Post-acute Ambulatory Care Service Use Among Patients Discharged Home After Stroke or TIA

The Cluster-randomized COMPASS Study

Anna M. Kucharska-Newton, PhD, MPH,† Jacquie R. Halladay, MD, MPH,§ Matthew A. Psioda, PhD,§ Sara B. Jones, PhD, MPH,* Anna M. Johnson, PhD, MSPH,* Sylvia W. Coleman, MPH, RN, BSN, CLNC,‖ Doyle M. Cummings, PharmD,¶ Janet K. Freburger, PhD,# Laurie C. Daras, PhD, MS,** Wayne D. Rosamond, PhD, MS, FAHA,* Pamela W. Duncan, PhD, PT, FAPTA, FAHA,‖ and Cheryl D. Bushnell, MD, MHS, FAHA‖*

Background and Objectives: We examined transitional care management within 90 days and 1 year following discharge home among acute stroke and transient ischemic attack patients from the Comprehensive Post-Acute Stroke Services (COMPASS) Study, a cluster-randomized pragmatic trial of early supported discharge conducted in 41 hospitals (40 hospital units) in North Carolina, United States.

Methods: Data for 2262 of the total 6024 (37.6%; 1069 intervention and 1193 usual care) COMPASS patients were linked with the Centers for Medicare and Medicaid Services fee-for-service Medicare claims. Time to the first ambulatory care visit was examined using Cox proportional hazard models adjusted for patient characteristics not included in the randomization protocol.

Results: Only 6% of the patients [mean (SD) age 74.9 (10.2) years, 52.1% women, 80.3% White)] did not have an ambulatory care visit within 90 days postdischarge. Mean time (SD) to first ambulatory care visit was 12.0 (26.0) and 16.3 (35.1) days in intervention and usual care arms, respectively, with the majority of visits in both study arms to primary care providers. The COMPASS intervention resulted in a 27% greater use of ambulatory care services within 1 year postdischarge, relative to usual care [HR = 1.27 (95% CI: 1.14–1.41)]. The use of transitional care billing codes was significantly greater in the intervention arm as compared with usual care [OR = 1.87 (95% CI: 1.54–2.27)].

Discussion: The COMPASS intervention, which was aimed at improving stroke post-acute care, was associated with an increase in the use of ambulatory care services by stroke and transient ischemic attack patients discharged home and an increased use of transitional care billing codes by ambulatory providers.

Key Words: stroke, post-acute care, pragmatic clinical trial, ambulatory care, transitional care management

(*Med Care* 2023;61: 137–144)

From the *Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill; ‡Department of Family Medicine, University of North Carolina School of Medicine; †Department of Epidemiology, College of Public Health, University of Kentucky, Lexington, KY; §Department of Biostatistics, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill; ‖Department of Neurology, Wake Forest School of Medicine, Winston-Salem; ¶East Carolina University, Brody School of Medicine, Family Medicine Center, Greenville, NC; #Department of Physical Therapy, University of Pittsburgh, Pittsburgh, PA; and **Insight Policy Research Arlington, VA.

All statements in this paper, including its findings and conclusions, are solely those of the authors and do not necessarily represent the views of PCORI, its Board of Governors or the Methodology Committee.

This research was supported by a Patient-Centered Outcomes Research Institute Project Program Award (PCS-1403-14532).

P.W.D. and C.D.B. report ownership interest in Care Directions, Inc.; Duncan is a research advisor for BQ Technologies. The remaining authors declare no conflicts of interest.

Correspondence to: Anna M. Kucharska-Newton, PhD, MPH, Department of Epidemiology, College of Public Health, University of Kentucky, 111 Washington Ave., Suite 212E, Lexington, KY 40536-0003. E-mail: anna_newton@unc.edu.

Supplemental Digital Content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's website, www.lww-medicalcare.com.

Clinical and organizational integration of the emergency department and in-hospital stroke care services has led to significant gains in the management of acute stroke.[1] By contrast, coordination and continuity between hospital stroke care and ambulatory care follow-up have received less attention in policy, research, or practice. Inadequate continuity and coordination can have a profound impact on outcomes for the 50% of stroke patients who are discharged home following an acute stroke hospitalization.[2] The transitional care services provided during the time of transfer between the inpatient stay and outpatient ambulatory care are critical for helping patients manage risk factors and adhere to medications, diet, rehabilitation, and physical activity recommendations—all designed to optimize secondary prevention and recovery.[3] Yet, little is known about the patterns of health care utilization for patients who have experienced a stroke and transitioned home from the hospital.

The importance of care transitions was recognized in several components of the Affordable Care Act, most explicitly with the development and implementation of community-based care transition programs and transitional care management (TCM) billing codes in 2013.[4] TCM billing was designed to facilitate care in the immediate posthospital discharge phase by increasing reimbursement for visits, which are typically more time-consuming than regular evaluation and management visits. Early outpatient follow-up of stroke patients discharged home has the potential to improve care coordination and reduce hospital readmissions[5]; yet, uptake of TCM billing codes, overall, has been low[4,6,7] and more research is needed to understand the variability in TCM billing code utilization in stroke care.[8]

We examined the use of ambulatory primary and specialty care and TCM billing code uptake within 1 year following discharge home from the hospital among acute stroke and transient ischemic attack (TIA) patients from the Comprehensive Post-Acute Stroke Services (COMPASS) Study. The COMPASS study was a cluster-randomized pragmatic trial that evaluated the comparative effectiveness of comprehensive post-acute care versus usual care in 41 hospitals in North Carolina.[9] Functional status, the main outcome of the COMPASS trial, ascertained at 90 days postdischarge, did not differ between the intervention and usual care arms.[10] The goal of the present study was to compare the use of ambulatory care services and TCM billing among patients from the intervention with the usual care hospitals.

METHODS

Study Design and Population

COMPASS study methods have been described elsewhere.[9] Briefly, 41 hospitals (40 hospital units with 2 hospitals paired as a single unit) located in NC were randomized to the COMPASS transitional care (COMPASS-TC) intervention or usual care in this pragmatic trial of transitional care for stroke and TIA patients discharged home. The COMPASS-TC intervention included a telephone follow-up within 2 business days postdischarge and a clinic visit at the discharging hospital within 7–14 days postdischarge. Standardized clinical assessments included social and functional determinants of health. In Phase 1 of the study (2016–2018), hospital staff enrolled 6024 adult stroke and TIA patients. In Phase 2 (2018–2019), hospitals that were randomized to the COMPASS-TC intervention were provided the opportunity to sustain that intervention with minimal study support, and hospitals that were randomized to usual care were able to cross over to the COMPASS-TC intervention. In Phase 2, 11 hospitals sustained the intervention, and 14 hospitals crossed over to the intervention.

Standard Protocol Approvals, Registrations, and Patient Consents

The COMPASS study protocols were approved by the Institutional Review Board (IRB) of Wake Forest University Health Sciences (central IRB), or through local hospital IRBs. The study met the criteria for a waiver of consent and Health Insurance Portability and Accountability Act authorization. The COMPASS study is registered, and all study protocols and statistical analysis plans are available at https://www.clinicaltrials.gov (unique identifier NCT02588664).

Linkage of COMPASS Data With CMS Medicare Claims

Centers for Medicare and Medicaid Services (CMS) Medicare fee-for-service (FFS) claims were linked to COMPASS data to examine healthcare utilization following discharge home. We performed deterministic linkages using the hospital unique CMS Certification number, and patients' gender, date of birth, and dates of admission and discharge as identifiers.[11] Claim dates were obtained from Inpatient, Outpatient, and Carrier files. We used the hospital's unique CMS Certification Numbers, equivalent to provider numbers found in Medicare Inpatient claims, to block the Medicare data before linkage. Additional linkages were conducted to allow for inexact matching; for example, dates were allowed to vary by +/-3 days, or matches of 2 out of the 3 date elements (day, month, year) were allowed. Matches were reviewed by 2 investigators, using admission status (inpatient, ED or observation stay), ICD-10 inpatient diagnostic codes, race, and zip code as verification variables. A third reviewer adjudicated discrepancies in match classification.

Ambulatory Visits

Visits to primary care (family medicine, internal medicine, geriatric medicine, general practice, and preventive medicine), specialty providers (cardiologists, neurologists, and neurosurgeons), and advanced practice providers (nurses, physician assistants, and nurse practitioners) were identified from the CMS Medicare Carrier claims obtained from July 2016 to March 2019, using Healthcare Common Procedure Coding System codes for new and established office visits (99201–99205; 99211–99215), new and established preventive medicine visits (99395–99387; 99395–99397), or consultations (99241–99245). We also identified claims from the Outpatient files using revenue center codes for visits to Federally Qualified Healthcare Centers, Rural Health Centers, and free-standing outpatient clinics (0510; 0516–0523; 0526; 0529). Provider specialty codes were used to identify provider types. We examined the totality of visits to providers over 1 year of follow-up. The primary endpoint was the time to first ambulatory care visit within 1 year following the index stroke discharge.

TCM Billing

Transitional care visits were identified using Healthcare Common Procedure Coding System code for services delivered during a face-to-face visit within 7 days postdischarge (99496) or a face-to-face visit within 14 days postdischarge (99495).

Analysis Cohorts

The analysis cohort for Phase 1 included COMPASS participants with FFS Medicare coverage at baseline (N = 2262). Information concerning beneficiaries' enrollment in FFS Medicare was obtained from monthly indicators of enrollment in Part A, Part B, and Medicaid buy-in available from the annual CMS Medicare Beneficiary Summary. Analyses

included those dually eligible for Medicare and Medicaid (n = 313, 13.8%) and excluded participants enrolled in Medicare Advantage (due to lack of individual claims for beneficiaries) or either Part A or B only. We excluded participants without 30 days of continuous FFS Medicare coverage [N = 10 (0.4%)] from the analyses of the TCM endpoint.

Within hospitals that sustained the COMPASS intervention in Phase 2 (N = 4066 patients), 856 patient records were linked with FFS Medicare claims. Within hospitals that crossed over from the usual care to the intervention, 1359 patient records were linked with FFS Medicare claims.

Statistical Methodology

Baseline characteristics of the study hospitals and patients were tabulated according to the study arm. Analysis of time to ambulatory care visit focused on the estimation of the cause-specific hazard ratio, with censoring at the time of death, loss of qualifying coverage, or the administrative end of the follow-up.[12] Analyses were performed using an adjusted Cox proportional hazards regression model. We used the method of Wei et al,[13] which models the marginal distribution for event times and accounts for the correlation between event times within a hospital unit through the use of a robust sandwich covariance estimator for the regression parameters. Only a small number of patients experienced death without a preceding ambulatory care visit (n = 26, 1.2%); therefore, competing risk models were not used. We used multiple imputations by chained equations to impute missing National Institute of Health Stroke Scale (NIHSS) scores obtained at admission, race, and other potential confounders.[14] Endpoint analyses were conducted on 100 imputed datasets, and estimates were combined using the proc mi suite of SAS commands. The following covariates were incorporated in the analyses: study arm (the effect of interest), race, age, sex, index hospitalization diagnosis (stroke, TIA), evidence of prior stroke or TIA diagnosis, and NIHSS category. In Phase 2 analyses, the study phase was included as the effect of interest in place of the study arm.

The analysis of the use of TCM billing codes (binary endpoint) employed logistic mixed model that included a hospital-specific random effect and the covariates specified above. We excluded participants without 30 days of continuous FFS Medicare coverage (N = 10, 0.4%). The analysis sample included patients with a continuous 30-day coverage period following discharge from the index hospitalization [overall N = 2252 (96.6%)].

We performed sensitivity analyses for both endpoints, adjusting for additional patient characteristics to evaluate the robustness of findings to covariate adjustment.

All analyses were performed overall and within strata of the race (white, nonwhite), sex, age categories (< 65; 65– < 75; 75– < 85; ≥ 85 y), NIHSS categories (0, 1–4, 5–15 and 16–42; where higher values are associated with greater stroke severity),[15] and diagnosis (stroke, TIA). In sensitivity analyses, participants were censored at the time of hospital readmission, admission to skilled nursing, or inpatient rehabilitation facility. In additional sensitivity analyses, we limited inferences to the population of patients with the COMPASS-TC ambulatory clinic visit by excluding from analyses the ambulatory care visits corresponding to the COMPASS-TC visit and examining time to first nonCOMPASS ambulatory care visit.

The SAS 9.4 (SAS Institute) programming software was used in all analyses.

Data Availability

CMS Medicare claims, on which this work was based, are provided to individual investigators under a specific Data Use Agreement and cannot be shared across institutions. Analytic methods and study materials will be made available to other researchers for purposes of reproducing results or replicating procedures upon reasonable request to the corresponding author and in accordance with Patient-Centered Outcomes Research Institute's Policy for Data Access and Data Sharing.

RESULTS

Of the 2262 COMPASS study patients enrolled in FFS Medicare at the time of index hospital discharge (CONSORT diagram, Fig. 1), 1069 were in the intervention arm, (19 hospitals) and 1193 in the usual care arm, (20 hospitals). The 2 groups of patients differed by the characteristics of the index hospitalization hospitals (Table 1); specifically, compared with hospitals randomized to usual care, those randomized to deliver the intervention were more likely to have Joint Commission certification as a primary stroke center (81.1% vs. 76.1%), less likely to have an academic affiliation (25.8% vs. 43.4%), and less likely to be located in an urban setting (55.2% vs. 84.7%). Compared with Medicare FFS patients in usual care hospitals, the patients admitted to intervention hospitals were similar overall, except that in the intervention group, there was a lower proportion of women (49.1% vs. 54.7%) and those residing in metropolitan areas (54,7% vs. 78.6%) and a greater proportion of patients of White race (85.7% vs. 76.6%). The distributions of Medicare FFS patients in the 2 groups were not statistically different with respect to stroke versus TIA diagnosis, stroke severity, medical history and comorbidities, admission status, hospital length of stay, and ambulation status at discharge.

As is shown in Table 2, the average number of ambulatory care visits within 30 days following index discharge was 2.1 (SD 1.5) across both groups and slightly higher in the intervention compared with the usual care group [2.3 (SD 1.4) vs. 1.9 (SD 1.5)]. By 90 days postdischarge, the mean number of ambulatory care visits was comparable by study arm (4.6 [SD 2.8] in the intervention arm; 4.3 [SD 3.1] in the usual care arm).

Overall, 251 (11.1%) patients did not have an ambulatory care visit by 30 days postdischarge. That proportion was greater in the usual care group (14.7%) compared with the intervention group (7%). However, by 90 days postdischarge, the total proportion of patients without ambulatory care visits decreased to 6.0% (3.7% intervention vs. 8.1% usual care).

During the first 30 days of follow-up after hospital discharge, 63.0% of patients saw a primary care provider, a proportion that was slightly higher among those discharged from hospitals in the intervention arm (65.4%) compared with the usual care arm (60.8%) (Table 2). Likewise, the proportion of patients with visits to advanced practice providers (nurse practitioners or physician's assistants) was also greater in the intervention arm (42.1%) than in the usual

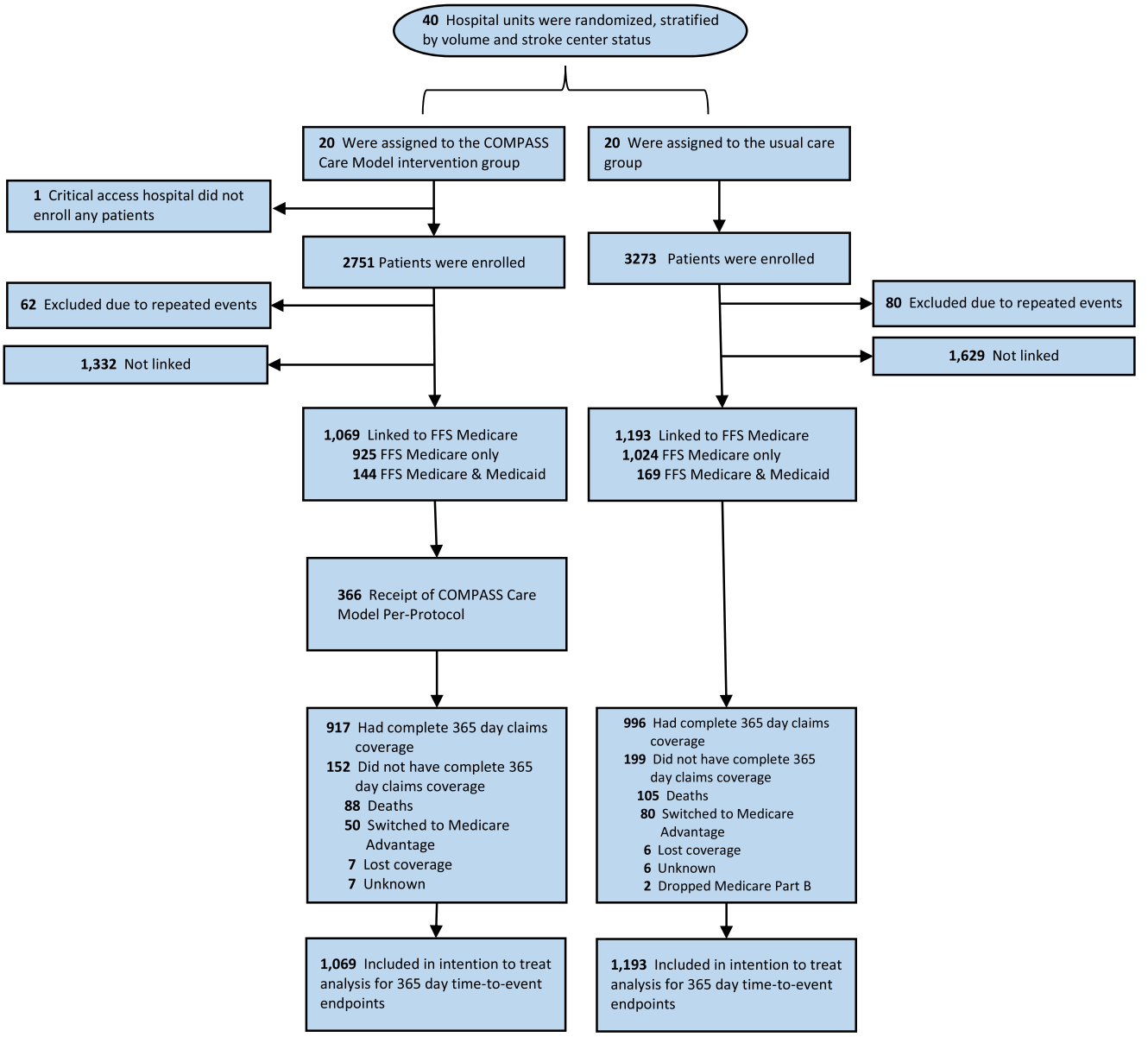

FIGURE 1. Consort Diagram of the COMPASS Study FFS Medicare Population. COMPASS indicates Comprehensive Post-Acute Stroke Services; FFS, Fee-For-Service. full color online

care arm (25.0%). The overall proportions of patients with visits to neurologists or neurosurgeons (16.7%), cardiologists (15.6%), and other providers (30.7%) were comparable between the 2 study arms. We observed a similar pattern of provider visits during the 90-day postdischarge period.

The majority of the first postdischarge ambulatory care visit (Table 3) was to primary care providers (48.3%), followed by visits to advance practice providers (20.6%). The greatest difference observed between the 2 study arms was in the proportion of first visits to advance practice providers, with 23.8% of such visits in the intervention arm and 17.7% in the usual care arm.

Relative to usual care, the COMPASS-TC intervention was associated with a 27% greater hazard of completing an ambulatory care visit within 1 year postdischarge (Table 4, HR = 1.27 [95% CI 1.14, 1.41]). This estimate was not attenuated in sensitivity analyses designed to evaluate the impact of inpatient readmissions or admissions to a skilled nursing or inpatient rehabilitation facility (Supplemental Table 1, Supplemental Digital Content 1, http://links.lww.com/MLR/C556) or covariate adjustment. Some attenuation, however, was observed when we excluded ambulatory claims corresponding to COMPASS-TC visits [HR = 1.21 (95% CI 1.00, 1.25)].

Subgroup analyses within the strata of race, gender, age categories, NIHSS categories, and type of diagnosis (stroke vs. TIA), did not reveal appreciable differences in estimates (Supplemental Table 2, Supplemental Digital Content 2, http://links.lww.com/MLR/C557).

TABLE 1. Baseline Characteristics of Patients According to Study Arm, Among Those With Baseline FFS Coverage

Characteristic	Intervention (N = 1069), n (% (95% CI))	Usual care (N = 1193), n (% (95% CI))
Hospitals		
No. hospital units	19	20
Joint Commission Primary Certified Stroke Center	867 (81.1 (78.8, 83.5))	908 (76.1 (73.7, 78.5))
Any academic affiliation	276 (25.8 (23.2, 28.4))	518 (43.4 (40.6, 46.2))
Hospital geographic location		
Central Piedmont	530 (49.6 (46.6, 52.5))	536 (44.9 (42.1, 47.7))
West	384 (35.9 (33, 38.7))	231 (19.4 (17.2, 21.6))
East	155 (14.5 (12.4, 16.6))	427 (35.8 (33.1, 38.5))
Urban-rural classification		
Metro	590 (55.2 (52.2, 58.1))	1011 (84.7 (82.7, 86.7))
Micro	355 (33.2 (30.4, 36))	175 (14.7 (12.7, 16.7))
Rural	124 (11.6 (9.7, 13.5))	8 (0.7 (0.2, 1.2))
Annual stroke discharge volume		
< 100 patients	83 (7.8(6.2, 9.4)	65 (5.4 (5.2, 7.8))
100- < 300 patients	349 (32.7 (29.9, 35.5))	551 (46.2 (43.4, 49))
≥ 300 patients	637 (59.6 (56.7, 62.5))	578 (48.4 (45.6, 51.2))
Patients		
No. patients	1069	1193
Age, years (mean, (SD))	74.9 (10.2)	73.9 (10.5)
Female sex	525 (49.1 (46.1, 52))	653 (54.7 (51.9, 57.5))
White race	912 (85.7 (83.6, 87.7))	906 (76.6 (74.2, 79))
Missing	5	11
Geographic area of residence		
Metro	584 (54.7 (51.7, 57.6))	938 (78.6 (76.3, 80.9))
Micro	303 (28.4 (25.7, 31.1))	179 (15 (13, 17))
Small Town/Rural	181 (17.0 (14.8, 19.3))	77 (6.5 (5.1, 7.9))
Missing	1	0
Stroke diagnosis		
Stroke	648 (60.6 (57.7, 63.5))	702 (58.8 (56, 61.6))
TIA	421 (39.4 (36.5, 42.3))	492 (41.2 (38.4, 44))
Aphasia at presentation	236 (22.1 (19.6, 24.5))	306 (25.6 (23.1, 28.1))
NIHSS score		
0	417 (39.3 (36.4, 42.2))	436 (37.8 (35, 40.6))
1-4	494 (46.6 (43.6, 49.5))	552 (47.9 (45.1, 50.7))
5-15	135 (12.7 (10.7, 14.6))	143 (12.4 (10.5, 14.3))
16–42	15 (1.5 (0.8, 2.2))	22 (1.9 (1.1, 2.7))
Missing	8	41
Medical history and comorbidity		
Hypertension	849 (79.4 (77, 81.8))	946 (79.2 (76.9, 81.5))
Diabetes Mellitus	363 (34.0 (31.2, 36.8))	419 (35.1 (32.4, 37.8))
Prior Stroke	229 (21.4 (18.9, 23.8))	276 (23.1 (20.7, 25.5))
Prior TIA	131 (12.3 (10.3, 14.2))	148 (12.4 (10.5, 14.3))
Atrial fibrillation or flutter	204 (19.1 (16.7, 21.4))	216 (18.1 (15.9, 20.3))
Heart failure	99 (9.3 (7.6, 11))	131 (11 (9.2, 12.8))
Coronary artery disease	267 (25.0 (22.4, 27.5))	280 (23.5 (21.1, 25.9))
Depression	97 (9.1 (7.4, 10.8))	149 (12.5 (10.6, 14.4))
Smoking in past year	143 (13.4 (11.4, 15.4))	178 (14.9 (12.9, 16.9))
Body mass index (kg/m^2) median (range)	27.7 (24.2–31.3)	27.0 (23.7–31.2)
Admission status		
Inpatient	835 (78.1 (75.6, 80.5))	943 (79 (76.7, 81.3))
ED	27 (2.5 (1.6, 3.4))	53 (4.4 (3.2, 5.6))
Observation	206 (19.3 (16.9, 21.6))	198 (16.6 (14.5, 18.7))
Other	1 (0.1)	0 (0.0)
Hospital length of stay, days median (range)	2 (1–3)	2 (1–3)
Missing	234	251
Ambulatory status at discharge		
Ambulate independent	742 (89.2 (87.3, 91))	832 (88.7 (86.9, 90.5))
With assistance	72 (8.7 (7, 10.3))	91 (9.7 (8, 11.4))
Unable to ambulate	18 (2.2 (1.3, 3))	15 (1.6 (0.9, 2.3))
Missing	237	256
Incomplete 90-day coverage	15 (1.4 (0.7, 2.1))	17 (1.4 (0.7, 2.1))

Characteristic is represented as n (% (95% CI)) unless otherwise noted.

Overall, 584 (25.8%) patients had TCM billing codes for visits occurring within either 7 or 14 days postdischarge (Table 2). That proportion was 32.3% in the intervention group and 20.0% in the usual care group. In covariate-adjusted analyses, the COMPASS-TC intervention resulted in an 87% greater odds of TCM billing,

TABLE 2. Use of Ambulatory Care Services Following Poststroke Discharge Home. The COMPASS Study

	Overall (N = 2262)	Intervention (N = 1069)	Usual care (N = 1163)
No. ambulatory care visits within 30 d postdischarge, mean (SD, N (%))	2.1 (1.5)	2.3 (1.4)	1.9 (1.5)
Visit types in first 30 d, n ((% (95% CI))			
PCP	1425 (63 (61.0, 65.0))	699 (65 (62.5 ,68.3))	726 (60.8 (58,63.6))
Neurologist	377 (16.7 (15.2, 18.2))	199 (18.6 (16.3, 20.9))	178 (14.9 (12.9, 16.9))
Cardiologist	352 (15.6 (14.1, 17.1))	179 (16.7 (14.5, 18.9))	173 (14.5 (12.5, 16.5))
APP	749 (33.1 (31.2, 35))	450 (42.1 (39.1, 45.1))	299 (25.0 (22.5, 27.5))
Other or unknown	694 (30.6 (28.7, 32.5))	351 (32.8 (30, 35.6))	343 (28.7 (26.1, 31.3))
No visit within 30 d	251 (11.1 (9.8, 12.4))	75 (7.0 (5.5, 8.5))	176 (14.7 (12.7, 16.7))
Number of ambulatory care visits within 90 d postdischarge, mean (SD)	4.4 (3.0 (2.3, 3.7))	3.7 (2.8 (1.8, 3.8))	4.3 (3.1 (2.1, 4.1))
Visit types in first 90 d, n ((% (95% CI))			
PCP	165 (73 (71.2, 74.8))	798 (74.7 (72.1, 77.3))	854 (71.5 (68.9, 74.1))
Neurologist	623 (27.5 (25.7, 29.3))	293 (27.4 (24.7, 30.1))	330 (27.6 (25, 30.2))
Cardiologist	600 (26.5 (24.7, 28.3))	299 (28.0 (25.3,3 0.7))	301 (25.2 (22.7, 27.7))
APP	999 (44.1 (42.1, 46.1))	567 (53.0 (50, 56))	432 (36.2 (33.4, 39))
Other or unknown	1245 (55.0 (53, 57))	614 (57.4 (54.4, 60.4))	631 (52.9 (50, 55.8))
No visit within 90 d	136 (6.0 (5.0, 7.0))	7 (3.7 (2.6, 4.8))	97 (8.1 (6.5, 9.7))
Time to first postdischarge ambulatory care visit, days for those with a visit within 1 y (d)			
N with visit (% (95% CI))	2180 (96.3 (95.5, 97.1))	1050 (98.2 (97.4, 99.0))	1130 (97.1 (96.1, 98.1))
Mean (SD)	14.3 (31.1)	12.0 (26.0)	16.3 (35.1)
Time to first primary care provider visit, days			
N with visit (% (95% CI))	1089	505	584
Mean (SD)	10.7 (17.2)	10.3 (17.2)	11.0 (17.3)
Time to first specialty care provider visit, days			
N with visit (% (95% CI))	297	138	159
Mean (SD)	13.3 (27.5)	11.0 (26.6)	15.2 (28.1)
Proportion of patients with claims for TCM billing codes within 7 d, n, (%, (95% CI))	348 (15.4 (13.2, 17.6))	200 (18.7 (16.4, 21.0))	148 (12.7 (10.7, 14.7))
Proportion of patients with claims for TCM billing codes within 14 d, n, (%, (95% CI))	283 (12.5 (10.5, 14.5))	172 (16.1 (13.9, 18.3))	111 (9.5 (7.7, 12.6))
Proportion of patients with claims for TCM billing codes overall, n, (%, (95% CI))	584 (25.8 (24, 27.6))	345 (32.3 (29.5, 35.1))	239 (20.0 (17.7, 22.3))

47 patients had a TCM claim within both 7 and 14 days.
*Among those who had an event within 1 year.
†Death considered as competing risk for time to event analyses.
‡Specialty care includes outpatient visits to cardiology, neurology and neurosurgery providers.
*In the intervention arm, the proportion of patients with an ambulatory care visit within a certain time frame will also include patients who received the COMPASS intervention.
TCM indicates transitional care management.

compared with usual care [Table 4, OR = 1.87 (95% CI 1.54, 2.27)].

Results of the Phase 2 analyses are presented in Supplemental Table 3, Supplemental Digital Content 3, http://links.lww.com/MLR/C558. Among patients discharged from the Phase 1 intervention hospitals that sustained the COMPASS-TC care model in Phase 2, the use of postdischarge ambulatory care services decreased modestly relative to the Phase 1 intervention [HR = 0.88 (95% CI 0.81, 0,96)]. The use of TCM billing codes increased by 29% relative to Phase 1, however, that increase was not statistically significant [OR = 1.29 (95% CI 0.95, 1,74)]. Among patients discharged from the Phase 1 usual care hospitals that crossed over in Phase 2 to the COMPASS-TC intervention, the use of postdischarge ambulatory care increased by 17% relative to Phase 1 [HR = 1.17 (95% CI 1.08, 1.26)], and use of TCM billing codes increased by 55% [OR = 1.55 (95% CI 1.18, 2.03)].

DISCUSSION

In this multicenter pragmatic trial of transitional care for stroke patients discharged home, we observed a greater use of posthospital ambulatory primary and specialty care services (physicians and APPs) in the 90 days after the index stroke hospital discharge among patients randomized to hospitals that delivered the COMPASS-TC intervention and a greater use of TCM billing codes, compared with patients treated at hospitals that delivered their usual care. The effect of the intervention was observed overall and within strata defined by sex, race, age categories, and severity of the index stroke event. Visits to primary care clinicians constituted the majority of visits overall and the majority of first posthospital visits in both study arms over 90 days. The COMPASS-TC intervention was also associated with an increase in stroke patients' use of APP services relative to usual care.

The objectives of the COMPASS trial were to implement a clinical model of care that would be consistent with CMS reimbursement for TCM.[9] The design of the study was motivated by our prior work with the Transition Coaching for Stroke model that demonstrated reduced readmissions[16] and encouraging effects on stroke patients' functional recovery resulting from early supported discharge transitional care interventions implemented in the United Kingdom and Canada.[17–20] The pragmatic nature of this study provided an assessment of the real-world implementation of the COMPASS-TC model in a diverse set of hospitals.[21] Our objective

TABLE 3. Provider Specialty at First Ambulatory Care Visit Following Index Hospitalization and use of TCM codes

Provider type, n (%)	Overall (N = 2263)	Intervention group (N = 1069)	Usual care group (N = 1194)
PCP	1093 (48.3 (6.2, 50.4)	506 (47.3 (44.3, 50.3))	587 (49.2 (46.4, 52.0))
APP	465 (20.6 (18.9, 22.3))	254 (23.8 (21.2, 26.4))	211 (17.7 (15.5, 19.9))
Neurology and neurosurgery	167 (7.4 (6.3, 8.5))	85 (8.0 (6.4, 9.6))	82 (6.9 (5.5, 8.3))
Cardiology	130 (5.7 (4.7, 6.7))	53 (5.0 (3.7, 6.3))	77 (6.5 (5.1, 7.9))
Other	294 (13.0 (11.4, 14.4))	127 (11.9 (10.0, 13.8))	167 (14.0 (12.0, 16.0))
Unknown	36 (1.6 (1.1, 2.1))	26 (2.4 (1.5, 3.3))	10 (0.8 (0.3, 1.3))
No Visit	78 (3.5 (2.7, 4.3)	18 (1.7 (0.9, 2.5))	60 (5.0 (3.8, 6.2))
Use of TCM codes	—	—	—
Within 7 d	—	—	—
Within 14 d	—	—	—

APP indicates advanced practice provider; PCP, primary care provider; TCM, Transitional care management.

was to provide a pathway for the patient and caregivers from inpatient care to ongoing outpatient care and enable continuity between inpatient and outpatient communications for these patients, who often have ongoing complex clinical needs. Comparing TCM billing and ambulatory care utilization in intervention and usual care arms allows us to evaluate our progress in achieving this objective.

The period of the first 90 days after hospital discharge is when stroke survivors are more likely to have a recurrence and require support managing their chronic disease, comorbidities, health behaviors, and social determinants of health.[22] Physical and emotional effects of stroke may be prolonged and, if not managed consistently in ambulatory care settings, may lead to unplanned hospitalizations. Guidelines for stroke recovery support the involvement of primary care providers in the management of stroke patients discharged home[23]; however, there is little consensus regarding the best way to coordinate post-acute stroke care between inpatient and outpatient settings or between primary care and specialty care providers.[24] Although this study was not designed to assess the roles of primary and specialty care providers in the care of stroke survivors discharged home, it provides evidence that both levels of care are being utilized by stroke patients. Current poststroke ambulatory care is siloed, with little communication between the provider groups.[25] Data from the National Health Interview Survey suggest that, although 85% of stroke survivors report having had a visit to a primary care provider within 12 months postdischarge, close to half will not have seen a neurologist during that time.[26] Importantly, federally-subsidized health insurance is available to nearly all individuals over the age of 65, but stroke survivors younger than 65 may have more limited access to physicians and medications than older stroke patients.[27] It is important to note, however, that the COMPASS intervention, as delivered, did not impact readmission rates or patients' functional status, despite the increased rate of ambulatory visits relative to usual care.[10,28] Additional research identifying effective models of cooperative and coordinated post-acute stroke care is therefore needed.

In recognition of the importance of the transition between inpatient and outpatient settings, and the need to reduce 30-day rehospitalizations, CMS developed (effective January 1, 2013) TCM reimbursement codes for patients with moderate or high-complexity medical needs discharged from inpatient care. Organized and timely follow-up after discharge home to the community was expected to improve patient outcomes and reduce costs associated with preventable readmissions. In this study, although we observed greater use of the TCM codes in the intervention arm, as compared with the usual care arm, the overall uptake of those codes was low: only 15.4% for TCM services delivered within 7 days and 13.2% for TCM services delivered within 14 days. Our findings are consistent with the national data on TCM code use, which suggest a 12.3% adoption rate.[6] This low rate may be due to low reimbursement offered by insurers relative to costs associated with the implementation of TCM services and the more rigid criteria for meeting billing requirements for TCM.

This study is subject to several limitations. Implemented within a highly pragmatic trial, COMPASS-TC was integrated into hospitals' patient care without additional staff resources.[10] As such, only 34% of COMPASS patients enrolled in the intervention arm returned as planned to the study clinics for their first postdischarge ambulatory care visit. The challenges of COMPASS-TC implementation were similar to those reported in the CMS Community-Based Care Transitions Program and other large, multicenter pragmatic trials.[29] Still, the results of our intention-to-treat analysis should be interpreted with caution. The limited return to planned study clinic visits combined with a preponderance of follow-up visits to primary care providers in the intervention arm strongly suggests patient preference for established relationships with a primary care provider and/or practice. Further, the high rate of postdischarge visits to advanced practice providers (APP) was likely influenced by the intentional recommendation provided by the study to engage APPs as transitional care providers in the intervention hospitals, despite the fact that the COMPASS intervention may not have been delivered (2-day phone call, functional assessment, and individualized care plan). The

TABLE 4. Comparative Effectiveness of the COMPASS Intervention on Ambulatory Care and Transitional Care Management

Endpoint		ITT estimand (95% CI)
TCM billing	Odds Ratio	1.87 (1.54–2.27)
Ambulatory care visit	Hazard Ratio	1.27 (1.14–1.41)

CI indicates confidence interval; ITT, intention-to-treat; TCM, transitional care management.

COMPASS trial was pragmatically designed to implement 1 transitional care visit as part of the intervention. A more comprehensive focus on a broadly defined transitional period engaging patients in different aspects of their care over time was outside of the scope of this trial. For example, a focus on hypertension control and physical activity, with longer-term management of lifestyle factors and comorbidities, would have been an ideal facet for secondary prevention and an opportunity for future studies. In addition, hospitals were randomized into the study according to the Joint Commission primary stroke center certification status and stroke patient discharge volume. The observed difference in Joint Commission certification status within the population of COMPASS patients enrolled in CMS Medicare may have introduced a bias in effect estimates. Another limitation is that the analyses here were limited to the population of COMPASS patients whose data were linked to Medicare FFS claims. Inferences are, therefore, limited to Medicare FFS beneficiaries. Although the use of ambulatory care service postdischarge was not associated with the rate of readmission,[30] we did not examine that association in detail. We could not, therefore, determine whether more visits were warranted or whether the higher number of ambulatory care visits among patients in the intervention group was a potential sign of increased utilization.

In conclusion, the COMPASS transitional care intervention for patients discharged home following a stroke or TIA was associated positively with the presence of a post-hospital ambulatory care visit within 90 days postdischarge and a shorter time to the first postdischarge ambulatory care visits. Further research should examine the effectiveness of such transitional care models regarding the coordination of care between primary care and specialty providers and its effectiveness on longer-term patient outcomes.

ACKNOWLEDGMENTS

The authors thank Gary Hunt, Molly Wen, and Samantha Levey for their valuable contributions to this analysis, Janet Prvu Bettger for her critical review of defining outcomes and communicating findings, and all COMPASS patients who made this study possible.

REFERENCES:

1. Baeza JI, Fraser A, Boaz DA. Integration in stroke services: the challenges for primary and community care services. *London J Prim Care*. 2012;5:24–28.
2. Prvu Bettger J, McCoy L, Smith EE, et al. Contemporary trends and predictors of postacute service use and routine discharge home after stroke. *J Am Heart Assoc*. 2015;4:e001038.
3. Puhr MI, Thompson HJ. The use of transitional care models in patients with stroke. *J Neurosci Nurs*. 2015;47:223–234.
4. Bindman AB, Cox DF. Changes in health care costs and mortality associated with transitional care management services after a discharge among medicare beneficiaries. *JAMA Intern Med*. 2018;178:1165–1171.
5. Terman SW, Reeves MJ, Skolarus LE, et al. Association between early outpatient visits and readmissions after ischemic stroke. *Circ Cardiovasc Qual Outcomes*. 2018;11:e004024.
6. Agarwal SD, Barnett ML, Souza J, et al. Adoption of medicare's transitional care management and chronic care management codes in primary care. *JAMA*. 2018;320:2596–2597.
7. Gardner RL, Youssef R, Morphis B, et al. Use of chronic care management codes for medicare beneficiaries: a missed opportunity? *J Gen Intern Med*. 2018;33:1892–1898.
8. Agarwal SD, Barnett ML, Souza J, et al. Medicare's care management codes might not support primary care as expected. *Health Aff*. 2020;39:828–836.
9. Duncan PW, Bushnell CD, Rosamond WD, et al. The comprehensive post-acute stroke services (COMPASS) study: design and methods for a cluster-randomized pragmatic trial. *BMC Neurol*. 2017;17:133.
10. Duncan PW, Bushnell CD, Jones SB, et al. Randomized pragmatic trial of stroke transitional care: The COMPASS study. *Circ Cardiovasc Qual Outcomes*. 2020;13:e006285.
11. Hammill BG, Curtis LH, Qualls LG, et al. Linkage of laboratory results to medicare fee-for-service claims. *Med Care*. 2015;53:974–979.
12. Austin PC, Lee DS, Fine JP. Introduction to the analysis of survival data in the presence of competing risks. *Circulation*. 2016;133:601–609.
13. Wei LJ, Lin DY, Weissfeld LA. Regression analysis of multivariate incomplete failure time data by modeling marginal distributions. *J Am Statist Assoc*. 1989;84:1065–1073.
14. Azur MJ, Stuart EA, Frangakis C, et al. Multiple imputation by chained equations: what is it and how does it work? *Int J Methods Psychiatr Res*. 2011;20:40–49.
15. Reeves M, Khoury J, Alwell K, et al. Distribution of National Institutes of Health stroke scale in the Cincinnati/Northern Kentucky Stroke Study. *Stroke*. 2013;44:3211–3213.
16. Condon C, Lycan S, Duncan P, et al. Reducing readmissions after stroke with a structured nurse practitioner/registered nurse transitional stroke program. *Stroke*. 2016;47:1599–1604.
17. Langhorne P, Taylor G, Murray G, et al. Early supported discharge services for stroke patients: a meta-analysis of individual patients' data. *Lancet*. 2005;365:501–506.
18. Olson DM, Bettger JP, Alexander KP, et al. Transition of care for acute stroke and myocardial infarction patients: from hospitalization to rehabilitation, recovery, and secondary prevention. *Evid Rep Technol Assess (Full Rep)*. 2011:1–197.
19. Cameron JI, O'Connell C, Foley N, et al. Canadian stroke best practice recommendations: managing transitions of care following Stroke, Guidelines Update 2016. *Int J Stroke*. 2016;11:807–822.
20. Fisher R, Chouliara N, Byrne A, et al. What is the impact of large-scale implementation of stroke Early Supported Discharge? A mixed methods realist evaluation study protocol. *Implement Sci*. 2019;14:61.
21. Johnson AM, Jones SB, Duncan PW, et al. Hospital recruitment for a pragmatic cluster-randomized clinical trial: Lessons learned from the COMPASS study. *Trials*. 2018;19:74.
22. Rohweder G, Salvesen O, Ellekjaer H, et al. Hospital readmission within 10 years post stroke: frequency, type and timing. *BMC Neurol*. 2017;17:116.
23. Winstein CJ, Stein J, Arena R, et al. Guidelines for Adult stroke rehabilitation and recovery: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2016;47:e98–e169.
24. Lim L, Mant J, Mullis R, et al. When is referral from primary care to specialist services appropriate for survivors of stroke? A modified RAND-appropriateness consensus study. *BMC Fam Pract*. 2020;21:66.
25. Aquino M, Mullis R, Moore C, et al. "It's difficult, there's no formula": qualitative study of stroke related communication between primary and secondary healthcare professionals. *Int J Integr Care*. 2020;20:11.
26. Levine DA, Neidecker MV, Kiefe CI, et al. Racial/ethnic disparities in access to physician care and medications among US stroke survivors. *Neurology*. 2011;76:53–61.
27. Levine DA, Kiefe CI, Houston TK, et al. Younger stroke survivors have reduced access to physician care and medications: National Health Interview Survey from years 1998 to 2002. *Arch Neurol*. 2007;64:37–42.
28. Bushnell CD, Kucharska-Newton AM, Jones SB, et al. Hospital readmissions and mortality among fee-for-service medicare patients with minor stroke or transient ischemic attack: findings from the COMPASS Cluster-Randomized Pragmatic Trial. *J Am Heart Assoc*. 2021;10:e023394.
29. Patsopoulos NA. A pragmatic view on pragmatic trials. *Dialogues Clin Neurosci*. 2011;13:217–224.
30. Bushnell CD, Kucharska-Newton AM, Jones S, et al Hospital Readmissions and Mortality in Patients with Minor Stroke or Transient Ischemic Attack: The COMPASS Study. *Stroke*. Under Review.