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Bouncing-Back: Rehospitalization in Patients with Complicated Transitions in the First Thirty Days After Hospital Discharge for Acute Stroke

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Abstract

BACKGROUND—“Bounce-backs” (movements from a less intense to a more intense care setting) soon after hospital discharge for acute stroke are common and are influenced by the initial discharge destination. However the reasons patients bounce-back from particular discharge settings remain unknown.

OBJECTIVE—To examine how the primary diagnosis for initial rehospitalization relates to thirty-day bounce-back number and initial hospitalization discharge destination in acute stroke patients

DESIGN—Retrospective analysis of administrative data

SETTING—422 hospitals, southern and eastern United States

PARTICIPANTS—5,250 Medicare beneficiaries ≥ 65 years discharged with acute ischemic stroke in 1998–2000 to a rehabilitation center, skilled nursing facility or home with home health care and with at least one thirty day rehospitalization.

ANALYSIS—Adjusted probabilities calculated using models which included age, sex, race, Medicaid/HMO status, census block group percentages for college education and poverty, prior hospitalization, prior stroke, comorbidities, stroke severity, length of stay and discharge site.

RESULTS—Infections and aspiration pneumonitis tended to be the most common reasons for rehospitalization after acute stroke, regardless of the initial discharge site, accounting for 15–43%

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of rehospitalizations depending on bounce-back category. Stroke patients initially discharged to skilled nursing facilities were the most strongly affected by these particular diagnoses (25–43%).

CONCLUSIONS—Aspiration pneumonitis and infections, the complications of immobility, are the most important reasons for thirty day rehospitalization in acute stroke patients. Prevention efforts specifically targeting populations at high risk for aspiration and infection may prove extremely valuable in decreasing bounce-backs.

Keywords

Transition; Stroke; Rehospitalization

INTRODUCTION

In the current system of specialized health care, patients with complex chronic health conditions like acute stroke often require care across multiple settings and experience numerous care transitions (Coleman, 2003). 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 (Coleman, Min, Chomiak & Kramer, 2004). Stroke patients are at especially high risk for bouncing-back with 20% of acute stroke patients experiencing at least one bounce-back and 16% of those experiencing more than one bounce-back within thirty days of hospital discharge (Kind, Smith, Frytak & Finch, 2006). Many of these bounce-backs are to the hospital (Kind, et al., 2006). A number of publications have examined factors influencing rehospitalization in acute stroke patients, including insurance type (Smith, Frytak, Liou & Finch, 2005), clinician specialty (Goldstein, Matchar, Hoff-Lindquist, Samsa & Horner, 2003, Mitchell, Ballard, Whisnant, Ammering, Samsa & Matchar, 1996, Smith, Liou, Frytak & Finch, 2006), initial discharge destination (Kind, et al., 2006), patient functional ability and race (Kind, et al., 2006, Ottenbacher, Smith, Illig, Fiedler, Gonzales & Granger, 2001). Yet few studies have examined specific rehospitalization diagnoses in acute stroke patients (Smith, et al., 2005, Smith, et al., 2006) and no studies have examined how initial discharge destination or number of thirty day bounce-backs relate to these diagnoses. A better understanding of this relationship may allow for the development of strategies to prevent or predict bounce-backs in acute stroke patients.

The goal of this study is to examine how the primary diagnosis for initial rehospitalization relates to thirty-day bounce-back number and initial stroke hospitalization discharge destination in acute stroke patients.

METHODS

Population and Sampling

We identified 5,250 Medicare beneficiaries 65 years of age and older discharged alive with acute ischemic stroke to a rehabilitation center, skilled nursing facility/long-term care or home with home health care during 1998–2000. Patients were from 11 metropolitan regions of the country (Smith, et al., 2005) and had at least one rehospitalization in the first thirty days after discharge. 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 (Benesch, Witter, Wilder, Duncan, Samsa & Matchar, 1997). If a patient had more than one acute ischemic stroke discharge over the study period, one discharge was randomly selected. This approach did not require analyses accounting for repeated observations on the same patient.

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 570 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 4,680 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 (Medicare/Medicaid Health Insurance Common Claim Form, 2002, National Uniform Billing Committee (NUBC), 1994). 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. 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 dependent variable was the primary diagnosis for the first rehospitalization within thirty days of discharge. Primary diagnoses for the first rehospitalization were categorized using Clinical Classification Software (Agency for Healthcare Research and Quality, 2003). The main explanatory variables were the number of bounce-backs within the first thirty days of acute stroke hospitalization and the acute stroke hospitalization discharge destination (i.e. rehabilitation center, skilled nursing facility or home with home health care). “Bounce-back” (i.e. complicated transition) was defined as movement from a less intense to a more intense care setting, with hospital being the most intense on the care spectrum, then emergency room (ER), followed by skilled nursing facility/rehabilitation center/long-term care, then home with home health care, and, finally, home without home health care as the least intense (Coleman, et al., 2004).

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 intense to a more intense care setting (a bounce-back). Patients were grouped into categories of one bounce-back and survived thirty days, one bounce-back and died within thirty days, and more than one bounce-back for analysis. Additional stratifications were not performed as too few patients were present in the ≥ 3 bounce-back category to allow for analysis.

We included individual and neighborhood sociodemographic characteristics as control variables. Individual characteristics included age, gender, race, 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 to obtain neighborhood socioeconomic characteristics including percent over 24 years of age with college degree and percent below poverty line (Krieger, Williams & Moss, 1997).

Individual comorbidities, length of index hospital stay and measures of stroke severity 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., (Elixhauser, Steiner, Harris & Coffey, 1998) and Klabunde, et al. (Klabunde, Potosky, Legler & Warren, 2000). Of these 30 conditions, we included the 12 comorbidities present in over 5% of our sample as explanatory variables. We also coded the following: hospitalization during the year prior to the index hospitalization, dementia (Pippenger, Holloway & Vickrey, 2001), stroke during the year prior to the index hospitalization (Samsa, Bian, Lipscomb & Matchar, 1999), 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 (Pope, Kautter, Ellis, Ash, Ayanian, Lezzoni, Ingber, Levy & Robst, 2004). Two validated indicator variables, mechanical ventilation (CPT 94656, 94657; ICD-9 96.7x) (Horner, Sloane & Kahn, 1998) and placement or revision of a gastrostomy tube (CPT 43750, 43760, 43761, 43832, 43246; ICD-9 43.11) (Quan, Parsons & Ghali, 2004), were used to represent disease severity during index hospitalization.

Analysis

For each thirty day bounce-back number and initial discharge destination combination, adjusted predicted probabilities were calculated for the primary diagnosis of the first rehospitalization. Analyses were conducted using SAS version 8.0 (SAS Institute, 2002) and Stata version 7.0 (Stata Corporation, 1999). Results of analyses are reported in adjusted probabilities and 95% confidence intervals (CI). All confidence intervals and significance tests were significant at $p < 0.05$ and were calculated using robust estimates of the variance that allowed for clustering of patients within hospitals. Models 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, length of index hospital stay, 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, mechanical ventilation and presence of gastrostomy tube.

RESULTS

Population Characteristics

Table 1 provides key characteristics of the acute stroke population studied stratified by thirty day bounce-back category (i.e. one bounce-back and survived thirty days, one bounce-back and died within thirty days and more than one bounce-back). Those with more than one bounce-back within the first thirty days were significantly more likely than the other two bounce-back groups to be African American (21%), have hypertension (78%) and fluid and electrolyte disorders (35%). Stroke patients with one bounce-back who died within thirty days of acute stroke discharge were significantly more likely to be older (averaging 83 years old), have a longer acute stroke hospitalization length of stay (average 8.64 days), have congestive heart

failure (39%) and chronic pulmonary disease (30%), have a higher HCC score, and were more apt to have been on mechanical ventilation (5%) and have had a gastrostomy tube (29%). They were less likely to be African American (13%). Stroke patients with one bounce-back who survived at least thirty days were generally younger and had fewer comorbidities. In all bounce-back groups the majority of stroke patients were initially discharged to skilled nursing facilities or long-term care. The group with one bounce-back who died within thirty days had the highest percentage of discharges to skilled nursing or long-term care facilities (71%).

Primary Diagnoses for First Rehospitalizations

Over the entire study sample, primary rehospitalization diagnoses differed slightly by bounce-back category (Table 2). Stroke patients with one bounce-back who survived thirty days and those with more than one bounce-back were most likely to be rehospitalized for infections and aspiration pneumonia, both with adjusted probabilities of 23% and 95% CI of (21.24, 24.56) and (19.75, 25.76) respectively. However, when these groups were compared to stroke patients with one bounce-back who died within thirty days, the stroke patients who died were significantly more likely to be rehospitalized for infections and aspiration pneumonia, with an adjusted probability of 38% (95% CI = 33.89-42.06). Heart disease was the second most common rehospitalization diagnosis for stroke patients with one bounce-back who survived thirty days and for those with multiple bounce-backs, both at 15%. For stroke patients with one bounce-back who died within thirty days, heart disease (12%), acute cerebrovascular disease (13%) and other respiratory and circulatory diseases (11%) were the next most common rehospitalization diagnoses.

Rehospitalization diagnoses differed depending upon the patient's acute stroke hospitalization discharge destination. Of acute stroke patients initially discharged home with home health care (Table 3), patients with one bounce-back who survived thirty days were most apt to be rehospitalized with infections and aspiration pneumonia (21%), followed by heart disease (16%). For patients with more than one bounce-back initially discharged home with home health care, heart disease (20%) and infections/aspiration pneumonia (15%) were also the most common rehospitalization diagnoses. Of stroke patients with one bounce-back who died within thirty days and who were initially discharged home with home health care, 30% of rehospitalizations were due to infections or aspiration pneumonia, while 17% were secondary to acute cerebrovascular disease.

For stroke patients initially discharged to rehabilitation centers (Table 4), infections and aspiration pneumonia were the most common rehospitalization diagnoses in all three bounce-back groups. For both the surviving one bounce-back group and the multiple bounce-back group, heart disease was the next most common reason for rehospitalization, while acute cerebrovascular disease was the second most common diagnosis observed for the one bounce-back and died group (19%).

Finally, stroke patients initially discharged to skilled nursing or long-term care facilities (Table 5) also experienced infections and aspiration pneumonia as the most common rehospitalization diagnoses. These particular diagnoses were significantly more common than all others over all bounce-back categories. When comparing between bounce-back categories in this discharge group, patients with one bounce-back who died were significantly more likely to have diagnoses of infections and aspiration pneumonia (43%) than their counterparts in the other two bounce-back categories.

Stroke patients surviving one bounce-back were very similar in their rehospitalization diagnoses to those with more than one bounce-back, regardless of discharge site. Confidence intervals for all diagnoses in these two bounce-back groups overlap.

DISCUSSION

In summary, infections and aspiration pneumonitis were the most common reasons for rehospitalization in stroke patients with at least one bounce-back to the hospital in the first thirty days after acute stroke hospitalization, regardless of the initial discharge site. However, infections and aspiration pneumonitis accounted for significantly more rehospitalizations in the group with one bounce-back who died within the first thirty days, and tended to account for more rehospitalizations for acute stroke patients initially discharged to skilled nursing facilities. Rehospitalizations for acute cerebrovascular disease were most common in the group with one bounce-back who died within thirty days of acute stroke hospitalization. Surviving one bounce-back stroke patients were very similar in their rehospitalization diagnoses to those with more than one bounce-back, regardless of discharge site.

Aspiration pneumonitis and infections are critically important diagnoses in acute stroke patients and one of the most common reasons for stroke mortality after hospitalization (Aslanyan, Weir, Diener, Kaste & Lees, 2004). It is well accepted that complications of immobility, like aspiration pneumonia and infections, account for as many as 51% of stroke deaths in the first thirty days (Bernhardt, Dewey, Thrift & Donnan, 2004). Our findings that these diagnoses were the primary reasons for bounce-backs to the hospital, therefore, agree well with the previous stroke literature in this regard. The high mortality rates accompanying aspiration pneumonia (Aslanyan, et al., 2004) likely also accounted for its significantly higher representation in the one bounce-back and died within thirty days category of patients. Overall, this particular bounce-back group was sicker with higher comorbidity burden and greater numbers of gastrostomy tubes. Gastrostomy tubes have high aspiration pneumonia complication rates (James, Kapur & Hawthorne, 1998). The high rate of gastrostomy tube use in the one bounce-back and died group likely at least partially accounts for the significant percentage of rehospitalizations for aspiration pneumonitis/infections in this particular group. By understanding the importance of aspirations and infections in stroke patient rehospitalization, strategies may be designed to prevent these conditions and, thus, potentially decrease bounce-backs.

We demonstrated that aspirations and infections caused the majority of rehospitalizations in skilled nursing and long-term care facility stroke patients. As these diagnoses are often the result of immobility (Bernhardt, et al., 2004, Stroke Unit Trialists' Collaboration (SUTC), 1997), they should be preventable to some degree. Stroke patients in skilled nursing and long-term care facilities may provide an excellent target group for universal aspiration pneumonitis and infection prevention efforts. Previous studies have demonstrated that neurology specialty and stroke unit care during an acute stroke hospitalization may decrease a stroke patient's subsequent risk for rehospitalization with infection or aspiration pneumonia, likely through the increased ordering of early mobilization and swallowing consultations (Smith, et al., 2006, Stroke Unit Trialists' Collaboration (SUTC), 1997). Targeted dysphagia programs, in particular, have been shown to substantially reduce pneumonia rates (Doggett, Tappe, Mitchell, Chapell, Coates & Turkelson, 2001). Further investigation into aspiration and infection prevention in acute stroke patients, and universal implementation of these preventive efforts in high risk settings, like skilled nursing and long-term care facilities, is needed.

Although infections and aspiration pneumonitis accounted for the majority of rehospitalizations in skilled nursing, long-term care and rehabilitation facility patients, each of these settings is well equipped to treat such medical disorders on-site, when not severe. Additionally, existing literature suggests an improved outcome for patients treated on-site (Dosa, 2005). While our data do not allow us to comment on medical appropriateness, it is reasonable to assume that some proportion of the observed rehospitalizations could have been treated on-site and, therefore, represent preventable bounce-backs. Unfortunately, the existing

U.S. health system incentive structure does not encourage on-site care for medical conditions that could be treated equally well in either the present sub-acute care setting or the hospital. There is little to no financial benefit and potential medical-legal risk to treating such patients on-site. Modifications to this incentive structure will play a critical role in any health policy strategy to reduce bounce-back rates.

The similarity of rehospitalization diagnoses regardless of initial discharge site supports the idea that post-acute care services may be interchangeable. However, this “interchangeability” concept remains controversial. Previous studies utilizing Medicare administrative data have supported the idea of interchangeability by noting that the choice of post-acute care service type depends more on region, availability and reimbursement form than on other factors (Buntin, Garten, Paddock, Saliba, Totten & Escarce, 2005, Kane, Lin & Blewett, 2002, Lin, Kane, Mehr, Madsen & Petroski, 2006). However, a number of stroke specific studies have found inpatient rehabilitation to result in superior patient outcomes when compared to other post-acute care settings (Deutsch, Granger, Heinemann, Fiedler, DeJong, Kane, Ottenbacher, Naughton & Trevisan, 2006, Kind, et al., 2006, Kramer, Steiner, Schlenker, Eilertsen, Hrinkevich, Tropea, Ahmad & Eckhoff, 1997). Continued research, including prospective randomized controlled trials, will be necessary before this debate reaches resolution.

Recurrent strokes were more strongly represented as a primary reason for rehospitalization in stroke patients with one bounce-back who died, than in any other bounce-back category. In patients with a previous ischemic stroke the 5 year risk for recurrent fatal stroke is 3.7% (Dhamoon, Sciacca, Rundek, Sacco & Elkind, 2006). However, within the first thirty days after an initial ischemic stroke, recurrent stroke has been demonstrated to cause 14% of all deaths (de Jong, van Raak, Kessels & Lodder, 2003). Our results agree well with the prior literature in this regard. Prevention of recurrent stroke provides another important way of potentially decreasing bounce-backs in acute stroke patients.

The stroke group with one bounce-back who survived thirty days and the group with multiple bounce-backs exhibited very similar rehospitalization diagnostic profiles. No one diagnostic category seems to differentiate stroke patients with multiple bounce-backs from those with one bounce-back. This finding supports the position that factors other than disease type, such as difficult to measure socioeconomic factors or patient choice, may be leading to multiple bounce-backs. Previous research examining predictors of bouncing-back demonstrated that African American race, in particular, was the strongest risk factor for multiple bounce-backs (Kind, et al., 2006). Additional research examining patients with multiple bounce-backs is needed to fully understand, and thus prevent, this costly phenomenon.

This study has limitations. To address the potential problems associated with administrative diagnosis and procedure codes, we used codes previously shown to accurately identify ischemic stroke (Benesch, et al., 1997). Nevertheless, in any study utilizing administrative data some misclassification may occur (McGlynn, Damberg, Kerr & Brook, 1998). Since patients with stroke documentation in the non-primary diagnostic position have greater comorbidity burden and 30-day mortality, by using the primary discharge diagnosis code we may have biased the sample toward more benign outcomes (Tirschwell & Longstreth, 2002). However, our use of the primary diagnosis code probably enabled us to avoid problems that might have been brought about by “up-coding”, an intensive coding methodology sometimes utilized by health systems to maximize revenue, since up-coding most likely affects secondary diagnoses. Our measures of stroke severity were limited but valid (Horner, et al., 1998, Quan, et al., 2004). However, in the absence of more definitive severity measures, such as post-stroke functional status, it is impossible to comment on the appropriateness of patient discharge from the index hospitalization. Additionally, administrative data provides no direct measures of patient preference. Stroke patients’ preferences, especially regarding code status, likely

influence their chance of experiencing bounce-backs and, possibly, rehospitalizations (Zweig, Kruse, Binder, Szafara & Mehr, 2004). Thus, lack of information regarding patient preference is a major limitation of this particular research approach. Finally, it is unclear whether these findings would apply to non-stroke populations. Further study of bounce-backs in patient populations other than acute stroke is needed.

In conclusion, our research has a number of broad implications. Aspiration pneumonitis and infections are the most important reasons for thirty day rehospitalization in acute stroke patients. Prevention efforts specifically targeting populations at high risk for these complications of immobility, like skilled nursing or long-term care facility patients, may prove extremely valuable in decreasing bounce-backs in stroke patients. Additionally, changes to the existing financial and medical-legal health system incentive structure for treating patients on-site will likely be critical in decreasing bounce-back rates. Recurrent stroke is another important reason for bounce-backs in acute stroke patients, especially for patients who die within thirty days of acute stroke hospitalization. Prevention of recurrent stroke provides another important way to potentially decrease bounce-back number, and possibly thirty day mortality, in acute stroke patients. Finally, since surviving stroke patients with one bounce-back and those with multiple bounce-backs do not differ significantly in their rehospitalization diagnoses, it is possible that non-medical unmeasured factors, such as patient culture or choice, drive recurrent bounce-backs.

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Table 1

Key characteristics of rehospitalized acute stroke patients, by bounce-back category (N=5,250)*

Characteristic	One bounce-back, survived 30 days (N=3,683)	One bounce-back, died 30 days (N=671)	More than one bounce-back (N=896)	p-value
<i>Sociodemographic</i>				
Age (mean in years)	80 (7)	83 (8)	81 (7)	<0.0001
Female	62	58	60	0.085
Caucasian	79	82	74	0.001
African-American	16	13	21	0.001
Other	4	4	5	0.001
Medicaid	20	23	22	0.103
HMO membership	11	9	12	0.160
% in block group below the poverty line (mean)	0.13 (0.12)	0.12 (0.12)	0.13 (0.12)	0.464
% adults >=25 years in block group with college degree (mean)	0.23 (0.16)	0.23 (0.16)	0.22 (0.16)	0.207
<i>Index Hospitalization</i>				
Length of Stay in days (standard deviation)	6.83 (5.45)	8.64 (6.41)	7.59 (5.72)	<0.0001
<i>Discharged from Index Hospital Stay to:</i>				
Home with Home Health	24	11	25	
Rehabilitation Center	26	18	17	
Skilled Nursing Facility or Long-Term Care	50	71	58	
<i>Prior medical history</i>				
HCC Score Prior to Index Hospital Discharge	2.6 (1.34)	3.09 (1.43)	2.78 (1.47)	<0.0001
Prior hospitalization	48	52	53	0.018
Prior stroke	9	9	10	0.725
Cardiac arrhythmias	43	50	46	0.001
Congestive heart failure	31	39	31	<0.0001
Chronic pulmonary disease	22	30	25	<0.0001
Diabetes, uncomplicated	25	27	25	0.352
Diabetes, complicated	10	9	10	0.588
Hypertension	76	71	78	0.011
Fluid and electrolyte disorders	30	33	35	0.010
Valvular disease	19	19	19	0.944
Peripheral vascular disorders	17	20	17	0.094
Hypothyroidism	12	13	12	0.718
Solid tumor without metastasis	13	11	13	0.396
Deficiency anemias	18	21	22	0.002
Depression	11	11	9	0.428
Dementia	27	29	29	0.240
Concurrent cardiac event	2	3	3	0.528
Other comorbidity count	0.54 (0.79)	0.66 (0.84)	0.65 (0.86)	<0.0001
<i>Disease severity</i>				
Mechanical ventilation	2	5	3	<0.0001
Gastrostomy tube	12	29	15	<0.0001

* Values represent percents unless specified otherwise. Parentheses indicate standard deviations.

Table 2
Probabilities and 95% confidence intervals (CI) for the relationship between bounce-back category and primary diagnosis for first rehospitalization (N=5,250)

Clinical Classification System (CCS)*	CCS Level	Frequency (N=5,250)	One bounce-back, survived 30 days		More than one bounce-back		One bounce-back, died 30 days	
			Prob [†]	95 % CI	Prob [†]	95 % CI	Prob [†]	95 % CI
Infections and aspiration pneumonia	1, 8.1, 9.1, 10.4.1, 12.1, 13.1	1,295	0.23	[0.2124, 0.2456]	0.23	[0.1975, 0.2576]	0.38	[0.3389, 0.4206]
Heart disease	7.2	301	0.15	[0.1370, 0.1642]	0.15	[0.1222, 0.1758]	0.12	[0.0972, 0.1502]
Acute cerebrovascular disease	7.3.1	168	0.08	[0.0674, 0.0882]	0.09	[0.0679, 0.1082]	0.13	[0.0964, 0.1546]
Non-acute cerebrovascular disease	7.3.2, 7.3.3, 7.3.4, 7.3.6	804	0.04	[0.0314, 0.0500]	0.03	[0.0220, 0.0466]	0.02	[0.0065, 0.0270]
Respiratory disease other than infection/aspiration and circulatory disease other than heart	7.1, 7.4, 7.5, 8.2, 8.3, 8.5, 8.6, 8.8, 8.9	261	0.08	[0.0728, 0.0920]	0.08	[0.0632, 0.1024]	0.11	[0.0808, 0.1349]
Symptoms, signs, and ill-defined conditions	17	429	0.03	[0.0231, 0.0376]	0.02	[0.0109, 0.0314]	0.01	[0.0017, 0.0257]
Injury and poisoning	16	478	0.06	[0.0553, 0.0742]	0.06	[0.0483, 0.0816]	0.02	[0.0099, 0.0302]
Other	Remaining codes	1,514	0.32	[0.3068, 0.3421]	0.33	[0.2994, 0.3652]	0.21	[0.1801, 0.2450]

* Category indicates primary diagnosis for first rehospitalization within 30 days of the index admission

[†] Adjusted for age, gender, race, Medicaid, HMO membership, % of the census block group aged 25+ with college degrees, % of persons in the census block group below the poverty line, length of index hospital stay, 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, mechanical ventilation, gastrostomy tube, other comorbidity count and CMS/HCC score.

Table 3

Probabilities and 95% confidence intervals (CI) for the relationship between bounce-back category and primary diagnosis for first rehospitalization for stroke patients discharged home with home health care (N=1,187)

Clinical Classification System (CCS)*	CCS Level	Frequency (N=1,187)	One bounce-back, survived 30 days		More than one bounce-back		One bounce-back, died 30 days	
			Prob [†]	95 % CI	Prob [†]	95 % CI	Prob [†]	95 % CI
Infections and aspiration pneumonia	1, 8.1, 9.1, 10.4.1, 12.1, 13.1	214	0.21	[0.1768, 0.2414]	0.15	[0.0953, 0.2002]	0.30	[0.2022, 0.4066]
Heart disease	7.2	66	0.16	[0.1303, 0.1828]	0.20	[0.1474, 0.2600]	0.08	[0.0161, 0.1526]
Acute cerebrovascular disease	7.3.1	52	0.10	[0.0752, 0.1205]	0.08	[0.0469, 0.1196]	0.17	[0.0725, 0.2670]
Non-acute cerebrovascular disease	7.3.2, 7.3.3, 7.3.4, 7.3.6	192	0.06	[0.0424, 0.0801]	0.05	[0.0233, 0.0830]	0.01	[-0.0114, 0.0344]
Respiratory disease other than infection/aspiration and circulatory disease other than heart	7.1, 7.4, 7.5, 8.2, 8.3, 8.5, 8.6, 8.8, 8.9	103	0.07	[0.0526, 0.0902]	0.09	[0.0567, 0.1313]	0.09	[0.0193, 0.1522]
Symptoms, signs, and ill-defined conditions	17	81	0.04	[0.0229, 0.0487]	0.02	[0.0038, 0.0414]	0.01	[-0.0092, 0.0283]
Injury and poisoning	16	135	0.06	[0.0470, 0.0823]	0.07	[0.0313, 0.1001]	0.01	[-0.0113, 0.0368]
Other	Remaining codes	344	0.30	[0.2694, 0.3376]	0.33	[0.2632, 0.3965]	0.32	[0.2101, 0.4337]

* Category indicates primary diagnosis for first rehospitalization within 30 days of the index admission

[†] Adjusted for age, gender, race, Medicaid, HMO membership, % of the census block group aged 25+ with college degrees, % of persons in the census block group below the poverty line, length of index hospital stay, 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, mechanical ventilation, gastrostomy tube, other comorbidity count and CMS/HCC score.

Table 4

Probabilities and 95% confidence intervals (CI) for the relationship between bounce-back category and primary diagnosis for first rehospitalization for stroke patients discharged to rehabilitation centers (N=1,230)

Clinical Classification System (CCS)*	CCS Level	Frequency (N=1,230)	One bounce-back, survived 30 days		More than one bounce-back		One bounce-back, died 30 days	
			Prob [†]	95 % CI	Prob [†]	95 % CI	Prob [†]	95 % CI
Infections and aspiration pneumonia	1, 8.1, 9.1, 10.4.1, 12.1, 13.1	224	0.19	[0.1592, 0.2242]	0.24	[0.1543, 0.3186]	0.33	[0.2368, 0.4148]
Heart disease	7.2	63	0.20	[0.1694, 0.2332]	0.24	[0.1532, 0.3281]	0.16	[0.0973, 0.2300]
Acute cerebrovascular disease	7.3.1	42	0.07	[0.0561, 0.0905]	0.11	[0.0568, 0.1570]	0.19	[0.1222, 0.2556]
Non-acute cerebrovascular disease	7.3.2, 7.3.3, 7.3.4, 7.3.6	268	0.03	[0.0207, 0.0456]	0.03	[-0.0004, 0.0525]	0.01	[-0.0050, 0.0328]
Respiratory disease other than infection/aspiration and circulatory disease other than heart	7.1, 7.4, 7.5, 8.2, 8.3, 8.5, 8.6, 8.8, 8.9	56	0.08	[0.0634, 0.1026]	0.06	[0.0206, 0.1042]	0.10	[0.0492, 0.1547]
Symptoms, signs, and ill-defined conditions	17	105	0.03	[0.0196, 0.0466]	0.01	[-0.0048, 0.0306]	0.01	[-0.0082, 0.0253]
Injury and poisoning	16	123	0.07	[0.0474, 0.0836]	0.03	[0.0023, 0.0645]	0.01	[-0.0082, 0.0260]
Other	Remaining codes	349	0.32	[0.2824, 0.3553]	0.28	[0.2010, 0.3614]	0.19	[0.1156, 0.2610]

* Category indicates primary diagnosis for first rehospitalization within 30 days of the index admission

[†] Adjusted for age, gender, race, Medicaid, HMO membership, % of the census block group aged 25+ with college degrees, % of persons in the census block group below the poverty line, length of index hospital stay, 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, mechanical ventilation, gastrostomy tube, other comorbidity count and CMS/HCC score.

Table 5

Probabilities and 95% confidence intervals (CI) for the relationship between bounce-back category and primary diagnosis for first rehospitalization for stroke patients discharged to a skilled nursing facility or long-term care (N=2,833)

Clinical Classification System (CCS)*	CCS Level	Frequency (N=2,833)	One bounce-back, survived 30 days		More than one bounce-back		One bounce-back, died 30 days	
			Prob [†]	95 % CI	Prob [†]	95 % CI	Prob [†]	95 % CI
Infections and aspiration pneumonia	1, 8.1, 9.1, 10.4.1, 12.1, 13.1	857	0.25	[0.2334, 0.2743]	0.26	[0.2225, 0.3058]	0.43	[0.3812, 0.4744]
Heart disease	7.2	172	0.13	[0.1151, 0.1474]	0.10	[0.0677, 0.1224]	0.11	[0.0825, 0.1436]
Acute cerebrovascular disease	7.3.1	74	0.07	[0.0595, 0.0850]	0.09	[0.0576, 0.1129]	0.09	[0.0602, 0.1184]
Non-acute cerebrovascular disease	7.3.2, 7.3.3, 7.3.4, 7.3.6	344	0.04	[0.0267, 0.0468]	0.03	[0.0162, 0.0458]	0.02	[0.0049, 0.0317]
Respiratory disease other than infection/aspiration and circulatory disease other than heart	7.1, 7.4, 7.5, 8.2, 8.3, 8.5, 8.6, 8.8, 8.9	102	0.09	[0.0726, 0.0984]	0.08	[0.0569, 0.1098]	0.11	[0.0810, 0.1478]
Symptoms, signs, and ill-defined conditions	17	243	0.03	[0.0176, 0.0348]	0.02	[0.0086, 0.0371]	0.02	[0.0017, 0.0302]
Injury and poisoning	16	220	0.06	[0.0499, 0.0769]	0.07	[0.0487, 0.0964]	0.02	[0.0103, 0.0377]
Other	Remaining codes	821	0.33	[0.3070, 0.3545]	0.35	[0.2968, 0.3947]	0.20	[0.1590, 0.2355]

* Category indicates primary diagnosis for first rehospitalization within 30 days of the index admission

[†] Adjusted for age, gender, race, Medicaid, HMO membership, % of the census block group aged 25+ with college degrees, % of persons in the census block group below the poverty line, length of index hospital stay, 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, mechanical ventilation, gastrostomy tube, other comorbidity count and CMS/HCC score.