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The Price of Bouncing-Back: One Year Mortality and Payments for Acute Stroke Patients with Thirty Day Bounce-Backs

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Abstract

Background—“Bounce-backs” (movements from less intensive to more intensive care settings) soon after hospital discharge for acute stroke are common, but the long-term costs and mortality consequences associated with bouncing-back remain unknown.

Objective—To examine one year mortality and healthcare payments of stroke patients experiencing zero, one and ≥ 2 bounce-backs within thirty days of discharge.

Design—Retrospective analysis of administrative data

Setting—422 hospitals, southern and eastern United States

Participants—11,729 Medicare beneficiaries ≥ 65 years surviving at least thirty days with acute ischemic stroke in 2000

Analysis—One year mortality and predicted total healthcare payments were calculated using log normal parametric survival analysis and quantile regression, respectively. Models included sociodemographics, prior medical history, stroke severity, length of stay and discharge site.

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Author's Contributions

Amy Kind and Maureen Smith were active in study concept and design, analysis and interpretation of data and preparation/revision of manuscript. Jinn-Ing Liou was involved in data analysis and revision of manuscript. Nancy Pandhi was active in revision of manuscript. Jennifer Frytak and Michael Finch participated in acquisition of data and revision of manuscript.

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Conflicts of Interest

None of the authors report a conflict of interest.

Results—Crude survival at one year for the zero, one and ≥ 2 bounce-back groups was 83%, 67% and 55% respectively. As compared to the zero bounce-back group, the one bounce-back group had a 49% decrease (Time Ratio [TR] = 0.51, 95% CI = 0.46, 0.56) and the ≥ 2 bounce-back group had a 68% decrease in adjusted one year survival time (TR = 0.32, CI = 0.27, 0.38). For both high and low cost patients, adjusted predicted payments increased with each additional bounce-back experienced.

Conclusion—Acute stroke patients experiencing bounce-backs within thirty days have strikingly poorer survival and higher healthcare payments over the subsequent year than their counterparts with no bounce-backs. Bounce-backs may potentially serve as a simple predictor for identifying stroke patients at extremely high risk for poor outcomes.

Keywords

stroke; patient discharge; survival; health insurance reimbursement; patient readmission

INTRODUCTION

In the current system of specialized health care, patients with complex chronic health conditions like acute stroke often require care across multiple settings, resulting in numerous care transitions.¹ These patients are at risk for “bounce-backs” (i.e. “complicated transitions”), movement from a less intense to a more intense care setting (e.g. home to the hospital) soon after hospital discharge.² Patients who undergo multiple bounce-backs may signify potential health system failures and represent promising targets for improved quality of care.^{2, 3}

Stroke patients are at high risk for bouncing-back with 20% of acute stroke patients experiencing at least one bounce-back and 16% of those experiencing two or more bounce-backs within thirty days of hospital discharge.⁴ Stroke is the third leading cause of death in the United States, affecting approximately 700,000 people and costing \$57.9 billion annually.⁵ Despite this high bounce-back prevalence and overall cost, no studies have examined the long-term costs and mortality consequences associated with bouncing-back soon after hospitalization for acute stroke. A better understanding of these long-term costs and mortality consequences may allow for simple prospective identification of acute stroke patients at high risk for death and health care expenditure and enable targeted implementation of prevention efforts.

The objective of this analysis is to examine the relationship between bounce-backs in the first thirty days after acute stroke hospitalization and patient survival and payments over the subsequent year. We expect that the number of bounce-backs within the first thirty days is directly associated with poorer survival and higher payments over the subsequent year.

METHODS

Population and Sampling

We identified Medicare beneficiaries 65 years of age and older who survived thirty days after hospital discharge for acute ischemic stroke during the year 2000 in 11 metropolitan regions of the country. Patients were included in the sample if they had an International Classification of Diseases, 9th edition (ICD-9) diagnosis code of 434 or 436 in the first position on the discharge diagnosis list from an acute care hospitalization, which has been found to accurately identify acute ischemic stroke in 89–90% of cases.⁶ If a patient had more than one acute ischemic stroke discharge over the study period, one discharge was randomly selected as the index hospitalization. We chose a random hospitalization so that the index hospitalization would reflect a mix of first admissions and readmissions.

We obtained health maintenance organization (HMO) data from a large national managed care organization and fee-for-service (FFS) data from the Centers for Medicare and Medicaid Services (CMS). Our sample included 1594 HMO patients with acute ischemic stroke (from 422 hospitals) enrolled in 11 Medicare Plus Choice plans serving 93 metropolitan counties primarily in the eastern half of the United States. Comparable data were obtained for 10,135 FFS patients discharged with acute ischemic stroke from the same hospitals. The Institutional Review Board at the University of Wisconsin approved this study.

Data Extraction

We obtained enrollment data and final institutional and physician/supplier claims for all study patients from one year prior to their index hospital admission date to one year after their index hospital admission date. Both HMO and FFS patients had claims submitted using identical forms.^{7, 8} We also obtained all claims for HMO patients submitted to the HMO from out-of-network facilities. For all patients, we obtained the Medicare denominator file to determine age, gender, race, zip code, Medicaid enrollment and date of death. The file was complete for all subjects in the study. This file was used to exclude beneficiaries who had end-stage renal disease, were missing Medicare Part A or Part B coverage or received railroad retirement benefits.

Variables

The main explanatory variable was the number of bounce-backs within the first thirty days after hospital discharge for acute stroke. "Bounce-back" was defined as movement from a less intensive to a more intensive care setting. The hospital care setting was defined as the most intensive on the care spectrum, followed by emergency room (ER), then skilled nursing facility/rehabilitation center/long-term care, then home with home health care, and lastly home without home health care as the least intensive.²

We obtained initial discharge destination from facility and non-facility claims occurring within one day of index hospitalization discharge date. Using facility claims, we identified patients admitted to rehabilitation facilities (freestanding or inpatient unit) and skilled nursing facilities. We used the place of service code on subsequent physician claims to identify patients discharged to long-term care facilities. Remaining patients were categorized as either home with home care claims within thirty days after the stroke discharge date or home with no home care claims. Patients with ER visits or rehospitalization within thirty days of the index hospitalization discharge date were identified using subsequent facility claims. For each patient, all identified sites of care within thirty days of the index hospitalization discharge date were sequentially ordered by date of service. This ordering enabled examination for movement from a less intensive to a more intensive care setting (a bounce-back). Patients were grouped into categories of zero bounce-backs, one bounce-back, and two or more bounce-backs for analysis. Too few patients were present in the three or more bounce-backs category (n= 45) to allow for additional subgroups.

We included individual and neighborhood sociodemographic characteristics as control variables. Individual characteristics included age, gender, race, region, index hospitalization admit year, HMO membership and an indicator identifying beneficiaries with low to modest income who were fully enrolled in Medicaid or received some help with Medicare cost-sharing through Medicaid. Zip+4 data were used to link patient data to the corresponding Census 2000 block group and obtain neighborhood socioeconomic characteristics including percent over 24 years of age with college degree and percent below poverty line.⁹

Individual comorbidities and measures of stroke severity and initial stroke treatment were also included as control variables. We identified 30 comorbid conditions by incorporating

information from the index hospitalization, all hospitalizations during the prior year, and all physician claims during the prior year using methods proposed by Elixhauser, et al.,¹⁰ and Klabunde, et al.¹¹ Of these 30 conditions, we directly included the 12 comorbidities present in over five percent of our sample as indicator variables. An “other comorbidity count” was generated for the remaining conditions present in less than five percent of our sample. We also coded the following: hospitalization during the year prior to the index hospitalization, dementia,¹² stroke during the year prior to the index hospitalization¹³ and concurrent cardiac events (acute myocardial infarction, unstable angina pectoris, coronary artery bypass graft and cardiac catheterization). Additionally, the Centers for Medicare and Medicaid Services hierarchical condition categories (CMS-HCC) score for the year prior to admission was calculated for each subject and included in models as a comprehensive risk adjustment measure.¹⁴ Two validated indicator variables, mechanical ventilation¹⁵ and placement or revision of a gastrostomy tube,¹⁶ were used to represent disease severity during index hospitalization. Measures of initial stroke treatment included length of index hospital stay as measured in days and initial discharge site from index hospitalization.

Analysis

Kaplan-Meier graphs for patient groups with zero, one and two or more bounce-backs during the first thirty days were constructed to demonstrate crude one year inter-group survival differences. The relationship between the number of bounce-backs and one year survival for stroke patients alive thirty days post-discharge was estimated using log normal parametric survival analysis with calculation of unadjusted and adjusted time ratios (TR) and 95% confidence intervals (CI). A TR describes a group of interest’s survival as a percentage of a baseline group’s total survival time. Predicted unadjusted and adjusted percentiles of payments for 30 to 365 days after index hospitalization were calculated for each bounce-back group utilizing quantile regression.¹⁷ Percentiles were constructed at the 10%, 25%, 50%, 75% and 90% payment levels for the sample as a whole. This approach allows for the effect of bouncing-back within thirty days to be separately examined for patients at the lower and the higher ends of the cost spectrum.

Analyses were conducted using SAS version 8.0 (SAS Institute, Inc., Cary, NC) and Stata version 7.0 (StataCorp, LP, College Station, TX). All CIs and significance tests were significant at $P < 0.05$. For survival analyses, CIs were calculated using robust estimates of the variance that allowed for clustering of patients within hospitals. Ninety-five percent CIs around payment predictors were estimated using bootstrap techniques to replicate analyses 1000 times.¹⁸ Control variables included age (65–69 years, 70–74 years, 75–79 years, 80–85 years and 85+ years), gender, race (Caucasian, African American and Other), Medicaid, HMO membership, percentage of the census block group aged 25+ with college degrees, percentage of persons in the census block group below the poverty line, region, index hospitalization admit year, prior hospitalization, prior stroke, cardiac arrhythmias, congestive heart failure, chronic pulmonary disease, uncomplicated diabetes mellitus, complicated diabetes mellitus, hypertension, fluid and electrolyte disorders, valvular disease, peripheral vascular disorders, hypothyroidism, solid tumor without metastasis, deficiency anemias, depression, dementia, concurrent cardiac event, other comorbidity count, CMS-HCC score, initial index hospitalization discharge destination (skilled nursing facility/long-term care, rehabilitation center, home with home health care and home without home health care), length of index hospital stay, mechanical ventilation and presence of gastrostomy tube.

RESULTS

Descriptive Characteristics

Overall, stroke patients with any bounce-backs within the first thirty days tended to be African-American, on Medicaid and sicker (i.e. have significantly more gastrostomy tubes) when compared to those with zero bounce-backs (Table 1). Those with two or more bounce-backs within the first thirty days tended to be African-American (22%) and on Medicaid (22%); to live in census block groups with higher levels of poverty and lower levels of college degrees; to have been discharged to a skilled nursing/long-term care facility (40%); and to have longer lengths of stay for their initial hospitalization and higher rates of prior hospitalization (55%) than their counterparts with zero or one bounce-back. Stroke patients with two or more bounce-backs also tended to have higher prevalence of comorbidities and to have lower rates of discharge to a rehabilitation center (14%) than their counterparts with zero or one bounce-back.

Thirty day bounce-back destinations differed depending on the total number of bounce-backs (data not shown). 62.3% of stroke patients with one bounce-back in the first thirty days bounced-back to the hospital while 29.8% bounced-back to the ER, 6.3% bounced-back to a skilled nursing/long-term care facility and 1.6% bounced-back to home with home care. Of stroke patients with two or more bounce-backs, 67% of the bounce-back episodes were to the hospital, 31% to the ER, 2% to a skilled nursing/long-term care facility and less than 0.01% to home with home care services. Average index hospital lengths of stay for subjects discharged to home, home with home health care, rehabilitation facilities and skilled nursing facilities was 4.3 (± 3.8), 5.0 (± 4.0), 6.0 (± 4.5) and 6.7 (± 4.8) days, respectively ($p < 0.001$).

Thirty Day Bounce-Backs and One Year Mortality

One year survival for acute ischemic stroke patients differs depending on the number of bounce-backs the patient experiences within the first thirty days. Crude survival for each bounce-back group is demonstrated by the Kaplan-Meier curves shown in Figure 1, with survival decreasing significantly with each additional bounce-back experienced ($P < 0.0001$). At one year, 83% of the zero bounce-back group, 67% of the one bounce-back group and 55% of the two or more bounce-back group survive.

Crude and adjusted time ratios show a similar pattern of significantly decreasing survival with increasing bounce-back number (Table 2). When compared to the zero bounce-back group, the one bounce-back group (TR = 0.42, 95% CI = 0.37, 0.46) has a 58% decrease in crude survival time and the two or more bounce-back group (TR = 0.25, 95% CI = 0.21, 0.30) has a 75% decrease in crude survival time. When adjusted for all the control variables in our model, the one bounce-back group (TR = 0.51, 95% CI = 0.46, 0.56) and the two or more bounce-back group (TR = 0.32, 95% CI = 0.27, 0.38) continue to echo this relative survival pattern. Interpreted differently, the zero bounce-back group survived 1.96 times as long as the one bounce-back group and 3.13 times as long as the two or more bounce-back group.

Thirty Day Bounce-Backs and Health Care Payments

For low and high cost patients predicted one year payments were directly associated with bounce-back number, significantly increasing with each additional bounce-back experienced (Table 3). This pattern was consistent in both adjusted and unadjusted models. Specifically, for patients with zero bounce-backs, adjusted predicted payments ranged from \$1,667 at the 10th percentile to \$35,854 at the 90th. In contrast, patients with one bounce-back had payments ranging from \$2,726 to \$45,404 and patients with two or more bounce-backs had payments ranging from \$3,753 to \$53,766 at the 10th and 90th percentiles respectively. The absolute difference between the zero bounce-back group and the two or more bounce-back group was

greatest at the 90th percentile of payments (\$17,912). This represents a 50% absolute increase in one year payments between these two groups.

DISCUSSION

Bouncing-back within the first thirty days of hospital discharge for acute stroke is associated with decreased survival and increased total health care payments over the subsequent year. Acute stroke patients with bounce-backs within the first thirty days are more likely to die than their counterparts with no bounce-backs, with survival inversely related to bounce-back number. One year predicted payments increase with each additional bounce-back experienced.

There is evidence that some bounce-backs in acute ischemic stroke patients are preventable. When compared to those with only one bounce-back, stroke patients with multiple bounce-backs are distinguished primarily by sociodemographic factors, like African-American race, and not by medical factors.⁴ Additionally, the preventable post-stroke complications of aspiration and infection^{19, 20} are by far the most common primary diagnoses for early rehospitalization in stroke patients with thirty day bounce-backs.²¹ Modifications of the traditional hospital discharge process have been successful in reducing long-term rehospitalization rates.^{22–24} However, few preventive trials of this type have been done specifically targeting stroke patients. Interestingly, health system type (i.e. Medicare fee-for-service versus HMO) does not significantly impact bounce-back risk.⁴ Research is needed to determine whether the significant financial and mortality burdens associated with stroke bounce-backs during the first thirty days are modifiable through preventive efforts such as these.

Given the strong association observed in this study between the number of thirty day bounce-backs and one year payments and mortality, bounce-back number shows promise for serving as a simple prospective predictor for long-term outcomes in acute ischemic stroke patients who survive at least thirty days from their initial hospitalization. Considering the large annual mortality and financial burden of stroke,⁵ a simple predictive marker such as this could be highly useful, enabling clinicians to more easily understand mortality risks and administrators to identify patients at high risk for poor outcomes. Current stroke prognostic tools tend to be complicated and rely upon a number of clinical variables for their calculation.^{25–27} A patient's bounce-back number is easy to calculate by comparison and can be completely obtained from any of a variety of sources including patient history, medical chart review or administrative data. Additional studies are necessary to understand the sensitivity, specificity and predictive value of thirty day bounce-back number as a predictor of long-term stroke outcome.

In order to design effective efforts to prevent poor long-term stroke outcomes, the underlying mechanism connecting bounce-backs to increased one year mortality and payments needs to be understood. Interestingly, despite controlling for comorbidity, stroke severity and sociodemographic factors, bounce-back number continues to show strong association with one year mortality and payment outcomes. This may be evidence of unmeasured or residual confounding. Nevertheless, it is possible that the bounce-back itself is harmful. Prior studies have demonstrated that bounce-backs, such as a transition to or a stay in a hospital or ER, can adversely impact patient health.^{28–30} However, bounce-backs are likely a reflection of many difficult to measure factors, like social support, health care access or patient cultural factors, that may themselves impact patient survival and payments. A better understanding of this relationship may lead to more targeted and effective efforts designed to impact long-term stroke outcomes.

The limitations of this study arise primarily from limitations inherent to administrative data. This type of data provides no direct measures of patient preference, especially code status,

which likely influences bounce-back risk³¹ and is worthy of further study. Also, although valid,^{15, 16} our measures of stroke severity were limited to those factors obtainable via administrative data. This may have led to incomplete adjustment for differences in stroke severity. Additionally, in the absence of more definitive severity measures, it is impossible to comment on the appropriateness of patient discharge from the index hospitalization. Finally, our data set contained no measures of social support,^{32–34} post-stroke functionality^{35, 36} or inpatient care process,^{37–40} all of which have been shown to be important predictors of rehospitalization. Without more information on social support, post-stroke functionality and care process it is impossible for us to comment further on the underlying mechanism driving bounce-backs. However, as all of these factors likely impact bounce-back risk, a patient's thirty day bounce-back number may be an indirect measurement of these more difficult to quantify factors.

In conclusion, the strong association between the number of bounce-backs in the first thirty days and the mortality and payments over the subsequent year in acute ischemic stroke patients has important implications. If bounce-backs directly worsen long-term stroke survival and payments, prevention of bounce-backs could have a significant impact on the mortality and financial burdens associated with stroke. Secondly, bounce-back number has potential to be utilized as a simple, easily measured prognostic survival and payment marker in stroke. It may be appropriate to offer increased discharge and transitional care support and more in-depth advanced care planning to stroke patients with bounce-backs. Additional research is necessary both to understand the role of bounce-backs in these areas and to explore whether discharge or transitional care interventions can improve the health outcomes of stroke patients with bounce-backs.

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Figure 1.

Kaplan-Meier curve depicting one-year survival of acute ischemic stroke patients with 0, 1 and 2 or more bounce-backs within the first thirty days (N= 11,729). Time zero is discharge from index stroke hospitalization. To be included in the sample patients had to survive at least thirty days from discharge.

Table 1
Key Characteristics of Surviving Acute Stroke Patients with 0, 1 and 2 or More Bounce-Backs within the First Thirty Days*

Characteristic	0 Bounce-Backs (N=9,463)	1 Bounce-Back (N=1,907)	2 or More Bounce-Backs (N=359)	P-Value
<i>Sociodemographic</i>				
Average age in years (standard deviation)	79 (± 7.4)	80 (± 7.4)	79 (± 7.4)	0.016
65–69 years	11	10	10	
70–74 years	19	17	18	
75–79 years	23	23	23	
80–84 years	22	22	23	
>85 years	25	28	26	
Male	39	37	41	0.049
Caucasian	82	78	72	<0.001
African-American	14	17	22	<0.001
Other minority	4	5	6	0.073
Medicaid	15	19	22	<0.001
HMO member	14	14	14	0.86
Percent in block group below the poverty line (standard deviation)	11 (± 11)	12 (± 12)	13 (± 13)	0.001
Percent adults 25 and older in block group with college degree (standard deviation)	24 (± 17)	23 (± 16)	22 (± 16)	<0.001
<i>Index hospitalization</i>				
Length of stay in days (standard deviation)	5.3 (± 4.0)	6.4 (± 6.2)	6.5 (± 4.6)	<0.001
<i>Discharged from index hospital stay to:</i>				
Home	29	24	22	<0.001
Home with home health	21	20	24	
Rehabilitation center	21	18	14	
Skilled nursing facility or long-term care	29	38	40	
<i>Prior medical history</i>				
HCC score prior to index hospital discharge (standard deviation)	2 (± 1.2)	2 (± 1.3)	3 (± 1.4)	<0.001
Prior hospitalization	36	47	55	<0.001
Prior stroke	7	9	11	<0.001
Cardiac arrhythmias	36	39	41	0.007
Congestive heart failure	20	29	26	<0.001
Chronic pulmonary disease	18	22	24	<0.001

Characteristic	0 Bounce-Backs (N=9,463)	1 Bounce-Back (N=1,907)	2 or More Bounce-Backs (N=359)	P-Value
Diabetes mellitus, uncomplicated	23	25	25	0.17
Diabetes mellitus, complicated	8	8	11	0.018
Hypertension	76	78	79	0.138
Fluid and electrolyte disorders	20	28	33	<0.001
Valvular disease	15	17	20	0.002
Peripheral vascular disorders	14	17	14	<0.001
Hypothyroidism	13	13	11	0.391
Solid tumor without metastasis	13	13	16	0.114
Deficiency anemias	15	18	22	<0.001
Depression	9	11	12	0.004
Dementia	22	27	28	<0.001
Concurrent cardiac event	2	2	3	0.02
Other comorbidity count	0 (± 0.7)	1 (± 0.8)	1 (± 0.9)	<0.001
<i>Disease severity</i>				
Mechanical ventilation	1	2	1	0.589
Gastrostomy tube	5	9	9	<0.001
Mechanical ventilation and Gastrostomy tube	0.6	0.5	0	0.329

* values represent percents unless otherwise specified

HMO = health maintenance organization

HCC = hierarchical condition categories

Table 2

Adjusted Time Ratios and 95% Confidence Intervals for One Year Survival (N=11,729)

Number of Bounce-Backs Within the First 30 Days	Time Ratios			
	Unadjusted	95% CI	Adjusted*	95% CI
0 Bounce-Backs	1.00	---	1.00	---
1 Bounce-Back	0.42	(0.37, 0.46)	0.51	(0.46, 0.56)
2 or More Bounce-Backs	0.25	(0.21, 0.30)	0.32	(0.27, 0.38)

* adjusted for age, gender, race, Medicaid, HMO membership, percentage of the census block group aged 25+ with college degrees, percentage of persons in the census block group below the poverty line, length of index hospital stay, index hospitalization discharge site, CMS/HCC score prior to index hospital discharge, prior hospitalization, prior stroke, cardiac arrhythmias, congestive heart failure, chronic pulmonary disease, uncomplicated diabetes, complicated diabetes, hypertension, fluid and electrolyte disorders, valvular disease, peripheral vascular disorders, hypothyroidism, solid tumor without metastasis, deficiency anemias, depression, dementia, concurrent cardiac events, other comorbidity count, mechanical ventilation and gastrostomy tube.

CI = confidence interval

Table 3

Predicted Percentiles of Payments for Surviving Acute Stroke Patients with 0, 1 and 2 or More Bounce-Backs within the First Thirty Days (N=11,729)

Number of Bounce-Backs Within First Thirty Days	Adjusted Subsequent Year Payments in U.S. Dollars (30 – 365 days) *				
	10th Percentile (95% CI)	25th Percentile (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)
0 Bounce-Backs	1,667 (1,531, 1,755)	4,112 (3,914, 4,295)	9,767 (9,226, 10,058)	20,397 (19,710, 20,945)	35,854 (34,924, 36,995)
1 Bounce-Back	2,726 (2,518, 2,936)	5,996 (5,435, 6,473)	13,627 (12,861, 14,558)	26,694 (25,098, 28,750)	45,404 (42,512, 47,896)
2 or More Bounce-Backs	3,753 (2,858, 5,014)	9,639 (7,571, 11,772)	20,334 (18,514, 24,534)	38,402 (34,035, 43,171)	53,766 (48,724, 58,521)

* adjusted for age, gender, race, Medicaid, HMO membership, percentage of the census block group aged 25+ with college degrees, percentage of persons in the census block group below the poverty line, length of index hospital stay, index hospitalization discharge site, CMS/HCC score prior to index hospitalization, prior stroke, cardiac arrhythmias, congestive heart failure, chronic pulmonary disease, uncomplicated diabetes, complicated diabetes, hypertension, fluid and electrolyte disorders, valvular disease, peripheral vascular disorders, hypothyroidism, solid tumor without metastasis, deficiency anemias, depression, dementia, concurrent cardiac events, other comorbidity count, mechanical ventilation and gastrostomy tube.

CI = confidence interval