at index admission		
<$3,542	9.83	29.77
$3,542-$5,295	9.44	29.23
$5,295-$8,131	9.53	29.37
≥$8,131	9.66	29.55

Note: APR DRG = All-Patient-Refined Diagnosis Related Groups.
Source: Agency for Healthcare Research and Quality, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, State Inpatient Databases, 14 States, 2006.

Multivariate Models

Table 2 contains results of the four multivariate models. Because the patient-level results dominated, because hospital and community characteristics (added in Models 2 and 3) themselves were unrelated to readmission odds, and because cost of index admission (added in Model 4) appears to capture some important differences between payer groups, we focus the description of results on Model 1 (patient only) and Model 4 (fully controlled including cost of index admission). We observed that several patient characteristics stand out with higher odds of being readmitted for CHF, with all else constant.

First, leaving the hospital against medical advice has the highest odds of readmission (about 1.9, $p < .001$) among the reasons for discharge at index admission, regardless of the controls included. The size of the effect is essentially unaffected by the inclusion of additional variables in other models.

Second, Medicaid coverage had the strongest association among payer groups with CHF readmissions, when other patient attributes were controlled; it remained the most important variable in the full model. However, the controls in the hospital, community, and cost models had an impact on the payer associations. With private insurance as the reference category, the odds of readmission for CHF patients covered by Medicaid were 1.7 ($p < .001$) before the community and cost-of-index-admission controls were added (odds were 1.3 with those controls). The Medicaid association with readmissions was much stronger than for Medicare coverage. Compared with privately insured patients, odds of readmission for Medicare patients ranged from 1.1 ($p < .01$) to 1.4 ($p < .001$), depending on the model.

Third, significant associations with readmissions existed for several clinical comorbidities, and those tended to be unaffected by the model specification (Table 2). Patients with a drug abuse comorbidity compared with those without such a comorbidity had the greatest positive association with readmissions (odds ratio [OR] = 1.6, $p < .001$) across the comorbidities. A "drug abuse diagnosis" may reflect prescription drug interactions or abuse. Other clinical comorbidities with large positive associations with readmissions were patients with renal failure (OR = 1.3, $p < .001$) and psychoses (OR = 1.2, $p < .01$). Clinical comorbidities with large negative associations with readmissions were patients with metastatic cancer (OR = 0.7, $p < .01$), obesity (OR = 0.8, $p < .001$), paralysis (OR = 0.8, $p < .01$), and rheumatoid arthritis (OR = 0.8, $p < .001$).

Fourth, patients in the CHF severity-of-illness classes (Table 2) of moderate, major, and extreme loss of function were associated with higher odds of readmission than those with minor loss of function. The "extreme loss of function" class had somewhat lower odds than the intermediate-loss groups; this may reflect fewer readmissions because more of the "extreme loss" patients may have died after the index admission, which is unobservable to this study.

Fifth, odds of readmission for female patients with CHF were lower (OR = 0.9, $p < .001$) compared with males (Table 2). Discharge to another institution (which includes nursing homes) was associated with lower odds of readmission for CHF (OR

Table 2. Hierarchical Logistic Model Odds Ratios: Association Between Readmissions Within 30 Days of Index Admission for Congestive Heart Failure Principal Diagnosis and Patient, Hospital, and Community Characteristics and Cost of Index Admission for Congestive Heart Failure

Variables	Model 1: Patient	Model 2: Patient, Hospital	Model 3: Patient, Hospital, Community	Model 4: Patient, Hospital, Community, Index Cost
Patient characteristics				
Age	0.992*	0.992	0.992	0.994
Age squared	1.000	1.000	1.000	1.000
Female (Reference = Male)	0.873***	0.875***	0.875***	0.877***
Expected primary payer (Reference = private insurance)				
Medicare	1.363***	1.348***	1.155***	1.055**
Medicaid	1.738***	1.720***	1.644***	1.321***
Uninsured	1.240***	1.217***	1.180**	0.939
Other	1.273***	1.260***	1.240***	0.977
Discharge status (Reference = Routine)				
Transferred to another facility	0.948*	0.946*	0.948*	0.964
Home health care	1.171***	1.163***	1.168***	1.183***
Against medical advice	1.963***	1.941***	1.938***	1.894***
APR DRG: Severity of illness (Reference = Minor loss of function)				
Moderate loss of function	1.133***	1.138***	1.148***	1.160***
Major loss of function	1.158***	1.165***	1.173***	1.205***
Extreme loss of function	1.100	1.106*	1.110*	1.152**
Comorbidities (Reference = Absence of specific comorbidity)				
Paralysis	0.792***	0.786***	0.800**	0.796**
Other neurological disorder	0.869***	0.866***	0.875***	0.868***
Diabetes without chronic complications	1.150***	1.144***	1.138***	1.135***
Diabetes with chronic complications	1.017	1.011	1.008	1.005
Hypothyroidism	1.050*	1.047	1.042	1.046
Renal failure	1.285***	1.289***	1.283***	1.281***
Liver failure	0.973	0.970	0.949	0.939
Peptic ulcer disease	0.513	0.512	0.529	0.448
AIDS	0.931	0.925	0.964	0.965
Lymphoma	1.112	1.108	1.097	1.095
Metastatic cancer	0.716***	0.714***	0.692***	0.709**
Solid tumor without metastasis	0.940	0.935	0.941	0.964
Rheumatoid arthritis	0.816***	0.814***	0.805***	0.793***
Coagulopathy	0.958	0.958	0.969	0.968
Obesity	0.778***	0.772***	0.770***	0.774***
Weight loss	0.950	0.951	0.972	0.959
Fluid and electrolyte disorder	1.046*	1.047*	1.054**	1.061**
Chronic blood loss anemia	0.819**	0.819**	0.863	0.880
Alcohol disorder	0.935	0.935	0.934	0.949

(continued)

Table 2. (continued)

Variables	Model 1: Patient	Model 2: Patient, Hospital	Model 3: Patient, Hospital, Community	Model 4: Patient, Hospital, Community, Index Cost
Deficiency anemia	1.020	1.011	1.012	1.010
Drug abuse	1.574***	1.568***	1.561***	1.567***
Psychoses	1.183***	1.175**	1.173**	1.163**
Depression	1.023	1.016	1.020	1.009
Hospital characteristics				
Bed size (Reference = 1-199)				
200-299		0.982	0.981	0.973
300-499		1.013	1.009	1.009
500+		1.040	1.028	1.029
Ownership (Reference = Private, investor owned (proprietary)				
Government, nonfederal (public)		0.978	0.981	0.981
Private, not-for-profit (voluntary)		0.968	0.977	0.976
Teaching status (Reference = Nonteaching)				
Teaching		1.023	1.023	1.019
Hospital location (Reference = Not micropolitan nor metropolitan)				
Micropolitan statistical area		0.912	0.978	0.979
Metropolitan statistical area		0.895	0.994	0.996
Community characteristics				
Median income of patient's ZIP code (Reference = Lowest < $37,000)				
Low, $37,000-$45,900			0.958	0.958
Moderate, $46,000-$60,900			0.983	0.990
Highest, >$61,000			0.981	0.980
Education				
Percentage of community with high school degree			0.991	0.991
Cost				
Cost at index admission (Reference = "< $3,542")				
$3,542-$5,295				0.964
$5,295-$8,131				0.922
≥$8,131				0.923***

Note: APR DRG = All-Patient-Refined Diagnosis Related Groups. Dichotomous variables for the 14 states in which the hospital was located were entered into the model but are not reported here.
Source: Agency for Healthcare Research and Quality, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, State Inpatient Databases, 14 States, 2006.
*$p < .05$. **$p < .01$. ***$p < .001$.

= 0.95, $p < .05$, except in Model 4 it was insignificant). Discharge to a home health care agency was associated with higher odds of readmission (OR = 1.2, $p < .001$).

Finally, the cost of treatment at the index CHF admission was weakly related to 30-day readmissions. Only the highest cost quartile (stays costing $8,131 and more) compared with the lowest quartile (stays costing less than $3,542) showed any statistically significant difference with the proportion readmitted for CHF and the associated odds ratio was negative (OR = 0.9, $p < .001$), so that the highest cost CHF index cases had lower odds of readmission than the lowest cost CHF index stays (or inversely, the lowest cost index stays had higher odds of readmission).

Limitations

Our study is limited is several ways. It examined readmissions only for patients with CHF and is not necessarily generalizable to other conditions. It is based on data from 14 states and is not necessarily generalizable to all states. It relied on administrative data that have limited clinical detail to fully control for disease severity and limited personal data such as disability and living circumstances. It cannot observe deaths postdischarge within 30 days to exclude them. It adjusts for socioeconomic differences among patients indirectly with community proxies that include measurement error. It is an observational and cross-sectional analysis that can only determine association, not causality. Finally, cost of care in this study is limited to the inpatient setting; although hospital costs make up the largest proportion of total health care expenditure, the lack of follow-up data in outpatient, emergency department, and long-term care settings limits the conclusions we can draw about whether follow-up care reduces readmissions.

Discussion

Medicaid Effects on Hospital Readmissions

Our study suggests that Medicaid readmissions for CHF are much higher than Medicare and that this differential persists even when clinical and other patient factors are controlled. Others have found higher readmission rates for Medicaid compared with privately insured patients with diabetes (Jiang, Stryer, Friedman, & Andrews, 2003), ambulatory care sensitive conditions (Friedman & Basu, 2004), and all-cause readmissions (Jiang & Wier, 2010).

The large Medicaid effects might be related to the culture of how Medicaid patients interact with the health care system, especially seriously ill patients. Gawande (2011) has described anecdotes—social anthropological observations—of medical personnel who have followed Medicaid patients with serious medical problems in their interactions with the health system. With limited social support, employment, and personal resourcefulness, some patients may get trapped in a cycle of admission and readmission. They may not follow discharge instructions after leaving the hospital. They may have reduced energy to take care of themselves and address their health problems. They may not comply with medication, exercise, and diet therapy. They may also have disabilities, mental illness, and/or substance abuse disorders that impede their recovery from physical diseases. The Medicaid-Medicare dually eligible population, many of whom have disabilities and behavioral health disorders, accounted for 15% of the Medicaid population but 39% of the Medicaid expenditures in 2007 (Kaiser Commission on Medicaid and the Uninsured, 2011).

Cost of an Index Admission

Regarding our assessment of hospital decisions to limit resources for initial admissions, we expected that the current fixed payment policy per hospitalization that allows full payments for readmissions may create incentives for hospitals to deliver care that is less than adequate on first admission. If this were the case, the new CMS policy to reduce payments to hospitals on 30-day readmissions (set for FY 2013; Medicare Payment Advisory Commission, 2010; Patient Protection and Affordable Care Act of 2010) might be offset by a substitution of higher cost initial stays after the policy goes into effect, as hospitals aim to minimize patient returns within 30 days. However, we found that the likelihood of CHF readmission bears little relation to the cost of the patient's index admission. The average cost differential of the index stay between patients with and without 30-day readmissions for CHF was only about $20 and the odds of readmission for the highest cost quartile compared with the lowest cost quartile was only slightly lower (OR = 0.92, $p < .001$).

Chen et al. (2009), who examined the cost of index admissions at the hospital level for hospitals grouped by cost-per-stay quartiles, found larger association of index admission costs on CHF 30-day readmissions for Medicare fee-for-service patients (18% higher odds of readmission for the lowest cost hospital group compared with the highest cost hospital group). Our HLM analysis with index cost quartiles at the patient level and applied to only Medicare patients (including Medicare Advantage patients) showed an odds difference of 14.8% in CHF 30-day readmission rates between Medicare patients in the lowest cost-of-index-admission group and those in the highest group. Methods could account for this lower result in our patient-level analysis: (a) inclusion of Medicare Advantage patients may include patients with fewer chronic conditions and thus fewer readmissions and (b) controlling for clustering of patients among hospitals.

The influence of the index cost effect with other variables leaves unclear whether the index cost is capturing patient severity-of-illness effects or quality-of-care effects. The negative association of index cost with readmissions suggests that the index cost is not capturing patient severity-of-illness effects (i.e., higher index costs did not imply higher readmissions); rather, the negative direction suggests weak quality-of-care effects in hospitals (i.e., lower index costs or shorter index stays implied later readmissions). On the one hand, the severity-of-illness effect became stronger, not weaker, when cost of index admission was included, and the comorbidity effects were unchanged. On the other hand, the diminished payer effects when cost of index admission was included could either signal that the cost of index admission represented an additional dimension of severity or reflected differential reimbursement levels among payers.

Future Research Needs

Although our analysis suggests a profile of patients likely to return to the hospital after an admission for heart failure, it is not a complete picture—nor does it answer questions of why such readmissions occur and what can be done to avoid them. More research is needed to answer these questions in the context of guiding the health care system on how to reduce admissions.

The information that can be derived from large databases (such as HCUP) enables a perspective that cannot be gleaned from individual hospital studies or clinical trials. Despite the main limitation of administrative claims-based databases—lack of specific clinical data to describe patients' conditions in detail—such databases offer valuable clinical insights. In the future, when more clinical detail can be captured, they may help explain inconsistent findings of smaller studies. In the meantime, large multistate databases can put the smaller studies into context by describing a framework of many subpopulations that have and have not been addressed in interventional, experimental studies.

Beyond the topic of congestive heart failure, large multistate databases can easily explore other conditions. A set of analyses similar to ours for conditions that have high readmission rates is needed. Such analyses should help hospitals and the health care system as a whole to know which clinical services to target for reducing readmissions and which subgroups of their patients to target for high readmission risk interventions.

For understanding the "whys" of readmissions, a framework of factors potentially related to readmissions should be developed. Such factors should include ineffective treatment protocols, medical errors and omissions, incomplete care transitions between providers, physicians' attitudes toward hospitalizing patients, lack of patient comprehension and compliance with medical regimens, normal progression of disease and comorbidities, patient preference for end-of-life treatment, socioeconomic circumstances that act as barriers to access to care and recovery from illness, and (soon) limits on payment for readmissions, among others factors. Research that attempts to measure these factors and assess their relative impacts on readmissions would help health care providers to understand how to prioritize their efforts to reduce admissions. Furthermore, research should be conducted on the most effective locations for intervening to reduce hospital admissions. Should such education occur in hospitals or in ambulatory care settings of physician offices, clinics, nursing homes, home health agencies, specialty provider settings, and social service agencies, in order to help patients think about alternatives to inpatient services?

Beyond identifying who readmitted patients are and why they are readmitted, researchers need to identify effective interventions to reach and influence those who are frequently readmitted. Reviews of interventions for managing readmissions show varying results. A systematic review of studies of patient predictors of readmission for heart failure concluded that patient predictors were not consistent across studies (Ross et al., 2008), suggesting that different factors may influence readmissions in different patient populations. A clearer link between interventions and populations for which they are most effective is needed. With that, a return-on-investment calculator based on a meta-analysis of the literature could be developed to guide hospitals and other points of service in the health care system on how to curb readmissions for specific populations. Alternatively, a systematic review can identify the gaps in effective interventions for specific populations—gaps that call for new interventions and evaluations.

Acknowledgments

We would like to thank Minya Sheng for her programming support.

Author's Notes

The analysis included data from the following HCUP Partner organizations: Arizona Department of Health Services, Arkansas Department of Health, California Office of Statewide Health Planning & Development, Florida Agency for Health Care Administration, Massachusetts Division of Health Care Finance and Policy, Missouri Hospital Industry Data Institute, Nebraska Hospital Association, New Hampshire Department of Health & Human Services, Nevada Department of Health and Human Services, North Carolina Department of Health and Human Services, South Carolina State Budget & Control Board, Tennessee Hospital Association, Utah Office of Health Care Statistics, and Washington State Department of Health. The views expressed in this article are those of the authors and do not necessarily reflect those of the Agency for Healthcare Research and Quality or the U.S. Department of Health and Human Services.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for research, authorship, and/or publication of this article:
This work was funded by Agency for Healthcare Research and Quality.

Notes

1. Race/ethnicity was not available for all states in this study.
2. A teaching facility was defined as having an approved American Medical Association accredited graduate medical education program, being a member of the Council of Teaching Hospitals (COTH), or having a ratio of full-time-equivalent interns and residents to beds of 0.25 or higher.

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