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Implications Of Discordances Between Stroke Clinical Diagnoses And Icd-9-Cm Codes – 2013 Data From The Paul Coverdell National Acute Stroke Program

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Implications of Discordances Between Stroke Clinical Diagnoses and ICD-9-CM Codes – 2013 Data from the Paul Coverdell National Acute Stroke Program

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ABSTRACT

Background/ Purpose: Epidemiology and health services research often use *International Classification of Diseases, 9th Revision*, Clinical Modification (*ICD-9*-CM) codes to translate clinical information contained in administrative databases. Since errors in ICD-9-CM codes can affect the interpretation of results from these studies, we sought to expand upon existing research by determining if there are systematic variations in concordance between stroke patient clinical diagnoses and ICD-9-CM codes by hospital characteristics and degrees of stroke severity.

Methods: We used patient records with a discharge date in 2013 from the Paul Coverdell National Acute Stroke Program (PCNASP). Our primary analysis quantified the concordance between the attending physician's clinical diagnosis and the primary ICD-9-CM billing code. Hospital characteristics data were used to examine concordance by presence/absence of a stroke unit and stroke team, hospital bed size categories, and urban/rural status of the hospital's location. Furthermore, concordance by stroke severity (NIHSS) categories was compared for ischemic stroke and TIA patients.

Results: The overall sensitivity was 93.8% for all stroke and TIA diagnosis groups. Concordance was relatively high for each diagnosis category except "stroke not otherwise specified". Carotid endarterectomy was a common reason for discordances between the clinical diagnosis and ICD-9-CM code. Concordance was highest for larger metropolitan hospitals with stroke units and teams, and more severe strokes.

Conclusions: Systematic variations in the coding accuracy of stroke patients' diagnoses by hospital and patient characteristics have implications for hospital reimbursements and stroke case identification in epidemiologic studies and quality metrics.

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TABLE OF CONTENTS

Introduction 5

Methods 6

Data Source 6

Primary Analysis 6

Hospital and Stroke Severity Analysis 7

Outcome Assessment 8

Results 9

Discussion 10

References 16

List of Figures

Figure I. Patient Population for Primary and Secondary Analyses 19

List of Tables

Table I. Characteristics of Included Patients 20

Table II. Concordance and Discordance by Stroke/TIA and Carotid Endarterectomy 21

Table III. Concordance and Discordance by Presence of a Stroke Unit and Stroke Team 23

Table IV. Concordance and Discordance by Hospital Bed Size 24

Table V. Concordance and Discordance by Hospital Urbanization 25

Table VI. Concordance and Discordance by NIHSS at Admission 26

INTRODUCTION

Stroke is a leading cause of hospitalization and serious long-term disability that incurs both direct and indirect costs.[1] There has been an increased focus and use of administrative databases, such as Medicare, to enhance stroke surveillance and quality of care studies. These studies use patient health information reflected in the *International Classification of Diseases, 9th Revision*, Clinical Modification (*ICD-9*-CM) codes to translate the clinical information in administrative databases. Despite the increased interest in administrative databases, there are issues with its use. Researchers sometimes use inconsistent definitions of stroke and TIA with ICD-9-CM codes, and administrative databases may not capture important variables such as stroke severity.[2,3] Additionally, studies inherently assume that ICD-9-CM codes accurately reflect the patient's clinical diagnosis. Consequently, previous studies have examined the accuracy of ICD-9-CM codes by comparing adjudicated stroke medical records with ICD-9-CM code billing data.[4-20] Some of these studies have found variations in accuracy by patient characteristics, such as age and race-ethnicity.[12-13] Whether similar variations in accuracy occur by hospital characteristics and stroke severity has not been as thoroughly characterized.

Accordingly, we used data from the Paul Coverdell National Acute Stroke Program (PCNASP) to compare the concordance between clinical diagnoses made by the attending physician and primary ICD-9-CM billing codes. Secondarily, we sought to understand if there are systematic variations in concordance by hospital characteristics (hospital bed size, presence of a stroke unit and team, urban/rural location of the hospital) and stroke severity.

METHODS

Data Source

The PCNASP was established in 2001 by the Centers for Disease Control and Prevention (CDC) to support state-based acute stroke quality-of-care registries and activities to decrease rates of premature death and disability from stroke.[21] Details about the design of the PCNASP have been previously published.[22,23] For this analysis, we used PCNASP patient records for individuals discharged between January 1, 2013 and December 31, 2013. Each record represented a unique de-identified hospital admission.

Primary Analysis

The primary analysis examined the accuracy between the attending physician's documented clinical diagnosis and the primary ICD-9-CM billing code, the former of which was our referent group. Both of these data elements are contained within Coverdell patient records. Patient records were restricted to those with a single distinct clinical diagnosis documented by the attending physician. Records were excluded if there was a missing ICD-9-CM code or if the patient had an in-hospital stroke.

We used ICD-9-CM code definitions for stroke and TIA that were based on a 2013 American Heart Association/American Stroke Association (AHA/ASA) expert consensus statement, but excluded retinal and spinal infarcts and included V12.54 for TIA.[2] Thus, primary ICD-9-CM codes were categorized as: 1, ischemic stroke (IS); 2, transient ischemic attack (TIA); 3, subarachnoid hemorrhage (SAH); 4, intracerebral hemorrhage (ICH); or 5, stroke not otherwise specified (SNS) (see footnote in Table II).

Each patient record was concordant or discordant for stroke or TIA diagnosis groups. Concordance was defined as agreement between the attending physician's clinical diagnosis (referent group) and the patient's primary ICD-9-CM code. Discordance was defined as instances when the clinical diagnosis and ICD-9-CM code did not align. In addition to concordance and discordance, using the clinical diagnosis as the referent group, we calculated the sensitivity and specificity of each stroke subtype and TIA category. Sensitivity was the proportion of records for a specific diagnosis group that was identified using ICD-9-CM codes out of the total records for the diagnosis group identified through the clinical diagnosis. For ischemic stroke, this was the proportion of records with an ICD-9-CM code for ischemic stroke out of the total number of records with a clinical diagnosis of ischemic stroke.

We also determined the concordance and discordance between documented receipt of a carotid endarterectomy (CE) procedure in the medical record and ICD-9-CM code 433.10. Records with a missing value for the CE variable were excluded, as were records from one Coverdell state that had an error in coding the CE variable. Concordance was defined as instances when the patient's medical record had documentation of CE and a primary ICD-9-CM billing code of 433.10.

Hospital and Stroke Severity Analyses

We further examined concordance and discordance by hospital characteristics (hospital bed size, presence of a stroke unit, presence of a stroke team, and urbanization of the hospital's location), which were self-reported by Coverdell hospitals in a survey administered by state departments of health. Accordingly, our analyses were restricted to hospitals that systematically collected this data between 2011-2013.

Hospital bed size was categorized as 0-100, 101-200, 201-300, 301-500, or ≥501 beds. Urbanization was defined using Rural Urban Commuting Area (RUCA) codes. Definitions from the United States Department of Agriculture Economic Research Service (USDA ERS) were used to collapse the RUCA codes into 3 categories (codes 1-3 were metropolitan, 4-6 were micropolitan, and ≥7 were small town/rural areas).[24]

Additionally, stroke severity was assessed using the National Institutes of Health Stroke Scale (NIHSS) score recorded in patient records. This represented the NIHSS recorded at hospital admission. Records that did not have a documented NIHSS score were excluded. The NIHSS scores were categorized into 5 commonly used categories: 0-1, 2-4, 5-15, 16-20, and ≥21.

Outcome Assessment

For our primary analysis, using the attending physician's clinical diagnosis as the referent group, we identified what the most frequent ICD-9-CM codes were for discordant records. For the secondary analysis of hospital characteristics, we quantified the proportion of records that were concordant and discordant within each category of a hospital's characteristic. For example, we calculated the proportion of ischemic stroke records that were concordant for hospitals with stroke units, and the proportion that were concordant for hospitals without stroke units. For NIHSS, we quantified the proportion of concordant and discordant records within each NIHSS category. Additionally, using the clinical diagnosis as the referent group, we identified the most frequent ICD-9-CM codes for discordant records within the NIHSS category of 0-4 for ischemic strokes.

RESULTS

There were 90,035 patient records from 11 Coverdell states and 371 hospitals in 2013. When we restricted our sample size to records with a single distinct clinical diagnosis, and excluded records with missing ICD-9-CM codes and in-hospital strokes, we had a final sample size of 85,024 records for the primary analysis (mean age 69.6±14.9 years, 48.1% men, 74.5% white, 23.5% with a prior stroke, and 9.3% with a prior TIA) (Figure I; Table I).

Using the attending physician's clinical diagnosis as the referent group, we found that its concordance with primary ICD-9-CM codes was high overall. Our overall sensitivity for all stroke and TIA diagnosis groups was 93.8%. Sensitivity was individually greater than 90% for IS, TIA, SAH, and ICH, but was only 2% for SNS. Specificity was >95% for each stroke and TIA diagnosis category.

Similarly, concordance for each stroke and TIA category was generally high, except for the stroke not otherwise specified category (Table II). For the TIA category, 91.4% of records were concordant (attending physician's clinical diagnosis of TIA and primary ICD-9-CM code correctly reflecting TIA). However, 5.3% of patient records in the TIA category had a clinically diagnosed TIA by the attending physician but did not have an ICD-9-CM billing code for TIA. These patients most frequently had ICD-9-CM codes for a carotid endarterectomy procedure and ischemic stroke. The remaining 3.3% of records in the TIA category were instances when the patient record had an ICD-9-CM billing code for TIA, but the attending physician's clinical diagnosis was not TIA. Instead, the attending physician's clinical diagnosis was most frequently ischemic stroke.

Within the carotid endarterectomy category, 62.3% of records were concordant and had documentation of CE as well as an ICD-9-CM billing code of 433.10 (Table II). A majority of discordant records were instances when the ICD-9-CM code was 433.10, but there was no documentation of carotid endarterectomy. A small proportion of discordant records were when there was documentation of CE, but ICD-9-CM codes that were most frequently ischemic stroke.

For the secondary analysis, we linked patient records to hospital characteristics data in 7 states and 255 hospitals, which yielded a sample size of 67,442 patient records (mean age 69.5±15.0 years, 48.3% men, 73.6% white, 23.8% with a prior stroke, and 9.7% with a prior TIA) (Figure I; Table I). Approximately 83% of hospitals that had stroke teams also had stroke units. When the attending physician's clinical diagnosis was IS or TIA, concordance with ICD-9-CM codes was higher among hospitals with stroke units and teams (Table III). For example, within the ischemic stroke category, 94.6% of records were concordant for hospitals with a stroke unit, while 86.7% of ischemic stroke records were concordant for hospitals without a stroke unit. Compared to other bed sizes, hospitals with the smallest bed size (0-100) had the lowest proportion of concordant records between the referent clinical diagnosis and ICD-9-CM code (Table IV). Hospitals in metropolitan areas had higher concordance across all stroke subtypes except for ICH (Table V).

Stroke severity analyses only utilized patient-level data, and included 55,373 patient records with a documented NIHSS score at hospital admission. When concordance and discordance was determined for each NIHSS category, mild ischemic strokes (NIHSS 0-4) were more predictive of discordant records compared to severe strokes (Table VI). Among discordant records that had a NIHSS score 0-4 as well as a documented clinical diagnosis of ischemic stroke, ICD-9-CM codes were for CE, TIA, and SNS. Additionally, we found that patients with a documented clinical diagnosis of TIA and a NIHSS score >1 more frequently had a previous history of stroke and less frequently were able to ambulate with or without a device prior to the current event.

DISCUSSION

In this analysis, we found that concordance and sensitivity were high overall for stroke and TIA when we compared the referent group of the attending physician's clinical diagnosis and the primary ICD-9-CM code in the Coverdell Program. Sensitivity and specificity for Coverdell hospitals was generally higher than values for cohorts in other studies that assessed the accuracy between the stroke clinical diagnosis in adjudicated medical records and ICD-9-CM code.[4-20] For example, the overall sensitivity was 93.8% for Coverdell hospitals, but was 46% using data from the Women's Health Initiative (WHI).[6] A more recent study used data from the Atherosclerosis Risk in Communities Study (ARIC) and had similar definitions for ICD-9-CM codes that were also based on the 2013 AHA/ASA consensus statement.[2,12] These investigators found an overall sensitivity of 68%.[12] The higher sensitivity for Coverdell hospitals may reflect the fact that Coverdell is a quality improvement program. It also demonstrates that higher levels of concordance are attainable.

Our results also have implications for hospital reimbursements, particularly for patients with a documented clinical diagnosis of TIA, but ICD-9-CM code for ischemic stroke. This may represent up-coding to increase hospital reimbursements.

Similar to other studies, we found that carotid endarterectomy procedures were a common reason for discordant records.[4,9] This shows that it is important to recognize that billing for procedures such as CE may be representing an episode of continuation of care. Additionally, this indicates that epidemiologic studies that use definitions of acute ischemic stroke that include 433.10 may not be solely capturing acute events.

Although other studies have quantified variations in concordance by patient demographic characteristics (race, age, sex), it has not been examined by stroke severity. Analysis of concordance by commonly used categories of NIHSS scores showed that mild ischemic strokes were more predictive of discordant records when compared to more severe stroke categories. This suggests that when epidemiologic studies seek to count stroke cases using ICD-9-CM codes, they may not be accurately capturing patients with milder strokes. We also found that discordant records with a clinical diagnosis of TIA but high NIHSS score were more frequently patients with a prior history of stroke who needed assistance to ambulate. Thus, these patients may be representing individuals with deficits from a prior cerebrovascular event.

Recommendations from the Brain Attack Coalition have suggested that stroke units and teams improve patient care and outcomes.[25] We saw that hospitals with stroke units and teams also have greater accuracy of ICD-9-CM codes. Additionally, certain hospital characteristics, such as location in a metropolitan area and larger bed size, were more predictive of concordance. The variations in concordance by hospital characteristics and stroke severity indicate that the identification of stroke events may differ by hospital characteristics. In particular, there is better case identification in the larger metropolitan hospitals with dedicated stroke units and teams. Thus, when using quality metrics, we may not be completely comparing the same stroke patients across hospital types.

Using data from the Coverdell Program provided many advantages because of the ability to synthesize patient characteristics, stroke diagnoses, and hospital characteristics together. We were able to incorporate hospital characteristics to provide insights into characteristics that were predictive of ICD-9-CM coding accuracy. Hospital characteristics data, such as stroke team and stroke unit, have not been previously incorporated into the analysis of ICD-9-CM code accuracy, possibly because this data is not routinely collected in large cohort studies. Additionally, our sample size of 85,024 patients across more than 300 hospitals is larger than previous stroke studies that have examined ICD-9-CM code accuracy. The Coverdell Program also provided data on stroke severity, which has been noted as vital in predicting mortality and constructing risk adjustment models, but is not always captured in administrative databases. Finally, our analysis included deeper insights into the main ICD-9-CM codes responsible for discordances seen between the attending physician's clinical diagnoses and ICD-9-CM codes.

The Coverdell Program is a quality improvement program, so results may not be generalizable to hospitals that are not enrolled in the program. In fact, we saw that values for sensitivity and specificity were higher among our cohort of Coverdell hospitals. Previous studies used individually adjudicated medical records by clinicians to determine the patient's clinical diagnosis. However, we assumed that the documented clinical diagnosis in the Coverdell records would be the gold standard, and did not conduct medical record adjudication. Another limitation is that data elements in this study were utilized based on instructions as provided by Coverdell to participating hospitals. Therefore, the accuracy and applicability of the results depend on hospitals' adherence to the instructions. Some of these limitations can be mitigated by the fact that Coverdell requires a certain number of records to be re-abstracted each year. Finally, this analysis could have been expanded on with information about neuroimaging capabilities at hospitals, since a diagnosis between stroke and TIA can differ between hospitals that use MRIs and those who do not.

Administrative data have been increasingly used to study disease prevalence, compare hospitals, and determine service utilization and cost. Similar to previous studies, this analysis found inaccuracies in the identification of stroke patients with ICD-9-CM codes, but overall found higher concordance among Coverdell hospitals compared to other cohorts. Use of the Coverdell Program enabled this study to expand on previous research by incorporating data on hospital characteristics and stroke severity to highlight how discordances vary, and its potential effects on epidemiologic studies, quality metrics, and hospital reimbursements. In the clinical setting, improvements can be made to increase ICD-9-CM code accuracy to enhance the validity of studies that use administrative databases. When using and interpreting results from studies that use administrative data, researchers should remain aware of systematic differences in the accuracy of ICD-9-CM codes.

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Figure I. Patient Population for Primary and Secondary Analyses

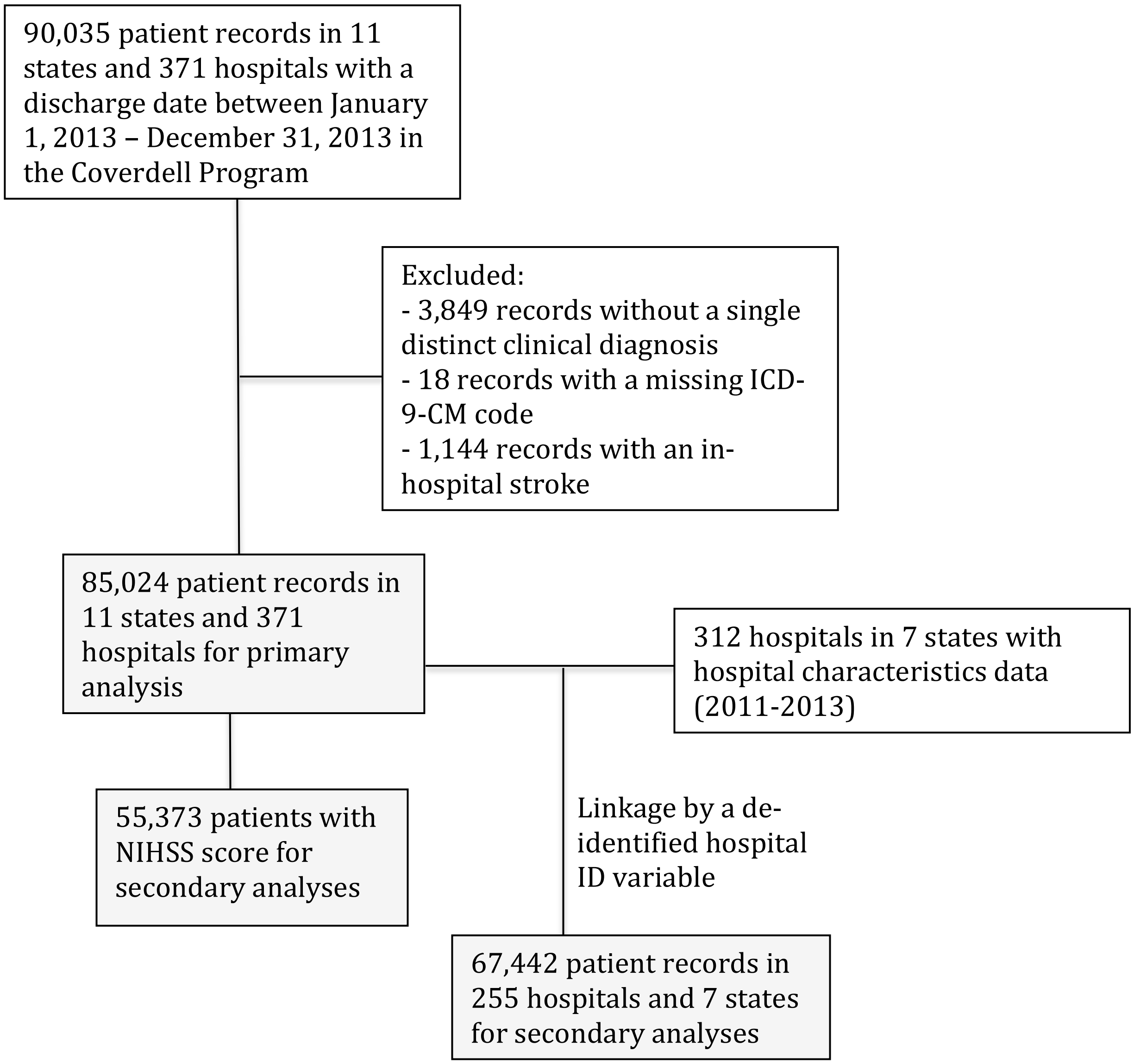

Table I. Characteristics of Included Patients

Characteristic	Primary analysis (n=85,024)	Secondary analysis (n=67,442)
Age (years), mean ± SD	69.6 ± 14.9	69.5 ± 15.0
Sex, n (%)		
Male	40,846 (48.1)	32,563 (48.3)
Female	44,059 (51.9)	34,873 (51.7)
Race-ethnicity, n (%)		
White	62,940 (74.5)	49,418 (73.6)
Black	15,966 (18.9)	13,597 (20.2)
Other	5,575 (6.6)	4,145 (6.2)
NIHSS, median (range)	3 (0-42)	3 (0-42)
Medical history, n (%)		
Hypertension	61,722 (72.6)	49,575 (73.5)
Dyslipidemia	37,330 (43.9)	30,135 (44.7)
MI or CAD	19,902 (23.4)	16,077 (23.8)
Heart failure	7,670 (9.0)	6,215 (9.2)
Diabetes	25,476 (30.0)	20,372 (30.2)
Atrial fibrillation	14,707 (17.3)	11,625 (17.2)
Prior stroke	20,004 (23.5)	16,020 (23.8)
Prior TIA/VBI	7,925 (9.3)	6,518 (9.7)
Smoking	15,951 (18.8)	13,025 (19.3)

* Numbers may not sum to totals due to missing data.

Table II. Concordance and Discordance by Stroke/TIA and Carotid Endarterectomy

Category	Diagnosis		Frequency	Percent Diagnosis Category	Frequency of Discordance Explanations
	Clinical Diagnosis by the Attending Physician	ICD-9-CM Code			
Ischemic Stroke (IS)*	IS	IS	55,794	94.1%	N/A
	IS	Not IS	2,136	3.6%	CE (989) TIA (363) SNS (222) Cerebral artery occl, unspec (68)- 434.90
	Not IS	IS	1,357	2.3%	SNS (892) TIA (251) ICH (127) No stroke related diagnosis (NoS) (77)
Transient Ischemic Attack (TIA)†	TIA	TIA	12,566	91.4%	N/A
	TIA	Not TIA	734	5.3%	CE (282) IS (243)
	Not TIA	TIA	456	3.3%	IS (385) NoS (36) SNS (29) SAH (5)
Subarachnoid Hemorrhage (SAH)‡	SAH	SAH	3,265	93.0%	N/A
	SAH	Not SAH	153	4.4%	ICH (64) Subdural hemorrhage (28)- 432.10 Intracranial hemorrhage (18)- 432.90 IS (7)
	Not SAH	SAH	93	2.6%	ICH (79) IS (11) NoS (2) SNS (1)
Intracerebral	ICH	ICH	8,130	89.4%	N/A

Hemorrhage (ICH)§	ICH	Not ICH	859	9.4%	Intracranial hemorrhage (527)- 432.90 IS (95) SAH (79) Subdural hemorrhage (27)- 432.10
	Not ICH	ICH	110	1.2%	SAH (64) IS (36) SNS (5) NoS (4)
Stroke Not Specified (SNS)¦	SNS	SNS	21	1.6%	N/A
	SNS	Not SNS	1,024	78.1%	IS (873) CE (35)
	Not SNS	SNS	266	20.3%	IS (222) TIA (19) ICH (16) NoS (8)
Carotid Endarterectomy (CE)	Admitted for CE	433.10	2,616	62.3%	N/A
	Admitted for CE	Not 433.10	120	2.9%	IS (97) Occlusion stenosis (7)- 433.30 ICH (3)
	Not admitted for CE	433.10	1,463	34.8%	IS (448) TIA (195) NoS (95) SNS (24)

* ICD-9-CM codes 433.01 433.11 433.21 433.31 433.81 433.91 434.01 434.11 434.91
† ICD-9-CM codes 435.0, 435.1 435.2 435.3 435.8 435.9, V12.54
‡ ICD-9-CM code 430
§ ICD-9-CM code 431
| | ICD-9-CM code 436
Any code not listed in a previous category

Table III. Concordance and Discordance by Presence of a Stroke Unit and Stroke Team*

Stroke Subtype / TIA	Concordant/ Discordant	Stroke Unit		Stroke Team	
		Yes % (n)	No % (n)	Yes % (n)	No % (n)
Ischemic Stroke	**Concordant**	94.6 (34,249)	86.7 (2,855)	94.5 (32,678)	89.7 (4,436)
	Discordant	5.4 (1,965)	13.3 (437)	5.5 (1,903)	10.3 (507)
TIA	**Concordant**	92.0 (7,718)	85.1 (811)	91.4 (7,395)	91.0 (1,197)
	Discordant	8.0 (672)	14.9 (142)	8.6 (695)	9.0 (119)
Subarachnoid Hemorrhage	**Concordant**	94.4 (2,399)	95.0 (94)	94.4 (2,354)	95.7 (134)
	Discordant	5.6 (142)	5.1 (5)	5.7 (141)	4.3 (6)
Intracerebral Hemorrhage	**Concordant**	89.3 (5,541)	84.9 (281)	89.3 (5,390)	88.4 (404)
	Discordant	10.7 (662)	15.1 (50)	10.8 (649)	11.6 (53)
Stroke not Specified	**Concordant**	1.0 (8)	2.0 (5)	0.4 (3)	3.2 (10)
	Discordant	99.0 (808)	98.0 (247)	99.6 (754)	96.8 (303)

*Included 196 hospitals for stroke unit analysis, and 199 hospitals for stroke team

Table IV. Concordance and Discordance by Hospital Bed Size*

Stroke Subtype / TIA	Concordant/ Discordant	Hospital bed size 0-100 % (n)	101-200 % (n)	201-300 % (n)	301-500 % (n)	501+ % (n)
Ischemic Stroke	**Concordant**	80.8 (1,422)	94.1 (5,006)	89.2 (6,446)	96.3 (11,974)	95.8 (18,833)
	Discordant	19.2 (337)	5.9 (315)	10.8 (782)	3.7 (460)	4.2 (823)
TIA	**Concordant**	79.1 (569)	92.2 (1,538)	91.7 (1,821)	93.1 (3,713)	91.6 (2,870)
	Discordant	20.9 (150)	7.8 (130)	8.3 (165)	6.9 (274)	8.4 (262)
Subarachnoid Hemorrhage	**Concordant**	25.0 (1)	90.8 (59)	91.4 (222)	90.9 (371)	95.5 (1,991)
	Discordant	75.0 (3)	9.2 (6)	8.6 (21)	9.1 (37)	4.5 (93)
Intracerebral Hemorrhage	**Concordant**	69.4 (50)	83.1 (330)	81.4 (804)	90.6 (1,541)	91.0 (3,613)
	Discordant	30.6 (22)	16.9 (67)	18.6 (184)	9.4 (160)	9.0 (358)
Stroke not Specified	**Concordant**	0.6 (1)	2.4 (3)	0.4 (2)	1.9 (1)	0.8 (2)
	Discordant	99.4 (167)	97.6 (121)	99.6 (552)	98.2 (53)	99.2 (246)

*Included 252 hospitals

Table V. Concordance and Discordance by Hospital Urbanization*

Stroke Subtype / TIA	Concordance/ Discordance	RUCA		
		Rural (≥7) % (n)	Micropolitan (4-6) % (n)	Metropolitan (1-3) % (n)
Ischemic Stroke	Concordant	91.7 (1,144)	86.9 (2,082)	94.8 (24,303)
	Discordant	8.3 (103)	13.1 (313)	5.2 (1,329)
TIA	Concordant	89.2 (297)	88.8 (501)	92.3 (4,892)
	Discordant	10.8 (36)	11.2 (63)	7.8 (411)
Subarachnoid Hemorrhage	Concordant	90.5 (57)	92.7 (89)	96.5 (1,682)
	Discordant	9.5 (6)	7.3 (7)	3.5 (61)
Intracerebral Hemorrhage	Concordant	93.5 (157)	88.7 (236)	91.0 (3,965)
	Discordant	6.6 (11)	11.3 (30)	9.0 (391)
Stroke not Specified	Concordant	1.9 (1)	1.9 (5)	1.2 (6)
	Discordant	98.1 (51)	98.1 (256)	98.8 (479)

* Included 140 hospitals

Table VI. Concordance and Discordance by NIHSS at Admission

Stroke Subtype / TIA	Concordant/ Discordant	NIHSS Category				
		0-1 % (n)	2-4 % (n)	5-15 % (n)	16-20 % (n)	21+ % (n)
Ischemic Stroke	Concordant	93.2 (10,610)	95.8 (11,160)	96.3 (11,622)	96.7 (2,525)	96.3 (2,812)
	Discordant	6.8 (769)	4.3 (495)	3.7 (444)	3.3 (87)	3.7 (107)
TIA	Concordant	92.9 (6,092)	92.7 (2,095)	90.5 (1,051)	89.2 (66)	83.6 (46)
	Discordant	7.1 (467)	7.3 (165)	9.5 (110)	10.8 (8)	16.4 (9)