

Table SI. Inclusion Criteria—Diagnosis Codes

	Inclusion criteria—diagnosis codes
Stroke-related spasticity – upper limb	ICD-10-CM Codes (2015-present) used alone:
	I69.03 (all) Monoplegia of upper limb following nontraumatic subarachnoid hemorrhage
	I69.05 (all) Hemiplegia and hemiparesis following nontraumatic subarachnoid hemorrhage
	I69.06 (all) Other paralytic syndrome following nontraumatic subarachnoid hemorrhage
	I69.13 (all) Monoplegia of upper limb following nontraumatic intracerebral hemorrhage
	I69.15 (all) Hemiplegia and hemiparesis following nontraumatic intracerebral hemorrhage
	I69.16 (all) Other paralytic syndrome following nontraumatic intracerebral hemorrhage
	I69.23 (all) Monoplegia of upper limb following other nontraumatic intracranial hemorrhage
	I69.25 (all) Hemiplegia and hemiparesis following other nontraumatic intracranial hemorrhage
	I69.26 (all) Other paralytic syndrome following other nontraumatic intracranial hemorrhage
	I69.33 (all) Monoplegia of upper limb following cerebral infarction
	I69.35 (all) Hemiplegia and hemiparesis following cerebral infarction
	I69.36 (all) Other paralytic syndrome following cerebral infarction
	I69.831 – I69.834, I69.839 Monoplegia of upper limb following other cerebrovascular disease
	I69.851 – I69.854, I69.859 Hemiplegia and hemiparesis following other cerebrovascular disease
	I69.861 – I69.865, I69.869 Other paralytic syndrome following other cerebrovascular disease
	I69.931 – I69.934, I69.939 Monoplegia of upper limb following unspecified cerebrovascular disease
	I69.951 – I69.954, I69.959 Hemiplegia and hemiparesis following unspecified cerebrovascular disease
	I69.961 – I69.965, I69.969 Other paralytic syndrome following unspecified cerebrovascular disease
	ICD-9-CM Codes (2010-2014) used alone:
	342.10 Spastic hemiplegia, affecting unspecified side
	342.11 Spastic hemiplegia, affecting dominant side
	342.12 Spastic hemiplegia, affecting nondominant side
	344.00 Other paralytic syndromes; quadriplegia, unspecified
	344.01 Other paralytic syndromes; quadriplegia and quadriparesis; C1-C4, complete
	344.02 Other paralytic syndromes; quadriplegia and quadriparesis; C1-C4, incomplete
	344.03 Other paralytic syndromes; quadriplegia and quadriparesis; C5-C7, complete
	344.04 Other paralytic syndromes; quadriplegia and quadriparesis; C5-C7, incomplete
	344.09 Other paralytic syndromes; quadriplegia and quadriparesis; other
	344.2 Other paralytic syndromes; diplegia of upper limbs
	344.40 Other paralytic syndromes; monoplegia of upper limb affecting unspecified side
	344.41 Other paralytic syndromes; monoplegia of upper limb affecting dominant side
	344.42 Other paralytic syndromes; monoplegia of upper limb affecting nondominant side
	344.5 Other paralytic syndromes; unspecified monoplegia
	344.89 Other paralytic syndromes; other specified paralytic syndromes; other specified paralytic syndrome
	344.9 Other paralytic syndromes; paralysis unspecified
	438.20 Late effects of cerebrovascular disease; hemiplegia affecting unspecified side
	438.21 Late effects of cerebrovascular disease; hemiplegia affecting dominant side
	438.22 Late effects of cerebrovascular disease; hemiplegia affecting nondominant side
	438.30 Late effects of cerebrovascular disease; monoplegia of upper limb affecting unspecified side

	438.31 Late effects of cerebrovascular disease; monoplegia of upper limb affecting dominant side
	438.32 Late effects of cerebrovascular disease; monoplegia of upper limb affecting nondominant side
Stroke-related spasticity – lower limb	ICD-10-CM Codes (2015-present) used alone:
	I69.041 – I69.044, I69.049 Monoplegia of lower limb following nontraumatic subarachnoid hemorrhage
	I69.051 – I69.054, I69.059 Hemiplegia and hemiparesis following nontraumatic subarachnoid hemorrhage
	I69.061 – I69.065, I69.069 Other paralytic syndrome following nontraumatic subarachnoid hemorrhage
	I69.141 – I69.144, I69.149 Monoplegia of lower limb following nontraumatic intracerebral hemorrhage
	I69.151 – I69.154, I69.159 Hemiplegia and hemiparesis following nontraumatic intracerebral hemorrhage
	I69.161 – I69.165, I69.169 Other paralytic syndrome following nontraumatic intracerebral hemorrhage
	I69.241 – I69.244, I69.249 Monoplegia of lower limb following other nontraumatic intracranial hemorrhage
	I69.251 – I69.254, I69.259 Hemiplegia and hemiparesis following other nontraumatic intracranial hemorrhage
	I69.261 – I69.265, I69.269 Other paralytic syndrome following other nontraumatic intracranial hemorrhage
	I69.341 – I69.344, I69.349 Monoplegia of lower limb following cerebral infarction
	I69.351 – I69.354, I69.359 Hemiplegia and hemiparesis following cerebral infarction
	I69.361 – I69.365, I69.369 Other paralytic syndrome following cerebral infarction
	I69.841 – I69.844, I69.849 Monoplegia of lower limb following other cerebrovascular disease
	I69.851 – I69.854, I69.859 Hemiplegia and hemiparesis following other cerebrovascular disease
	I69.861 – I69.865, I69.869 Other paralytic syndrome following other cerebrovascular disease
	I69.941 – I69.944, I69.949 Monoplegia of lower limb following unspecified cerebrovascular disease
	I69.951 – I69.954, I69.959 Hemiplegia and hemiparesis following unspecified cerebrovascular disease
I69.961 – I69.965, I69.969 Other paralytic syndrome following unspecified cerebrovascular disease	
Stroke-related spasticity – upper limb requiring a diagnosis of stroke	ICD-10-CM Codes (2015-present) that require a diagnosis of stroke:
	*It is assumed that the qualifying stroke documented within 12 months prior to stroke-related spasticity claim satisfies these criteria. Patients for whom there is no qualifying stroke diagnosis prior to, or concurrent with, one of the following spasticity diagnosis claims will be excluded from the study.
	G81.10 – G81.14 Spastic hemiplegia
	G82.50 – G82.54 Quadriplegia
	G83.0 Diplegia of upper limbs
	G83.20 – G83.24 Monoplegia of upper limb
	G83.30 – G83.34 Monoplegia, unspecified
	G83.89 Other specified paralytic syndromes
	G83.9 Paralytic syndrome, unspecified
S06.9X0S – S06.9X5S, S06.9X9S Unspecified intracranial injury, sequela	
	ICD-10-CM Codes (2015-present) that require a diagnosis of stroke:

Stroke-related spasticity – lower limb requiring a diagnosis of stroke	<p>*It is assumed that the qualifying stroke documented within 12 months prior to stroke-related spasticity claim satisfies these criteria. Patients for whom there is no qualifying stroke diagnosis prior to, or concurrent with, one of the following spasticity diagnosis claims will be excluded from the study.</p> <p>G81.10 – G81.14 Spastic hemiplegia</p> <p>G82.20 Paraplegia, unspecified</p> <p>G82.21 Paraplegia, complete</p> <p>G82.22 Paraplegia, incomplete</p> <p>G82.50 Quadriplegia, unspecified</p> <p>G82.51 Quadriplegia, C1-C4 complete</p> <p>G82.52 Quadriplegia, C1-C4 incomplete</p> <p>G82.53 Quadriplegia, C5-C7 complete</p> <p>G82.54 Quadriplegia, C5-C7 incomplete</p> <p>G83.10 – G83.14 Monoplegia of lower limb</p> <p>G83.30 – G83.34 Monoplegia, unspecified</p> <p>G83.89 Other specified paralytic syndromes</p> <p>G83.9 Paralytic syndrome, unspecified</p> <p>S06.9X0S – S06.9X5S, S06.9X9S Unspecified intracranial injury, sequela</p>
Stroke-related spasticity – upper limb requiring a secondary diagnosis from specified list	<p>ICD-9-CM Codes (2010-2014) requiring secondary diagnosis from List A:</p> <p>438.50 Late effects of cerebrovascular disease; other paralytic syndrome affecting unspecified side</p> <p>438.51 Late effects of cerebrovascular disease; other paralytic syndrome affecting dominant side</p> <p>438.52 Late effects of cerebrovascular disease; other paralytic syndrome affecting nondominant side</p> <p>438.53 Late effects of cerebrovascular disease; other paralytic syndrome, bilateral</p> <p>Secondary diagnosis codes (List A):</p> <p>*Must be documented concurrent with, or within 12 months prior to, stroke-related spasticity claim identified on one of the above noted ICD-9-CM codes.</p> <p>344.00 Other paralytic syndromes; quadriplegia, unspecified</p> <p>344.01 Other paralytic syndromes; quadriplegia and quadriparesis; C1-C4, complete</p> <p>344.02 Other paralytic syndromes; quadriplegia and quadriparesis; C1-C4, incomplete</p> <p>344.03 Other paralytic syndromes; quadriplegia and quadriparesis; C5-C7, complete</p> <p>344.04 Other paralytic syndromes; quadriplegia and quadriparesis; C5-C7, incomplete</p> <p>344.09 Other paralytic syndromes; quadriplegia and quadriparesis; other</p> <p>344.2 Other paralytic syndromes; diplegia of upper limbs</p> <p>344.5 Other paralytic syndromes; unspecified monoplegia</p> <p>344.89 Other paralytic syndromes; other specified paralytic syndromes; other specified paralytic syndrome</p> <p>344.9 Other paralytic syndromes; paralysis unspecified</p>
Diagnosis of stroke	<p>ICD-10-CM Codes (2015-present):</p> <p>I60 (all) Nontraumatic subarachnoid hemorrhage</p> <p>I61 Nontraumatic intracerebral hemorrhage</p> <p>I62 Other and unspecified nontraumatic intracranial hemorrhage</p> <p>I63 Cerebral infarction</p> <p>I67.2 Cerebral atherosclerosis</p> <p>I67.81 Acute cerebrovascular insufficiency</p> <p>I67.82 Cerebral ischemia</p> <p>ICD-9-CM Codes (2010-2014):</p>

	432.9 Intracranial hemorrhage not otherwise specified (NOS)
	434.01 Cerebral thrombosis with cerebral infarction
	434.11 Cerebral embolism with cerebral infarction
	434.90 Cerebral artery occlusion, unspecified without mention of cerebral infarction
	435.0 Basilar artery syndrome
	435.1 Vertebral artery syndrome
	435.2 Subclavian steal syndrome
	435.3 Vertebrobasilar artery syndrome
	435.8 Other specified transient cerebral ischemia
	435.8 Unspecified transient cerebral ischemia
	435.91 Cerebral artery occlusion, unspecified with cerebral infarction
	436 Acute, but ill-defined, cerebrovascular disease
	437.0 Cerebral atherosclerosis
	437.1 Other generalized ischemic cerebrovascular disease
	437.2 Hypertensive encephalopathy
	437.3 Cerebral aneurysm, nonruptured
	437.4 Cerebral arteritis
	437.8 Other ill-defined cerebrovascular disease
	437.9 Unspecified cerebrovascular disease

Table SII. Service Codes for Other Outpatient Claims

Project	Coding
Occupational therapy	CPT: 97165, 97166, 19767, 97168 with a diagnosis of spasticity HCPCS: S9129, G0129, G0152, G0158, G0160 PT and OT visit claims were required to include primary or secondary ICD-9-CM diagnosis codes for the patients' conditions
Physical therapy	CPT: 97161, 97162, 97163, 97164 with a diagnosis of spasticity HCPCS: G0151, G0157, G0159, S8990, S9131 PT and OT visit claims were required to include primary or secondary ICD-9-CM diagnosis codes for the patients' conditions Other codes that cover both PT and OT: Supervised (untimed) modalities (97010–97028) Constant attendance (one-on-one) modalities (97032–97039, which are billable in 15-minute increments) Therapeutic (one-on-one) procedures (97110–97546) Active wound care management (97597–97606) Tests and measurements (97750–97755) Orthotic and prosthetic management (97760–97762)

CPT, Current Procedural Technology; HCPCS, Healthcare Common Procedure Coding System; OT, occupational therapy; PT, physical therapy

Table SIII. Cohort attrition

Step	Criteria	Patients, n	% Excluded in Step
1	Include patients diagnosed with stroke-related spasticity at any time during the study period. Earliest qualifying diagnosis date is defined as spasticity onset date.	352,064	–
2	Exclude patients with a spasticity onset date before 1/1/2010	294,054	16
3	Exclude patients with a spasticity diagnosis unrelated to stroke	269,685	8
4	Continuous enrolment ≥ 1 year before and after initial spasticity diagnosis	85,051	68
5	Exclude patients treated with toxins other than onabotulinumtoxinA	83,574	2
6	Exclude those with prior treatment with onabotulinumtoxinA within 1 year of initial spasticity diagnosis	83,009	1
7	OnabotulinumtoxinA administration between 1/1/2010 and 06/30/2018 (initial administration as index date)	2,696	97
8	Spasticity diagnosis ≤ 30 days before or after index date and no onabotulinumtoxinA claims for other indications on index date	1,876	30
9	Continuous enrolment ≥ 1 year before and after index date	1,425	24
10	Aged ≥ 18 years at index date	1,336	6
11	Exclude those with evidence of contracture ≤ 1 year pre-index	1,116	16
12	OnabotulinumtoxinA cohort	735	34