COMPASS

COMPREHENSIVE POST-ACUTE STROKE SERVICES

Statistical Analysis Plan: Claims Analysis Addendum

July 9 2020

Claims Analysis Addendum

STUDY TITLE: Comprehensive Post-Acute Stroke Services (COMPASS) Study

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1 LIST OF ABBREVIATIONS

Term	Abbreviation
Agency for Healthcare Research and Quality	AHRQ
Blue Cross & Blue Shield of North Carolina	BCBSNC
Centers for Medicare & Medicaid Services	CMS
Current Procedural Terminology	CPT
Emergency department	ED
Healthcare Common Procedure Coding System	HCPCS
International Classification of Diseases	ICD
Inpatient rehabilitation facility	IRF
Post-acute care	PAC
Skilled nursing facility	SNF
Transient ischemic attack	TIA
Transitional care management	TCM
Usual care	UC

2 CLAIMS STATISTICAL ANALYSIS ADDENDUM OBJECTIVES

The objective of the COMPASS Study as it pertains to this addendum is to evaluate the comparative effectiveness of the COMPASS Intervention compared to usual care (UC) with respect to a collection of claims-based outcomes and mortality. The COMPASS Study design is described in the Phase 1 Statistical Analysis Plan, available at https://clinicaltrials.gov/ct2/show/NCT02588664.

3 ADMINISTRATIVE DATA SOURCES & LINKAGE

3.1 Data Sources

Administrative claims data will be used to examine the following secondary endpoints: 1) hospital readmissions, 2) emergency department visits, 3) skilled nursing and inpatient rehabilitation facility admissions, 4) ambulatory care visits, and 5) transitional care management services. Patients' longitudinal claims data for inpatient and ambulatory care services utilized in the year after index discharge will be obtained for Centers for Medicare and Medicaid Services (CMS) Medicare fee-for-service, State Medicaid, and Blue Cross Blue Shield of North Carolina (BCBSNC) beneficiaries residing in North Carolina.

Administrative data will be obtained from the Centers for Medicare and Medicaid Services (Medicare), the Division of Medical Assistance, NC Department of Health and Human Services (Medicaid), and the BCBSNC. Claims from each of the insurance providers contain several component datasets. Each payer's data include a beneficiary summary or enrollment file, which captures each patient's demographic and enrollment information. Additional datasets containing the claims provide detailed information on inpatient and outpatient healthcare utilization. The healthcare utilization file structure and organization vary by insurance provider (e.g., Medicare, BCBSNC). Files are broadly categorized under: Inpatient; Outpatient; Physician; Prescription drugs; Medical equipment; post-acute care (e.g., skilled nursing facility, home health); and hospice or end-of-life-care services. The administrative claims will be obtained through data re-use agreements and direct data purchase.

When harmonized, these claims files will allow us to ascertain details about healthcare service utilization, including diagnoses and procedures for which an insurance claim was filed. The analytical file will be organized at the beneficiary level, with multiple observations reflecting relevant healthcare encounters. Primary and comorbid diagnoses will be identified using the International Classification of Disease Diagnosis Group coding, version 10 (ICD-10-CM diagnoses). Diagnostic discharge codes will also be grouped into clinically meaningful categories using the Clinical Classification Software.[1] Healthcare procedure and service utilization will be defined from the Healthcare Common Procedure Coding System, including Current Procedural Terminology codes and ICD-10-CM procedure codes.

Combining the codes from all relevant insurance claims files will enable us to observe patients before and during the hospital encounter, and in post-discharge follow-up. Service utilization and outcomes can be observed within the claims files as long as the patient maintains continuous insurance coverage and an insurance claim is filed for the event.

3.2 Linkage Methodology

Given that the claims may not include direct patient identifiers that can be merged with study data, we need to develop a linkage methodology. We will document the proportion of records that were successfully linked by data source. Following is a description of the proposed methodology for each data source.

Medicare. The Medicare Master beneficiary Summary File will be linked with COMPASS patient data using iterative deterministic linkage protocols. Linkage variables will include: gender, date of birth, index discharge hospital, and date of discharge/dates of service. Dates will be allowed to match within +/- 3 days or on 2 of 3 date elements (day, month, and year). Such fuzzy matches will be reviewed and verified the presence of stroke-related ICD10 diagnostic codes in the claims and comparisons of Zip code information between COMPASS records and Medicare enrollment data.

BCBSNC. The BCBSNC claims will be linked with the COMPASS data using an iterative deterministic linkage protocol. Linkage variables will include patients' first name, middle name (initial) and last name, as well as patients' date of birth and gender. Manual review of matches will be conducted by two independent reviewers with discrepancies adjudicated by a third reviewer. Review of the possible linkages will include comparison of service dates (e.g., discharge date) and patient addresses available from the BCBS NC claims and the COMPASS data.

Medicaid. The North Carolina Department of Health and Human Services, as the custodian of the state Medicaid data, will perform the linkage of those data with COMPASS patient data, using as linkage variables patients' first name, middle name (initial) last name, date of birth and sex.

Mortality. COMPASS data will be linked to the North Carolina mortality data for the years 2016-2020 to obtain information on death up to 1 year following the index hospitalization discharge. A deterministic linkage of the mortality data with COMPASS data will be performed using name, address, sex, and date of birth as the identifier variables. Two independent reviewers will determine the matches and a third person will adjudicate differences.

4 ENDPOINTS

Table 1 describes the set of outcomes and associated endpoints to be analyzed as a part of the claims analyses described in this statistical analysis plan. For each outcome, the data source, endpoint, reference period for which the endpoint is defined, and estimand are provided. For ITT analyses, the estimand defines a comparison between the COMPASS Intervention arm and the UC arm.

Table 1. Endpoints for Claims and Mortality Analysis

Source	Outcome	Endpoint	Reference Period	Estimand
Claims	All Cause Hospital Readmissions	Incidence	30-days post index hospitalization discharge (unplanned)	Odds Ratio
		Incidence	90-days post index hospitalization discharge (unplanned)	Odds Ratio
		Time-to-hospital readmission	1-year post index hospitalization discharge	Hazard Ratio from recurrent events model
	Recurrent Stroke Hospital Readmissions	Time-to-recurrent stroke	1-year post index hospitalization discharge	Hazard Ratio from recurrent events model
	Emergency Department Visits	Time-to-first emergency department visit	1-year post index hospitalization discharge	Hazard Ratio
	Admission to Skilled Nursing/Inpatient Rehab Facility	Time-to first SNF/IRF admissions	1-year post index hospitalization discharge	Hazard Ratio
	Continuity of Care	Time-to-first visit with any provider	1-year post index hospitalization discharge	Hazard Ratio
	TCM Billing	Incidence	14-days post index hospitalization discharge	Odds Ratio
Claims & Mortality Index	All-Cause Mortality	Time-to-death by any cause	1-year post index hospitalization discharge	Hazard Ratio

Specific details regarding the definition of the endpoints is given subsequently in Section 4. Details regarding the analysis populations for the Phase 1 and Phase 2 analyses is given in Section 5. Specific details on statistical analysis methodology for endpoints having a common estimand (e.g., an odds ratio) are described in Section 6 as is general statistical methodology pertinent to all analyses.

4.1 All-Cause Hospital Readmissions

The primary readmission endpoint is defined as incidence of readmission (as an inpatient or under observation status) to a non-federal, acute care hospital for any unplanned reason within 90 days of discharge from the index stroke event. Reasons for hospital readmission will be

defined using the principal ICD-10-CM diagnostic code from the associated claim. Planned readmissions will be defined as a hospital readmission for a scheduled procedure for which acute stroke is not also listed as the primary discharge diagnosis code (suggesting the readmission was due to recurrent stroke) and will be excluded.[2] The following procedures will be considered as planned following the index stroke hospitalization: carotid endarterectomy, carotid stenting, percutaneous carotid stenting, intracranial and intervertebral stenting, patent foramen ovale closure, ablation, aortic or mitral valve replacement and cranioplasty. All planned procedures will be identified by ICD-10 procedure codes. Observation stays will be identified from outpatient (Medicare) and facility (Medicaid and BCBSNC) claims using the G0378 and G0379 Healthcare Common Procedure Coding System (HCPCS) codes.

We will also analyze two secondary all-cause readmission endpoints. The first, unplanned readmissions within 30 days of discharge from the index stroke hospitalization will be defined analogously to the primary readmissions endpoint. The other secondary readmission endpoint will be defined as the hazard ratio from a recurrent time-to-event analysis over the 12 month period following discharge from the index stroke hospitalization. Planned readmissions will not be excluded from the recurrent time-to-event analysis.

4.2 Emergency Department Visits

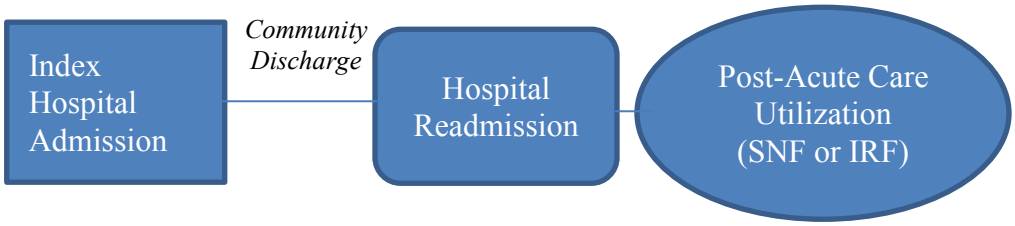
The ED visits endpoint will be defined as the time to first ED visit with the associated estimand being the hazard ratio from a recurrent time-to-event analysis. Emergency department visits will be identified from Medicare Outpatient claims files using the HCPCS codes for evaluation and management of a patient seen in the ED without further admission to the hospital (HCPCS codes: 99281-99285) and from the MedPAR (year 2016) and Inpatient files (years 2017-2019) as claims with revenue center codes 0450-0459, 0981 or a hospital inpatient claim with an emergency room charge>$0. Emergency department visits will be identified from CMS Medicaid Professional claims with revenue service codes 99281-99285. ED visits will be identified from the BCBS Professional and Facility claims with place of service code=23 and the following revenue service codes: 0450', '0451', '0452', '0456', '0459', '0981','450', '451', '452', '456', '459', '981' ,'00450', '00451', '00452', '00456', '00459', '00981'. Patients will be administratively censored one year after index hospitalization discharge.

4.3 Admission to a Skilled Nursing Facility or Inpatient Rehabilitation Facility

The skilled nursing facility (SNF) and inpatient rehabilitation facility (IRF) endpoint will be defined as the time to the first admission to a SNF or IRF with the associated estimand being the hazard ratio from a time-to-event analysis. Patients will be administratively censored one year after index hospitalization discharge. The typical process for admission to a SNF or IRF is depicted in Figure 1.

COMPASS participants were discharged to the community following their index stroke event and the vast majority of SNF and IRF admissions will occur following a hospital discharge from a subsequent readmission (i.e., +/- 1 day) although we will identify any SNF or IRF admissions that occur after community discharge without a readmission. SNF and IRF admissions will be identified based on provider codes. The actual variable names and codes used to identify these events will vary depending on the claim type (i.e., Medicare, Medicaid, BCBS). SNF admissions will include swing bed stays.

Figure 1. Post-Acute Care Utilization after Hospital Readmission



4.4 Continuity of Care

The continuity of care endpoint will be defined as the time to the first outpatient ambulatory care visit with any provider. The associated estimand will be the hazard ratio from a time-to-event analysis. Patients will be administratively censored one year after index hospitalization discharge. In Medicare claims, ambulatory visits will be identified from Carrier claims using Evaluation and Management HCPCS codes for new or established office visit, consultation, or new/established preventive medicine visit. Additionally, we will use revenue center codes (0510-050521, 0523, 0526, 0529) from the Outpatient claims to identify visits to federally qualified health centers, rural health centers and other health clinics. For descriptive purposes, we will use physician specialty codes to classify providers as primary care physicians (including general practice, family practice, internal medicine, geriatric medicine, nurse practitioner, and multispecialty/group practice) as well as specialty provides (including cardiology, neurology, and neurosurgery). We will use provider specialty codes in the Medicaid and BCBS Professional claims as well as facility names to identify qualifying primary specialty care providers (**Appendix A**).

4.5 Transitional Care Management Billing

According to CMS guidelines,[3] transitional care management (TCM) requires four core components: (1) transition in care from an inpatient setting to a community setting; (2) receipt of communication from a provider (direct contact, telephone, or electronic) within 2 business days of discharge; (3) moderate or high complexity medical decision making; and (4) a face-to-face clinical visit within 7 or 14 calendar days of discharge from the inpatient setting.

The TCM billing endpoint will be defined as incidence of TCM billing with the associated estimand being the odds ratio from a logistic model. Transitional care management billing is defined as an office visit billing through Current Procedural Terminology (CPT) codes 99495 (for a visit within 14 days of index hospitalization discharge) and 99496 (for a visit within 7 days of index hospitalization discharge). Because TCM billing codes became effective under Medicare's Physician Fee Schedule, and BCBS and Medicaid may not consistently use these codes, this endpoint will be defined for FFS Medicare participants only. The 30-day TCM eligibility period begins on the beneficiary's inpatient discharge date and continues for the next 29 days. Medicare beneficiaries who die or who have a hospital readmission within 30 days following the index discharge are not eligible to have a TCM claim. Therefore, even if they received TCM core components, such patients do not meet the TCM billing criteria. Because TCM billing can be rendered by physicians and non-physician practitioners in inpatient and outpatient setting, our assessment of TCM code billing will include claims from all practitioners.

4.6 Recurrent Stroke

The recurrent stroke endpoint will be defined as the time to admission for stroke (inpatient or observation stay) to a non-federal, acute care hospital. Readmissions for stroke will be identified using the primary discharge diagnosis ICD-10 codes associated with cerebral infarction, subarachnoid hemorrhage, and intracerebral hemorrhage (**Appendix B**). The associated estimand is the hazard ratio from a recurrent time-to-event analysis. Patients will be administratively censored one year after index hospitalization discharge.

4.7 All-Cause Mortality

Deaths within 1 year of index discharge were ascertained from the North Carolina State Death Index as well as insurance claims beneficiary summary files. A death identified in either database will be considered a death.

5 CLAIMS ANALYSES

5.1 Phase 1 Intent-to-Treat Analyses

We will perform intent-to-treat analyses comparing the COMPASS intervention to UC with respect to all endpoints listed in Table 1 stratified by insurance provider (i.e., FFS Medicare, NC Medicaid (excluding patients with dual Medicare coverage), BCBS-NC). Comparisons will be made based on the intervention arm to which a patient belongs regardless of whether the patient received any intervention. For intent-to-treat analyses, all individuals must have been enrolled at the time of the index discharge event in one or more of the insurers (CMS Medicare, NC Medicaid, or BCBSNC). The FFS Medicare analysis population will include participants enrolled in CMS Medicare Parts A & B. Participants only enrolled in Part A or those enrolled in Part C (Medicare Advantage) will be excluded. The Medicaid analysis population will include participants enrolled in a qualifying Medicaid plan. Examples of non-qualifying plans include plans only covering children, plans for pregnancy-related care, cancer-related care, or those covering emergency services only. Participants dually enrolled in Medicaid and Medicare will be excluded from the Medicaid analyses. The BCBS analysis population will consist of participants enrolled in BCBS of NC, not also enrolled in Medicare.

5.2 Phase 2 Intent-to-Treat Analyses

We will perform intent-to-treat analyses comparing outcomes in Phase 2 to Phase 1 with respect to all endpoints listed in Table 1 stratified by insurance provider as described in Section 5.1. Phase 2 analyses will include an analysis of Sustainability that compares Phase 2 Sustainability to the Phase 1 Intervention phase. The analysis populations will be defined as above in Section 5.1 with the added requirement that the analysis is restricted to hospitals that were randomized to INV in Phase 1 and that delivered the COMPASS intervention per protocol to at least 1 participant in Phase 2 Sustainability. Phase 2 analyses will also include an analysis of pre-post comparative effectiveness that compares Phase 2 Intervention to Phase 1 Usual Care. This analysis is restricted to the set of hospitals that were randomized to Usual Care in Phase 1 and that delivered the COMPASS intervention per protocol to at least 1 participant in Phase 2.

6 STATISTICAL METHODS

In the following section we will describe the general statistical methodology to be used for the analysis of endpoints described in Table 1.

6.1 Covariate Adjustment

Unless otherwise stated below, where feasible the following covariates will be incorporated in analysis models for all endpoints described in Table 1.

1. Study Arm (intervention, usual care) – ITT Phase 1 analyses only
2. Study Phase (sustainability, intervention) – ITT Phase 2 sustainability analyses only
3. Study Phase (intervention, usual care) – ITT Phase 2 effectiveness analyses only
4. Race (non-white; white)
5. Age (degree two polynomial)
6. Index hospitalization diagnosis (stroke; TIA)
7. NIH Stroke Scale (NIHSS) Score category (0, 1-4, 5-15, and 16-42) – categories may be collapsed to 5-42 due to sample size requirements.
8. Sex (female; male)
9. Prior stroke
10. Prior TIA

6.1.1 Sensitivity to Covariate Adjustment

Where feasible, we will also perform analysis using different covariate sets that includes as possible adjustment variables the set above as well as other covariates. These additional covariates include but are not limited to:

1) Whether the patient lives in a rural or urban area (based on RUCA codes)
2) Whether the hospital is in a rural or urban area (based on RUCA codes)
3) Whether the patient had a rehabilitation referral at discharge (physical therapy, occupational therapy, or speech therapy)
4) Whether the patient had a home health referral at discharge
5) Whether the patient had a documented PCP in their medical record
6) Dual eligibility for Medicaid (FFS analyses only)
7) History of depression
8) History of hypertension
9) History of smoking
10) History of CVD comorbidities

Covariates listed above will be ascertained as part of the COMPASS study and not from claims. Variables will be selected for inclusion in the sensitivity analysis model using a backward selection procedure that accounts for missing covariate data using methods described in Section 6.5. The sensitivity model will include key clinical covariates as well as any of the above variables that have a p-value > 0.10 (unadjusted for multiple comparisons). Estimates of treatment effects will be produced for each step in the model selection procedure to understand how effect estimates change based on different adjustment sets.

6.2 Analysis of Binary Endpoints

The set of binary endpoints to which this section pertains are given as follows:

1. Incidence of 30-day all cause readmissions

2. Incidence of 90-day all cause readmissions
3. Use of TCM billing codes

For the analysis of 30- and 90-day all cause readmissions, patients who have continuous coverage over the 30- or 90-day reference period will be included in the analysis. For analysis of TCM billing codes, patients who have continuous coverage over the 30-day period following discharge from the index hospitalization will be included in the analysis. The percentage of patients with incomplete coverage over the 90-day period following discharge from the index hospitalization is expected to be low. In the event that more than 10% of the patients linked to claims data have incomplete coverage over the relevant 30- or 90-day reference period, we will assess the robustness of any important findings to exclusion of these patients from analyses using techniques such as multiple imputation from a time-to-event model that accounts for the observed follow-up period for patients who drop out of coverages during the relevant reference period.

For readmission endpoints, patients who die prior to the end of the reference period without a qualifying readmission will be treated as not having a readmission. Prior analyses of 90-day mortality based on the full COMPASS cohort has demonstrated that the percentage of patients who die within 90 days of discharge from the index hospitalization is approximately 2.0% and did not differ by treatment arm.[4] Thus, the impact of excluding patients who did not survive for the entire reference period is not expected to strongly influence results. Nonetheless, in the event that more than 5% of the patients linked to claims data die within the reference period, we will assess the robustness of any important findings by performing a sensitivity analyses that includes these patients as having met the endpoint for all cause readmissions.

For all binary endpoints, we will employ generalized linear mixed models (GLMM) with a logistic link function. Models will include a hospital-specific random effect, and adjust for the covariates described in Section 6.1.

6.3 Analysis of Time-to-Event Endpoints

6.3.1 One-Year Mortality Analysis

Analysis of the one-year mortality endpoint will be performed using a Cox proportional hazards model that adjusts for the covariates described in Section 6.1. Analyses will be performed using the method of Wei, et al.[5] which models the marginal distribution for event times and account for correlation between event times within a hospital unit through use of a robust sandwich variance estimator for model parameters.

6.3.2 Time-to-First Occurrence Endpoints

The methodology in this section pertains to the following endpoints:

1. Time-to-SNF or IRF admission
2. Continuity of care
3. Time to ED visit

Analysis of these time-to-event endpoints will focus on estimation of the cause-specific hazard and thus will censor patients who die at the time of their death. Such an approach is suggested by

Austin, Lee, and Fine (2016) when the focus of the analysis is addressing etiologic questions and not prediction of individual patient prognoses.[6] The method of Wei, et al. will be used as described in Section 6.3.1. We will also censor patients without continuous insurance coverage at the time of their first break in coverage. For Phase 2, participants who have not had one year of follow-up for claims are administratively censored at the last date for which claims were available, June 30, 2019.

When only a small number of patients experience death prior to observing the time-to-event endpoint of interest, the estimated covariate effects on the cause specific hazard will be highly similar to the estimated covariate effects on the subdistribution hazard associated with the time-to-event endpoint of interest that takes into accounting death as competing risk (using the Fine-Gray model).[7] If more than 10% of patients experience death during the one-year follow-up period prior to observing the time-to-event endpoint of interest, we will supplement estimation of covariate effects on the cause specific hazard by estimating covariate effects on the subdistribution hazard using the Fine-Gray model. As noted in Section 6.3.1, correlation between event times with a hospital unit will be accounted for through use of a robust sandwich variance estimator for model parameters.

6.3.3 Recurrent Time-to-Event Analysis

The methodology in this section pertains to the following endpoints:

1. Time-to-All cause hospital readmission
2. Time-to-Recurrent Stroke

Analysis of these time-to-event endpoints will focus on estimation of the cause-specific hazard and thus will censor patients who die at the time of their death. The primary analysis methodology will make use of the PWP model[8] and account for correlation between event times within a hospital unit through use of a robust sandwich variance estimator for model parameters. The PWP model only includes in the risk set for the $(k+1)^{th}$ event those patients who have had k events previously. If more than 10% of patients experience death during the one-year follow-up period we will supplement estimation of covariate effects on the cause specific hazard by estimating covariate effects on the subdistribution hazard using the approach of Fine and Gray in the context of the PWP model.

6.4 Approaches for Dealing with Missing Data

All analyses performed will make use of data only for COMPASS Study patients who are able to be linked with the claims database.

Data from the COMPASS Study indicate that several important baseline characteristics will be missing for 5-10% of patients.[4] We will use multiple imputation by chained equations (MICE) to impute missing NIHSS, race, and other potential confounders as necessary. Primary and secondary endpoint analyses will be based on 100 imputed datasets. For each imputed dataset analysis procedures described above will be performed and the parameter estimates will be combined across imputed datasets using standard techniques. More details can be found in the COMPASS Study Phase I Statistical Analysis Plan to which this document is an addendum.

6.5 Subgroup Analyses

It is of *a priori* interest to examine the comparative effectiveness of the COMPASS Intervention in key subgroups of the studied population. We will examine the comparative effectiveness of the COMPASS Intervention in the following subgroups for the FFS analyses, where feasible:

- Diagnosis group – stroke; TIA
- Race – non-white; white
- Sex – female, male
- Age -- <65; 65-<75; 75-<85; >=85
- NIHSS – 0, 1-4, 5-15, and 16-42

Categories may be collapsed due to small sample sizes within each subgroup.

For each of the characteristic above (e.g., race) and to the extent that samples size permits, we will evaluate the comparative effectiveness of the COMPASS Intervention against usual care within each of the corresponding subgroups (e.g., for whites and non-whites) using the following procedure.

We will first assess the degree to which the data support the assumption of a homogeneous intervention effect across levels of each subgroup. This will be done by fitting an augmented model that includes a treatment by subgroup interaction and by formally testing the interaction at significance level 0.10. If the interaction is not statistically significant at level 0.10, the analyses adjusted for, but not stratifying by, subgroup will be presented for primary interpretation. However, if the interaction is significant at level 0.10, analyses will be presented that estimate separate treatment effects for each subgroup level using a single model with the familywise type I error rate controlled using Hommel's method.[9]

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Appendix A: Identification of Provider Visits

Type of visit	Code type	Code	Files where data are located	
			Medicare	NC Medicaid/BCBS-NC
New office visit	HCPCS	99201-99205	Carrier	Professional and Facility
Established office visit	HCPCS	99211-9215	Carrier	Professional and Facility
Consultation	HCPCS	99241-99245	Carrier	Professional and Facility
New preventive medicine visit	HCPCS	99385-99387	Carrier	Professional and Facility
Established preventive medicine visit	HCPCS	99395-99397	Carrier	Professional and Facility
Federally Qualified Health Center	Revenue Center Code	520 and 521	Outpatient	Professional and Facility
Free standing clinics	Revenue Center Code	0510, 0517, 0519, 0523, 0529	Outpatient	Professional and Facility

Appendix B: ICD-10 Codes Associated with Stroke-Specific Hospital Readmissions

ICD-10 diagnostic code	Description
I60.00	Nontraumatic subarachnoid hemorrhage from unspecified carotid siphon and bifurcation
I60.01	Nontraumatic subarachnoid hemorrhage from right carotid siphon and bifurcation
I60.02	Nontraumatic subarachnoid hemorrhage from left carotid siphon and bifurcation
I60.10	Nontraumatic subarachnoid hemorrhage from unspecified middle cerebral artery
I60.11	Nontraumatic subarachnoid hemorrhage from right middle cerebral artery
I60.12	Nontraumatic subarachnoid hemorrhage from left middle cerebral artery
I60.20	Nontraumatic subarachnoid hemorrhage from unspecified anterior communicating artery
I60.21	Nontraumatic subarachnoid hemorrhage from right anterior communicating artery
I60.22	Nontraumatic subarachnoid hemorrhage from left anterior communicating artery
I60.30	Nontraumatic subarachnoid hemorrhage from unspecified posterior communicating artery
I60.31	Nontraumatic subarachnoid hemorrhage from right posterior communicating artery
I60.32	Nontraumatic subarachnoid hemorrhage from left posterior communicating artery
I60.4	Nontraumatic subarachnoid hemorrhage from basilar artery
I60.50	Nontraumatic subarachnoid hemorrhage from unspecified vertebral artery
I60.51	Nontraumatic subarachnoid hemorrhage from right vertebral artery
I60.52	Nontraumatic subarachnoid hemorrhage from left vertebral artery
I60.6	Nontraumatic subarachnoid hemorrhage from other intracranial arteries
I60.7	Nontraumatic subarachnoid hemorrhage from unspecified intracranial artery
I60.8	Other nontraumatic subarachnoid hemorrhage
I60.9	Nontraumatic subarachnoid hemorrhage, unspecified
I61.0	Nontraumatic intracerebral hemorrhage in hemisphere, subcortical
I61.1	Nontraumatic intracerebral hemorrhage in hemisphere, cortical
I61.2	Nontraumatic intracerebral hemorrhage in hemisphere, unspecified
I61.3	Nontraumatic intracerebral hemorrhage in brain stem
I61.4	Nontraumatic intracerebral hemorrhage in cerebellum
I61.5	Nontraumatic intracerebral hemorrhage, intraventricular
I61.6	Nontraumatic intracerebral hemorrhage, multiple localized
I61.8	Other nontraumatic intracerebral hemorrhage
I61.9	Nontraumatic intracerebral hemorrhage, unspecified
I63.00	Cerebral infarction due to thrombosis of unspecified precerebral artery
I63.011	Cerebral infarction due to thrombosis of right vertebral artery
I63.012	Cerebral infarction due to thrombosis of left vertebral artery
I63.019	Cerebral infarction due to thrombosis of unspecified vertebral artery
I63.02	Cerebral infarction due to thrombosis of basilar artery
I63.031	Cerebral infarction due to thrombosis of right carotid artery
I63.032	Cerebral infarction due to thrombosis of left carotid artery
I63.039	Cerebral infarction due to thrombosis of unspecified carotid artery
I63.09	Cerebral infarction due to thrombosis of other precerebral artery
I63.10	Cerebral infarction due to embolism of unspecified precerebral artery
I63.111	Cerebral infarction due to embolism of right vertebral artery
I63.112	Cerebral infarction due to embolism of left vertebral artery
I63.119	Cerebral infarction due to embolism of unspecified vertebral artery
I63.12	Cerebral infarction due to embolism of basilar artery
I63.131	Cerebral infarction due to embolism of right carotid artery
I63.132	Cerebral infarction due to embolism of left carotid artery
I63.139	Cerebral infarction due to embolism of unspecified carotid artery
I63.19	Cerebral infarction due to embolism of other precerebral artery
I63.20	Cerebral infarction due to unspecified occlusion or stenosis of unspecified precerebral arteries
I63.211	Cerebral infarction due to unspecified occlusion or stenosis of right vertebral arteries
I63.212	Cerebral infarction due to unspecified occlusion or stenosis of left vertebral arteries
I63.219	Cerebral infarction due to unspecified occlusion or stenosis of unspecified vertebral arteries
I63.22	Cerebral infarction due to unspecified occlusion or stenosis of basilar arteries
I63.231	Cerebral infarction due to unspecified occlusion or stenosis of right carotid arteries
I63.232	Cerebral infarction due to unspecified occlusion or stenosis of left carotid arteries
I63.239	Cerebral infarction due to unspecified occlusion or stenosis of unspecified carotid arteries
I63.29	Cerebral infarction due to unspecified occlusion or stenosis of other precerebral arteries

I63.30	Cerebral infarction due to thrombosis of unspecified cerebral artery
I63.311	Cerebral infarction due to thrombosis of right middle cerebral artery
I63.312	Cerebral infarction due to thrombosis of left middle cerebral artery
I63.319	Cerebral infarction due to thrombosis of unspecified middle cerebral artery
I63.321	Cerebral infarction due to thrombosis of right anterior cerebral artery
I63.322	Cerebral infarction due to thrombosis of left anterior cerebral artery
I63.329	Cerebral infarction due to thrombosis of unspecified anterior cerebral artery
I63.331	Cerebral infarction due to thrombosis of right posterior cerebral artery
I63.332	Cerebral infarction due to thrombosis of left posterior cerebral artery
I63.339	Cerebral infarction due to thrombosis of unspecified posterior cerebral artery
I63.341	Cerebral infarction due to thrombosis of right cerebellar artery
I63.342	Cerebral infarction due to thrombosis of left cerebellar artery
I63.349	Cerebral infarction due to thrombosis of unspecified cerebellar artery
I63.39	Cerebral infarction due to thrombosis of other cerebral artery
I63.40	Cerebral infarction due to embolism of unspecified cerebral artery
I63.411	Cerebral infarction due to embolism of right middle cerebral artery
I63.412	Cerebral infarction due to embolism of left middle cerebral artery
I63.419	Cerebral infarction due to embolism of unspecified middle cerebral artery
I63.421	Cerebral infarction due to embolism of right anterior cerebral artery
I63.422	Cerebral infarction due to embolism of left anterior cerebral artery
I63.429	Cerebral infarction due to embolism of unspecified anterior cerebral artery
I63.431	Cerebral infarction due to embolism of right posterior cerebral artery
I63.432	Cerebral infarction due to embolism of left posterior cerebral artery
I63.439	Cerebral infarction due to embolism of unspecified posterior cerebral artery
I63.441	Cerebral infarction due to embolism of right cerebellar artery
I63.442	Cerebral infarction due to embolism of left cerebellar artery
I63.449	Cerebral infarction due to embolism of unspecified cerebellar artery
I63.49	Cerebral infarction due to embolism of other cerebral artery
I63.50	Cerebral infarction due to unspecified occlusion or stenosis of unspecified cerebral artery
I63.511	Cerebral infarction due to unspecified occlusion or stenosis of right middle cerebral artery
I63.512	Cerebral infarction due to unspecified occlusion or stenosis of left middle cerebral artery
I63.519	Cerebral infarction due to unspecified occlusion or stenosis of unspecified middle cerebral artery
I63.521	Cerebral infarction due to unspecified occlusion or stenosis of right anterior cerebral artery
I63.522	Cerebral infarction due to unspecified occlusion or stenosis of left anterior cerebral artery
I63.529	Cerebral infarction due to unspecified occlusion or stenosis of unspecified anterior cerebral artery
I63.531	Cerebral infarction due to unspecified occlusion or stenosis of right posterior cerebral artery
I63.532	Cerebral infarction due to unspecified occlusion or stenosis of left posterior cerebral artery
I63.539	Cerebral infarction due to unspecified occlusion or stenosis of unspecified posterior cerebral artery
I63.541	Cerebral infarction due to unspecified occlusion or stenosis of right cerebellar artery
I63.542	Cerebral infarction due to unspecified occlusion or stenosis of left cerebellar artery
I63.549	Cerebral infarction due to unspecified occlusion or stenosis of unspecified cerebellar artery
I63.59	Cerebral infarction due to unspecified occlusion or stenosis of other cerebral artery
I63.6	Cerebral infarction due to cerebral venous thrombosis, nonpyogenic
I63.8	Other cerebral infarction
I63.9	Cerebral infarction, unspecified
I67.89	Other cerebrovascular disease