ORIGINAL RESEARCH

Contemporary Trends and Predictors of Postacute Service Use and Routine Discharge Home After Stroke

Janet Prvu Bettger, ScD; Lisa McCoy, MS; Eric E. Smith, MD; Gregg C. Fonarow, MD; Lee H. Schwamm, MD; Eric D. Peterson, MD, MPH

***Background*—**Returning home after the hospital is a primary aim for healthcare; however, additional postacute care (PAC) services are sometimes necessary for returning stroke patients to their pre-event status. Recent trends in hospital discharge disposition specifying PAC use have not been examined across age groups or health insurance types.

***Methods and Results*—**We examined trends in discharge to inpatient rehabilitation facilities (IRFs), skilled nursing facilities (SNFs), home with home health (HH), and home without services for 849 780 patients ≥18 years of age with ischemic or hemorrhagic stroke at 1687 hospitals participating in Get With The Guidelines—Stroke. Multivariable analysis was used to identify factors associated with discharge to any PAC (IRF, SNF, or HH) versus discharge home without services. From 2003 to 2011, there was a 2.1% increase (unadjusted P=0.001) in PAC use after a stroke hospitalization. Change was greatest in SNF use, an 8.3% decrease over the period. IRF and HH increased 6.9% and 3.6%, respectively. The 2 strongest clinical predictors of PAC use after acute care were patients not ambulating on the second day of their hospital stay (ambulation odds ratio [OR], 3.03; 95% confidence interval [CI], 2.86 to 3.23) and those who failed a dysphagia screen or had an order restricting oral intake (OR, 2.48; 95% CI, 2.37 to 2.59).

***Conclusions*—**Four in 10 stroke patients are discharged home without services. Although little has changed overall in PAC use since 2003, further research is needed to explain the shift in service use by type and its effect on outcomes. **(*J Am Heart Assoc*. 2015;4:e001038 doi: 10.1161/JAHA.114.001038)**

Key Words: rehabilitation • stroke • trends

The decisions made about the services to provide after an acute hospitalization can be life altering for a stroke survivor. With a 5-day average length of hospital stay for stroke in the United States,[1] patients, families, and providers have a short window of time for discharge planning given the complexities of the process and acute stroke. Analysis of administrative claims data from over a decade ago suggested postacute care (PAC) service use, including care in inpatient rehabilitation (IRFs) and skilled nursing facilities (SNFs) or by home health (HH) providers, was largely driven by availability of services.[2] However, predictors and trends of use among stroke survivors have not been investigated since implementation of the prospective payment system (PPS). With this new method of reimbursement fully in place for each individual service by 2002, and in the absence of clinical guidelines to guide discharge planning, patient-centered decision making could be compromised.

PAC is an essential and effective healthcare component for returning stroke patients to their pre-event status.[3,4] In this study, we extend previous work[2,5–7] by using clinical data sources with detailed patient information, examining hospital characteristics as independent predictors, and analyzing stroke patients across the age spectrum, and with different sources of health insurance over a time period of continued payment reform for PAC (Figure 1). Although prospective payment systems were specific to Medicare beneficiaries, the impact of implementation for hospitals and PAC alike was anticipated to shift practice patterns and reorganize care for all patients. It was not clear whether the new method for reimbursement fully effective for all services by the end of 2002 would differentially impact patients, for example, with more-severe strokes who may have reduced access to PAC owing to the expected high costs requiring

From the Duke University School of Nursing (J.P.B.), Duke Clinical Research Institute (J.P.B., L.M., E.D.P.), Durham, NC; University of Calgary, Calgary, Alberta, Canada (E.E.S.); University of California, Los Angeles, CA (G.C.F.); Massachusetts General Hospital, Boston, MA (L.H.S.).

Correspondence to: Janet Prvu Bettger, DSc, Duke University School of Nursing, DUMC 3322, 307 Trent Drive, Durham, NC 27710. E-mail: janet.bettger@duke.edu

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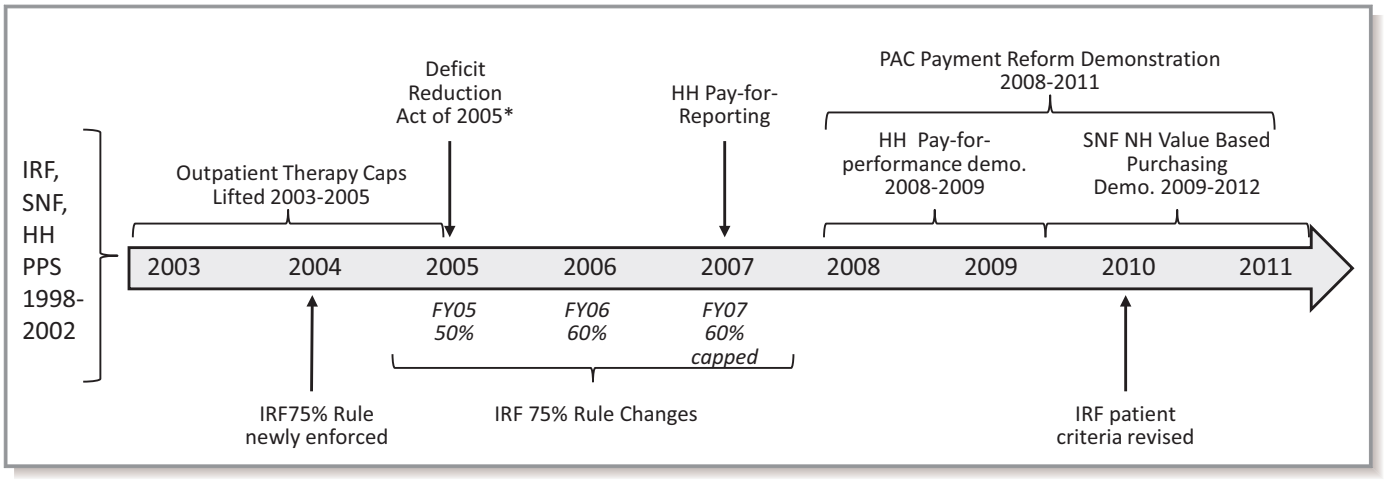

Figure 1. Timeline of postacute payment changes for this study period (2003–2011). *Outpatient therapy caps were re-instated in 2005 with an exceptions process for Medicare beneficiaries needing coverage beyond the cap until December 2006. Additional efforts extended the exceptions process almost continuously until December 2011 (*the Tax Relief and Health Care Act of 2006 in December until 2007*, *SCHIP, Medicare, and Medicaid Extension Act in December 2007 until July 2008*, *Medicare Improvement for Patients and Providers in July 2008 until December 2009*, *Patient Protection and Affordable Care Act in March 2010 until December 2010*, *and Medicare and Medicaid Extenders Act of 2010 in December until December 2011*). FY indicates fiscal year; HH indicates home health; IRF, inpatient rehabilitation facility; NH, nursing home; PAC, postacute care; PPS, prospective payment system; SNF, skilled nursing facility.

reimbursement or minor strokes who might receive PAC unnecessarily and could otherwise have been discharged home.[8] In this study, we first present the contemporary trends for all stroke patients and important subgroups of stroke patients' discharged to PAC and routine discharge home after implementation of the prospective payment systems for acute and PAC (2003–2011). We then identified patient and hospital characteristics independently associated with discharge to any of the most common discharge dispositions for stroke survivors—IRF, SNF, HH, and discharge home without services.

Methods

This study is a retrospective analysis of clinical registry data collected for a cohort of patients treated at Get With The Guidelines—Stroke (GWTG-Stroke) participating hospitals. Initiated by the American Heart Association, GWTG-Stroke is an ongoing, voluntary, continuous registry and performance improvement initiative for acute hospitals that collect patient-level data on characteristics, diagnostic testing, treatments, and in-hospital outcomes in patients hospitalized with stroke.[9,10] Each participating hospital received either human subjects research approval to enroll cases without individual patient consent under the common rule or a waiver of authorization and exemption from subsequent review by their institutional review board (IRB). Outcome Sciences, Inc., serves as the data collection coordination center. The Duke Clinical Research Institute (Durham, NC) serves as the data analysis center and has IRB approval to analyze the aggregate data for research purposes.

Case Identification and Data Abstraction for GWTG-Stroke

Personnel at each GWTG-Stroke participating hospital were trained to ascertain consecutive patients admitted with acute ischemic stroke (The International Classification of Diseases, Ninth Revision [ICD-9], discharge codes 433.x, 434.x, and 436), hemorrhagic stroke (ICD-9 430.x, 431.x, and 432.x), and transient ischemic attack admissions with symptoms present on arrival (ICD-9 435.x).[11,12] Additional descriptions of the case ascertainment, data collection, and quality auditing methods have been previously published.[9–12]

Study Population

GWTG-Stroke became available nationally in April 2003. Our analysis of trends in discharge to PAC includes 8 years of data (April 1, 2003–March 31, 2011). Patients with no stroke-related diagnosis and patients admitted with a transient ischemic attack were excluded from this study because the benefits of PAC have not been documented for these populations.[3,4] To allow for comparison to other nationally reported rates of referral and utilization, patients with discharge destinations other than IRF, SNF, home with HH, or home without services were excluded. These other discharge destinations included short-term general hospital,

critical access hospital, long-term care hospital, federal healthcare facility, hospice, discontinued care, intermediate care, designated cancer center, and psychiatric care.

Outcome Measures

Discharge destination is routinely collected on all patients as part of GWTG-Stroke. The structure of the variable was designed according to nationally established billing codes and was available as part of the registry for this study. Among the different 2-digit universal billing codes used to define discharge disposition, we used the following: 01 home or self-care (home without services); 06 home under care of organized home health service organization (HH); 62 inpatient rehabilitation facility including rehabilitation distinct part units of a hospital (IRF); and 03 skilled nursing facility with Medicare certification or hospital-based Medicare approved swing bed (SNF). The outcome of interest to identify factors associated with PAC service use was discharge to PAC in an IRF, SNF, or by HH (compared with home without services).

Study Variables

Patient characteristics in this study included both sociodemographics (age, gender, race, and health insurance) and clinical characteristics. Clinical characteristics were grouped into those pre-existing and those newly documented as a result of measurement or evaluation during the stroke admission. On admission, medical history of 8 conditions and 1 behavior were recorded. Three in-hospital assessments and evaluations provided additional clinical detail (stroke severity measured by the National Institutes of Health [NIH] Stroke Scale [NIHSS], inability to ambulate on hospital day 2, and failed dysphagia screen or no food or liquid intake during the hospital stay). Arrival to the hospital by emergency medical services was also reported.

GWTG-Stroke data were used to describe the hospital length of stay and whether care was provided in a stroke unit. Data on hospital structural characteristics (number of hospital beds, geographical region, urban or rural location of the hospital, and whether the hospital was an academic medical center) were obtained from the American Hospital Association database.

Analyses

Patient and hospital characteristics were compared for stroke patients discharged to IRF, SNF, HH, and home without services. *P* values were based on Pearson chi-square tests for all categorical variables and chi-square rank-based group means score statistics for all continuous/ordinal variables (equivalent to Kruskal-Wallis tests). All tests were 2-sided and calculated by comparing only nonmissing values.

We calculated the quarterly proportion of patients discharged to each of the groups (IRF, SNF, HH, and home without services) overall and by the subgroups of interest. A Cochran-Armitage test was used to assess for monotone increasing trend for each discharge group versus all other discharge destinations. Change was also calculated annually (eg, 2004 value to 2003 value) for each outcome and subgroup to determine mean change over the 8-year period. Trends in service use were compared for patients 65 years or older with patients younger than 65 to illustrate any differences for Medicare-eligible patients independent of the documented health insurance type. Trends by stroke severity were examined for variation in discharge disposition for patients with minor stroke (NIHSS scores 0 to 4), moderate stroke (NIHSS scores 5 to 9), moderate-to-severe (NIHSS scores 10 to 14), and severe stroke (NIHSS scores 15 to 42).

To assess the association between PAC use and patient and hospital factors, we fit a logistic regression model with generalized estimating equations to account for within-hospital correlation for discharge to PAC (IRF, SNF, or HH) versus no PAC (home without services). Some patients in this study may have had multiple strokes and may be represented in the analysis more than once over the 8-year period. A second model was created to examine the patient and hospital factors associated with PAC use among patients without a previous stroke or transient ischemic attack. To determine the specific association of stroke severity and insurance type with discharge disposition and examine the patient and hospital characteristics given the inclusion of these factors thought to influence discharge planning, but only available for a subgroup of the total study population, we repeated the primary model using inverse probability weighting to address missing data in these key variables (NIHSS score and insurance type).[13] Sensitivity analyses restricted to the subset of patients with a documented NIHSS score and insurance type, respectively, were conducted and produced similar results (data not shown). Because of the large sample size, some results may be statistically significant, but not clinically meaningful. Model discrimination was assessed by determining the C-index for each model. The percentile method was used to obtain 95% bootstrap confidence intervals (CIs) for the C-index. We generated N=200 bootstrap samples, fit models, estimated the C-index, and selected the 2.5th and 97.5th percentiles to estimate the CIs. SAS software (version 9.2; SAS Institute Inc., Cary, NC) was used for all analyses.

Results

Of the 1 598 026 stroke patients cared for in 1730 GWTG-Stroke participating hospitals from 2003 to 2011, we excluded patients with no stroke-related diagnosis, unspec-

Table 1. Patient and Hospital Characteristics Associated With Discharge to Postacute Care

Variable*	Home Without Services	HH	SNF	IRF
N (%)	371 092 (43.7)	97 471 (11.5)	165 411 (19.5)	215 806 (25.4)
Age, mean No. of years (SD)	64.3 (14.5)	71.9 (13.6)	77.8 (12.0)	69.9 (13.9)
Sex (female)	45.6	55.8	60.3	50.9
Race/ethnicity				
White	68.9	68.1	73.2	70.1
Black or African American	16.4	17.9	14.4	17.9
Asian	2.8	2.7	2.8	2.6
Hispanic	7.0	7.2	5.2	5.5
Other, UTD	4.7	3.9	4.3	3.8
Health insurance†				
Medicare	18.4	27.5	28.4	25.8
Private/VA	31.2	26.5	21.4	28.3
Medicaid	5.4	7.3	5.4	5.5
Self-pay/no insurance	7.2	3.6	1.8	3.8
Medical history, condition present				
Previous stroke/TIA	25.8	34.5	36.3	28.9
Diabetes mellitus	28.9	34.3	32.0	32.2
Hypertension	73.3	79.5	80.7	78.6
Atrial fibrillation/flutter	10.6	17.2	23.8	16.2
CAD/previous MI	22.8	28.8	28.9	25.5
Peripheral vascular disease	3.7	5.6	5.7	4.4
Dyslipidemia	40.7	42.3	36.8	39.3
Heart failure	3.2	6.3	6.4	4.7
Smoker	25.4	18.5	11.9	19.8
Stroke type, ischemic	88.6	90.0	85.1	83.8
Inability to ambulate on day 2	31.5	49.1	77.4	75.2
Failed dysphagia screen/NPO	4.74	8.1	19.7	16.0
Stroke severity, NIHSS† mean (SD)	3.5 (4.4)	5.0 (5.5)	9.9 (8.1)	8.5 (6.9)
Minor stroke (NIHSS 0 to 4)	58.9	11.8	11.8	17.6
Moderate stroke (NIHSS 5 to 9)	31.1	10.7	22.4	35.9
Moderate-to-severe (NIHSS 10 to 14)	19.2	7.7	30.9	42.3
Severe stroke (NIHSS 15 to 42)	11.7	6.0	42.0	40.3
Length of stay				
Mean (SD)	4.2 (5.1)	5.5 (6.2)	9.0 (10.5)	7.2 (7.3)
Median (IQR)	3 (2 to 5)	4 (3 to 6)	6 (4 to 10)	5 (4 to 8)
Hospital arrival by EMS	34.5	46.3	66.2	57.0
Cared for in a stroke unit†	50.8	55.0	51.3	54.2
No. of hospital beds, mean (SD)	444 (317)	448 (320)	415 (304)	471 (320)
Geographical region				
Northeast	22.5	26.6	24.7	29.1
South	38.6	41.9	34.1	35.0
Midwest	19.8	16.3	19.8	20.4

Continued

Table 1. Continued

Variable*	Home Without Services	HH	SNF	IRF
West	19.0	15.1	21.3	15.2
Hospital type, academic	56.6	52.5	53.1	60.9
Hospital location, urban	95.1	96.0	94.3	96.4

CAD indicates coronary artery disease; EMS, emergency medical services; HH, home health; IQR, interquartile range; IRF, inpatient rehabilitation facility; MI, myocardial infarction; NIHSS, National Institutes of Health Stroke Scale; NPO, food and fluid intake was withheld for hospital stay; SNF, skilled nursing facility; TIA, transient ischemic attack; UTD, unable to determine; VA, Veteran's Healthcare Administration.

*All factors were significantly different ($P<0.0001$). Data represent an 8-year average.

†Missing data or not documented for >5% of sample: health insurance, 38.2%; NIHSS, 51.5%; No. of beds, 7.8%; stroke unit care, 11.2%.

ified stroke type, and transient ischemic attack (N=388 227), patients who had an inpatient stroke (N=137 442), died in the hospital (N=108 383), were missing documentation of a discharge destination (N=10 136), or had a discharge destination other than IRF, SNF, home with HH, or home without services (N=104 058). Our final study sample included 849 780 stroke admissions from 1687 hospitals (Table 1). Of these, 86.9% of patients had an ischemic stroke, 10.0% intracerebral hemorrhage, and 3.2% subarachnoid hemorrhage. The majority were discharged to PAC: 11.5% HH; 19.5% SNF; and 25.4% IRF (Table 1).

Contemporary Trends

Unadjusted analyses of change in discharge to PAC over the 8-year period showed discharge to PAC rose slightly (2.1%; Figure 2). The increase was greatest for discharge to IRF (6.9%) followed by HH (3.6%). Discharge to SNF decreased 8.3%.

Temporal trends in discharge to PAC, according to different age groups, are shown in Figure 3. Across all study years, comparing patients younger than 65 years to patients 65 years or older, 22.6% versus 25.3% were discharged to IRF, 8.2% versus 28.0% to SNF, 8.7% versus 12.1% to HH, and 60.4% versus 37.5% were discharged home without services.

Discharge to PAC increased over time for all ranges of stroke severity. Almost 20% of patients with minor stroke (NIHSS scores 0 to 4) were discharged to an IRF in addition to the 35.9% of patients with moderate stroke (NIHSS scores 5 to 9), 42.3% moderate-to-severe (NIHSS scores 10 to 14), and 40.3% severe stroke (NIHSS scores 15 to 42). There was a significant positive trend for more patients with minor stroke to be discharged to IRF and HH over the 8-year period ($P<0.0001$) and fewer were discharged to SNF ($P=0.02$) or home without services ($P<0.0001$). The same trends for IRF, SNF, and HH were found for patients with moderate and moderate-to-severe stroke severity. The greatest change over 8 years was for patients with severe stroke: 9.4% mean increase to IRF and 12.4% decrease to SNF. The increasing trend in patient referral to HH for this group changed very little (1.9%). On average, 11.7% of patients with severe stroke were discharged home without services and the 1.2% mean increase was not significant ($P=0.5$).

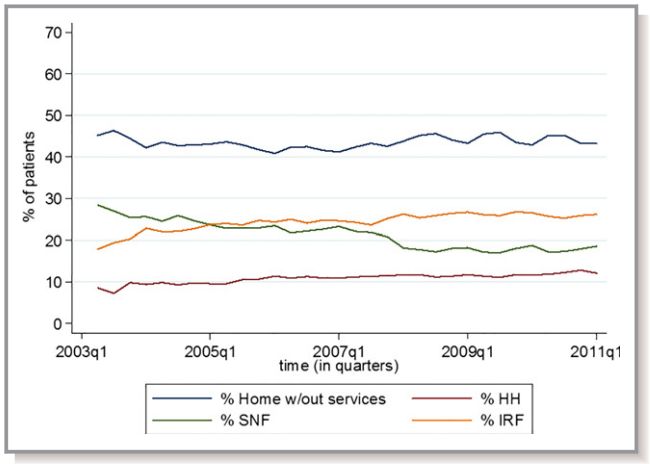

Figure 2. Proportion of patients discharged to postacute care of IRF, SNF, and HH or discharged home. HH indicates home health; IRF, inpatient rehabilitation facility; SNF, skilled nursing facility.

Predictors of PAC Use

More patient characteristics than hospital characteristics independently predicted discharge to PAC (IRF, SNF, or HH) in multivariable analyses (Table 2). The strongest patient predictor was mobility: patients not ambulating on the second day of their hospital stay were more likely to be discharged to receive PAC services (odds ratio [OR], 3.03; 95% CI, 2.86 to 3.23). Findings were similar in the model examining patients without a previous stroke or transient ischemic attack (Table 3). Exploratory analysis of the interaction between age group (≥65 vs <65 years) and calendar time was statistically significant where patients 65 years or older were more likely to be discharged to receive PAC; however, the difference in trends over time by age was not clinically meaningful (not shown).

Analysis of the relationship of NIHSS score with discharge disposition showed that a higher NIHSS score (more-severe stroke) increased the likelihood of being discharged to PAC

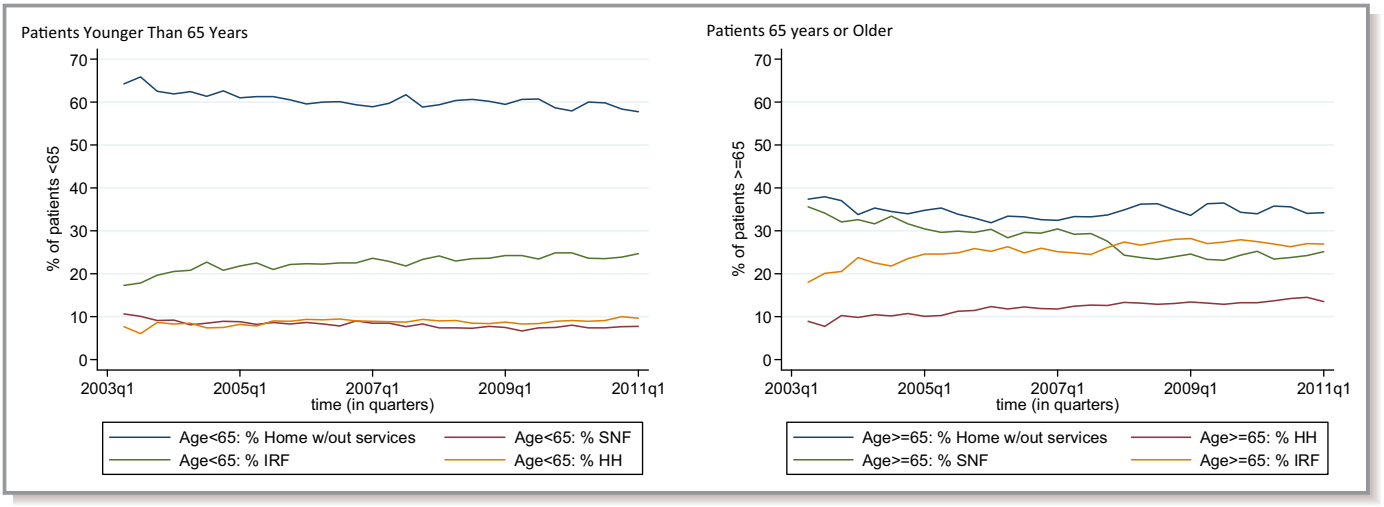

Figure 3. Proportion of patients by age discharged to postacute care. HH indicates home health; IRF, inpatient rehabilitation facility; SNF, skilled nursing facility.

(OR=1.11 per additional NIHSS point; 95% CI, 1.10 to 1.11; Table 4). In this model with slightly improved model discrimination (C-index=0.82), receiving care in a stroke unit and calendar time were also associated with discharge to PAC (stroke unit OR=1.12; 95% CI, 1.06 to 1.18; calendar time OR=1.01 per additional year; 95% CI, 1.01 to 1.02).

Analysis of the relationship of insurance type with discharge to PAC found that Medicare patients were more likely to be discharged to PAC ($P<0.0001$; Table 5). Patients with no insurance or private insurance were less likely than patients with Medicare to be discharged to PAC (C=0.80). All other variables in this model had similar OR and 95% CI to those in the full model.

Discussion

Descriptive trends coupled with factors associated with PAC use provide an important knowledge base for health systems invested in organizing stroke care to meet the needs of patients, and in the United States, the requirements of programs such as accountable care and episode-based bundled payments. In this large contemporary evaluation of patients hospitalized with acute ischemic and hemorrhagic stroke, almost 6 in 10 patients were discharged from the hospital to receive PAC, a slight increase over the 8-year study period. However, patterns varied significantly by age and stroke severity and for the individual service types.

Few studies in the United States have examined discharge disposition as well as referral to, or utilization of, PAC among young stroke patient populations. Analysis of working-age stroke patients in the National Inpatient Sample identified fewer patients discharged to IRF, but not SNF, than in our sample.[7] Similar to our study, no difference was found in the proportion of patients in the National Inpatient Sample with Medicaid who received IRF or SNF (15.9% and 16.8%, respectively), and IRF use was higher than SNF use for patients with private health insurance or who were uninsured. Hospital characteristics examined in the National Inpatient Sample study were similar to our study; however, the National Inpatient Sample lacks the patient clinical characteristics we were able to examine using the GWTG-Stroke registry data. This is true and acknowledged as a limitation of most analyses entirely reliant on administrative claims data.[2,5] For example, analyses of Medicare claims for PAC use could identify that stroke was the only diagnostic condition for which all patients had at least one comorbidity[14]; however, additional markers of health status and potential need of PAC, such as ability to ambulate during the acute admission or possible swallowing dysfunction, are less often coded in claims data, but were available in the clinical data in GWTG-Stroke.

Although each of the PAC services varies by the provision of rehabilitation therapy, nursing on staff, and physician oversight, the primary goal of PAC is to restore recently hospitalized patients to the highest level of functioning possible. Acute stroke patients are the second-most common Medicare users of PAC.[13] Medicare's introduction of a prospective payment system for PAC (1998–2002) was associated with reduced utilization over that period.[8,14,15] A number of PAC payment policy changes have occurred over the last decade and there are limited data on whether these changes affected referral trends and use among stroke patients. It is possible that some of the changes, such as the

Table 2. Multivariable Logistic Regression Demonstrating Characteristics Independently Associated With Discharge to Any Postacute Care (IRF, SNF, or HH) Versus Home Without Services for Acute Stroke Patients

Parameter	OR	LCL	UCL	*P* Value	Wald χ^2	Overall *P* Value
Age ≥65 vs <65 years	2.75	2.69	2.82	<0.0001	614.46	
Calendar time (per year increase)	1.00	0.99	1.00	0.11	2.52	
Sex (female)	1.27	1.25	1.29	<0.0001	413.42	
Race/ethnicity (ref. other)					51.42	<0.0001
White	1.20	1.13	1.28	<0.0001		
Black	1.34	1.24	1.45	<0.0001		
Previous stroke/TIA	1.25	1.23	1.27	<0.0001	334.71	
Diabetes mellitus	1.23	1.21	1.25	<0.0001	279.89	
Hypertension	1.20	1.18	1.22	<0.0001	237.68	
Atrial fibrillation/flutter	1.15	1.13	1.18	<0.0001	115.40	
Previous MI/CAD	1.00	0.98	1.02	0.76	0.09	
Peripheral vascular disease	1.19	1.15	1.24	<0.0001	70.02	
Dyslipidemia	0.93	0.91	0.95	<0.0001	42.09	
Heart failure	1.28	1.23	1.33	<0.0001	143.91	
Smoker	0.92	0.90	0.94	<0.0001	41.23	
Stroke type, ischemic (vs hemorrhagic)	1.19	1.14	1.24	<0.0001	49.58	
Patient arrived by EMS	1.69	1.65	1.74	<0.0001	548.32	
Ambulating on day 2	0.33	0.31	0.35	<0.0001	537.40	
Failed dysphagia screen/NPO	2.48	2.37	2.59	<0.0001	358.11	
Length of stay ≥4 days (vs <4)	3.20	3.11	3.30	<0.0001	640.24	
Cared for in a stroke unit	1.00	0.95	1.05	0.98	0.00	
No. of hospital beds (per 100 increase)	0.99	0.98	1.01	0.36	0.87	
Geographic region (ref. west)					21.27	<0.0001
Northeast	1.20	1.05	1.38	0.01		
Midwest	1.07	0.96	1.19	0.23		
South	0.95	0.86	1.06	0.34		
Hospital type, academic	0.84	0.78	0.91	<0.0001	16.85	
Hospital location, urban	0.95	0.86	1.05	0.32	0.99	

C-index=0.80; 95% confidence interval, 0.80 to 0.81. CAD indicates coronary artery disease; EMS, emergency medical services; HH, home health; IRF, inpatient rehabilitation facility; LCL, lower confidence limit; MI, myocardial infarction; NPO, food and fluid intake as withheld for hospital stay; OR, odds ratio; SNF, skilled nursing facility; TIA, transient ischemic attack; UCL, upper confidence limit.

IRF 75% rule, favored stroke patients. Our exploration of stroke severity identified an important subgroup of patients with minor stroke who increasingly were discharged to IRF and HH, contrary to previous studies suggesting these patients be considered early in their acute care stay for discharge home.[16] We also found discharge to IRF increased from 2003 to 2011 for adults 65 years or older. These increases occurred in parallel with Medicare's redefined and renewed enforcement of the IRF "75 percent rule." The rule requires that a certain percentage of IRF patients have one or more qualifying medical conditions, which includes stroke.[17] Although the percentage of IRF patients was never enforced over 60%,[18] it is possible that increased attention to this federal rule contributed to the increase in discharges to IRF and decrease in discharges to SNF, as found in this study. Although SNF use immediately following hospital discharge has decreased, future studies inclusive of PAC service use across an episode of illness are warranted to determine whether stroke patients are using SNF subsequent to an IRF stay. The prospective payment systems designed to reimburse for each individual service favor care patterns that include multiple stays in different services, but our data are unable to delineate patterns of use beyond hospital discharge.

Table 3. Characteristics Independently Associated With Discharge to Any Postacute Care (IRF, SNF, or HH) Versus Home Without Services for Patients Without a History of Previous Stroke or Transient Ischemic Attack (N=597 999)

Parameter	OR	LCL	UCL	*P* Value	Wald χ^2	Overall *P* Value
Age ≥65 vs <65 years	2.84	2.77	2.91	<0.0001	600.68	
Calendar time (per year increase)	1.00	1.00	1.01	0.02	5.78	
Sex (female)	1.28	1.26	1.30	<0.0001	439.29	
Race/ethnicity (ref. other)					46.47	<0.0001
White	1.17	1.10	1.24	<0.0001		
Black	1.29	1.20	1.39	<0.0001		
Diabetes mellitus	1.22	1.20	1.24	<0.0001	290.60	
Hypertension	1.19	1.16	1.21	<0.0001	200.88	
Atrial fibrillation/flutter	1.14	1.12	1.17	<0.0001	113.71	
Previous MI/CAD	1.00	0.98	1.02	0.71	0.14	
Peripheral vascular disease	1.19	1.14	1.24	<0.0001	67.26	
Dyslipidemia	0.90	0.88	0.92	<0.0001	90.24	
Heart failure	1.34	1.29	1.40	<0.0001	159.41	
Smoker	0.92	0.90	0.94	<0.0001	47.31	
Stroke type, ischemic (vs hemorrhagic)	1.23	1.18	1.28	<0.0001	75.24	
Patient arrived by EMS	1.78	1.73	1.82	<0.0001	513.72	
Ambulating on day 2	0.27	0.25	0.28	<0.0001	587.53	
Failed dysphagia screen/NPO	2.40	2.26	2.55	<0.0001	347.10	
Length of stay ≥4 days (vs <4)	3.13	3.04	3.22	<0.0001	628.47	
Cared for in a stroke unit	1.02	0.97	1.07	0.40	0.70	
No. of hospital beds (per 100 increase)	0.99	0.97	1.01	0.26	1.28	
Geographic region (ref. west)					19.35	0.0002
Northeast	1.16	1.03	1.31	0.02		
Midwest	1.04	0.94	1.16	0.42		
South	0.93	0.84	1.02	0.13		
Hospital type, academic	0.84	0.78	0.91	<0.0001	18.51	
Hospital location, urban	0.99	0.88	1.11	0.81	0.06	

C-index=0.81; 95% confidence interval, 0.81 to 0.81. CAD indicates coronary artery disease; EMS, emergency medical services; HH, home health; IRF, inpatient rehabilitation facility; LCL, lower confidence limit; MI, myocardial infarction; NPO, food and fluid intake as withheld for hospital stay; OR, odds ratio; SNF, skilled nursing facility; UCL, upper confidence limit.

This study has several limitations. We restricted analyses to include data in a clinical registry and hospital characteristics obtained from public sources, excluding data on the availability of PAC services (ie, geographical distribution of licensed programs). Our smallest geographical unit of analysis was multistate region, and previous studies found that PAC availability varies at the county level.[2] Participation in GWTG-Stroke is voluntary, and hospitals that participate are larger and, more often, located in urban areas. Although participating hospitals may not be representative of the overall U.S. hospital population, patient admissions in GWTG-Stroke appear to be representative of the overall U.S. stroke population in terms of age, demographics, and medical comorbidities.[10] We found that the assessment of stroke severity, as documented by the NIHSS, was frequently missing, and restricting our sample to patients with stroke severity documented would have introduced significant selection bias. On the other hand, we chose to describe the relationship of stroke severity with PAC use over a number of years in order to illustrate unique subgroups as we found with 1 in 5 patients with minor strokes being discharged for intensive rehabilitation care and an increase over time in the number of patients with severe stroke being discharged to receive intensive rehabilitation. Finally, we recognize that there may be other factors that influence discharge disposition not available in these data or examined in this study.

Table 4. Analysis of Stroke Severity (NIHSS) and Its Association With Discharge to Any Postacute Care (IRF, SNF, or HH) Versus Home Without Services for Acute Stroke Patients

Parameter	OR	LCL	UCL	*P* Value	Wald χ^2	Overall *P* Value
NIHSS	1.11	1.10	1.11	<0.0001	352.85	
Age ≥65 vs <65 years	2.74	2.67	2.82	<0.0001	439.84	
Calendar time (per year increase)	1.01	1.01	1.02	<0.0001	21.82	
Sex (female)	1.26	1.23	1.28	<0.0001	272.59	
Race/ethnicity (ref. other)					34.48	<0.0001
White	1.23	1.15	1.32	<0.0001		
Black	1.23	1.13	1.35	<0.0001		
Previous stroke/TIA	1.16	1.14	1.19	<0.0001	121.02	
Diabetes mellitus	1.25	1.23	1.28	<0.0001	204.79	
Hypertension	1.19	1.16	1.22	<0.0001	150.03	
Atrial fibrillation/flutter	1.07	1.04	1.09	<0.0001	20.18	
Previous MI/CAD	1.01	0.99	1.03	0.43	0.63	
Peripheral vascular disease	1.22	1.16	1.28	<0.0001	60.88	
Dyslipidemia	0.96	0.93	0.98	0.0004	12.06	
Heart failure	1.27	1.21	1.33	<0.0001	74.94	
Smoker	0.93	0.90	0.95	<0.0001	29.69	
Stroke type, ischemic (vs hemorrhagic)	0.93	0.89	0.98	0.0046	7.81	
Patient arrived by EMS	1.43	1.39	1.47	<0.0001	270.90	
Ambulating on day 2	0.35	0.33	0.37	<0.0001	364.05	
Failed dysphagia screen/NPO	1.50	1.41	1.60	<0.0001	146.11	
Length of stay ≥4 days (vs <4)	2.70	2.61	2.80	<0.0001	433.56	
Cared for in a stroke unit	1.12	1.06	1.18	<0.0001	15.36	
No. of hospital beds (per 100 increase)	0.99	0.97	1.01	0.38	0.81	
Geographic region (ref. west)					20.06	0.0002
Northeast	1.16	1.00	1.35	0.05		
Midwest	1.07	0.94	1.22	0.28		
South	0.89	0.79	1.01	0.06		
Hospital type, academic	0.82	0.75	0.90	<0.0001	16.02	
Hospital location, urban	1.13	0.98	1.31	0.09	2.52	

C-index=0.82; 95% confidence interval, 0.82 to 0.82. CAD indicates coronary artery disease; EMS, emergency medical services; HH, home health; IRF, inpatient rehabilitation facility; LCL, lower confidence limit; MI, myocardial infarction; NIHSS, National Institutes of Health Stroke Scale; NPO, food and fluid intake as withheld for hospital stay; OR, odds ratio; SNF, skilled nursing facility; TIA, transient ischemic attack; UCL, upper confidence limit.

In summary, this study identified important patient demographic and clinical characteristics independently associated with referral to PAC. These findings underscore the need for research into the effectiveness of the different options for PAC on meaningful patient-centered outcomes with data that include patient sociodemographic and clinical characteristics. For both patients with strokes of different severity, and younger and older stroke patients, an increase in discharge to IRF and HH and a decrease in discharge to SNF continued over the 8-year period. As we move into an era of value-driven, rather than volume-driven, healthcare, publicly reported trend analyses should be embedded into quarterly quality monitoring of new policies and pilot payment reform programs to determine whether shifts in utilization are clinically appropriate and services are available to meet patients' needs.

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Table 5. Analysis of Insurance Type and Its Association With Discharge to Any Postacute Care (IRF, SNF, or HH) Versus Home Without Services for Acute Stroke Patients

Parameter	OR	LCL	UCL	*P* Value	Wald χ^2	Overall *P* Value
Insurance type (ref. Medicare)					145.72	<0.0001
Private/VA/Champus/other insurance	0.85	0.82	0.88	<0.0001		
Medicaid	0.95	0.90	1.01	0.12		
Self-pay/no insurance	0.51	0.47	0.55	<0.0001		
Age ≥65 vs <65 years	2.42	2.33	2.50	<0.0001	463.04	
Calendar time (per year increase)	1.00	0.99	1.01	0.90	0.02	
Sex (female)	1.26	1.24	1.28	<0.0001	310.19	
Race/Ethnicity (ref. other)					25.88	<0.0001
White	1.19	1.11	1.28	<0.0001		
Black	1.27	1.23	1.44	<0.0001		
Previous stroke/TIA	1.22	1.19	1.25	<0.0001	235.91	
Diabetes mellitus	1.22	1.19	1.24	<0.0001	167.24	
Hypertension	1.19	1.16	1.22	<0.0001	130.57	
Atrial fibrillation/flutter	1.16	1.12	1.20	<0.0001	60.22	
Previous MI/CAD	1.00	0.97	1.02	0.74	0.11	
Peripheral vascular disease	1.19	1.13	1.25	<0.0001	38.09	
Dyslipidemia	0.89	0.87	0.92	<0.0001	53.29	
Heart failure	1.28	1.23	1.33	<0.0001	122.74	
Smoker	0.92	0.88	0.95	<0.0001	18.91	
Stroke type, ischemic (vs hemorrhagic)	1.20	1.14	1.26	<0.0001	42.19	
Patient arrived by EMS	1.71	1.66	1.76	<0.0001	411.84	
Ambulating on day 2	0.29	0.27	0.31	<0.0001	353.31	
Failed dysphagia screen/NPO	2.52	2.39	2.65	<0.0001	320.34	
Length of stay ≥4 days (vs <4)	3.08	2.98	3.19	<0.0001	533.67	
Cared for in a stroke unit	1.00	0.95	1.06	0.95	0.00	
No. of hospital beds (per 100 increase)	0.99	0.97	1.01	0.15	2.26	
Geographic region (ref. west)					24.51	<0.0001
Northeast	1.28	1.11	1.48	0.0008		
Midwest	1.10	0.98	1.24	0.11		
South	0.96	0.86	1.07	0.44		
Hospital type, academic	0.83	0.77	0.91	<0.0001	16.38	
Hospital location, urban	0.97	0.86	1.08	0.55	0.36	

C-index=0.80; 95% confidence interval, 0.80 to 0.80. CAD indicates coronary artery disease; EMS, emergency medical services; HH, home health; IRF, inpatient rehabilitation facility; LCL, lower confidence limit; MI, myocardial infarction; NPO, food and fluid intake as withheld for hospital stay; OR, odds ratio; SNF, skilled nursing facility; TIA, transient ischemic attack; UCL, upper confidence limit; VA, Veterans Healthcare Administration.

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Contemporary Trends and Predictors of Postacute Service Use and Routine Discharge Home After Stroke

Janet Prvu Bettger, Lisa McCoy, Eric E. Smith, Gregg C. Fonarow, Lee H. Schwamm and Eric D. Peterson

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