HOSPITAL-DISCHARGE-DATA UNDERESTIMATE HEMORRHAGIC STROKE EVENTS: data from a multicenter validation survey in the Florence area (Italy)

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BACKGROUND

Patients with **Hemorrhagic Stroke (HS)** are often selected for epidemiological reporting, research, and surveillance using **Hospital Discharge Records (HDR)**, that reflect real-world practice both at hospital and population level. Moreover, HDR are the only source of information everywhen ad-hoc registration systems are not affordable. Obtaining reliable information requires that stroke diagnoses in hospital discharge data are correct, but, at variance with several cardiac events, stroke remains difficult to classify reliably.[1,2]

AIMS

Estimating **accuracy** of ICD9-CM coding for **Hemorrhagic Strokes, both intracerebral hemorrhage (ICH) and subarachnoid hemorrhage (SH),** across the 6 hospitals covering the entire Florence Area, in Italy.

METHODS

The Florence Area spans 3500 Km^2 with a total population of 838,000 inhabitants. The health system is entirely financed by public regional authority and is structured with 6 hospitals, only 1 entitled to perform endovascular interventions and provided with neurosurgery facility.

We estimated **accuracy** of ICD9-CM ICH and SH codes in terms of sensitivity and PPV **against medical record review** with clinical adjudication.

TEST METHOD

ICD-9CM codes 430 and 431 in primary diagnosis on the HOSPITAL DISCHARGE RECORDS (HDR)

REFERENCE METHOD

MEDICAL RECORD REVIEW by stroke neurologist, stroke subtyping according to WHO-MONICA criteria.[3] Exclusion of: TIA, spinal and retinal arterial infarctions.

IDENTIFICATION OF POTENTIAL ACUTE STROKE EVENTS

We identified 3915 potential acute stroke (any type of stroke) events by summing up all events triaged as stroke or TIA, recorded either in the Emergency Department (ED) or in hospital discharge data with an ICD9-CM diagnostic code 430-435 (any type of stroke and TIA) in primary position, from January 1 through December 31, 2015. For each of the 3915 potential stroke events **an exhaustive medical record was built up and reviewed by a stroke neurologist** (MB). All Florence Area hospitals have CT scanners available in ED and could therefore provide neuroimaging to all the potential stroke events included in our study.

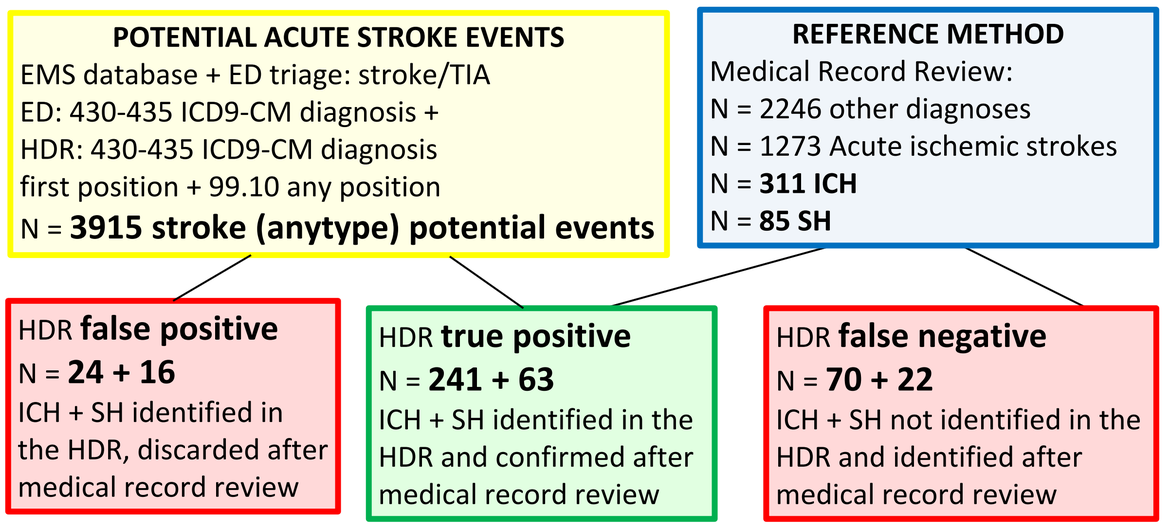
DATA ANALYSES

Sensitivity was defined as the proportion of true-positive cases identified by reference method also identified by test method. **Positive Predictive Value (PPV)** was defined as the proportion of true-positive cases among those identified as ICH and SH by the test method.

For each false positive case we obtained the actual diagnosis. For each false negative case we obtained the primary and secondary ICD9-CM diagnoses on the HDR.

The Regional Committee for Medical and Research Ethics gave the approval to conduct this study without patient consent.

FIGURE 1. INCLUSION FLOW-CHART



EMS: Emergency Medical Services; ED: Emergency Department; HDR: Hospital Discharge Records

TABLE 1. PERFORMANCES OF HDR TO IDENTIFY HEMORRHAGIC STROKE (HS) EVENTS

	Hemorrhagic Stroke (HS)					Accuracy	
	Identified by test method	Identified by reference method	True-positive	False-negative	False-positive	Sensitivity# (95% CI)	PPV## (95%CI)
All events 430 + 431	436	396	304	92	40	76.8 (72.3-80.8)	69.7 (65.2-74.0)
430	101	85	63	22	16	74.1 (63.5-83.0)	62.4 (52.2-71.8)
431	335	311	241	70	24	77.5 (72.4-82.0)	71.9 (66.8-76.7)

#True-positive events/events identified by reference method; ##True-positive events/events identified in HDR

TABLE 2. ICD-9CM CODES IN PRIMARY POSITION FOR 92 DISCHARGES WITH HS EVENTS NON CODED EITHER 430 OR 431 IN PRIMARY POSITION (FALSE-NEGATIVE EVENTS)

Disease	ICD-9CM code	N	%
Died in ED	No HDR	13	14.1
Refused hospitalization	No HDR	5	5.4
Respiratory failure	518.81	12	13.0
ICH in secondary positions	431	30	32.5
SH in secondary positions	430	4	4.3
SH in primary diagnosis for ventricular flood	430	4	4.3
Other: hemiplegia, epilepsy, neoplasms, intracranial injury	342, 345, 140-239, 850-854	24	26.1

CONCLUSIONS

Our findings have relevant implications for stroke surveillance. Tracking HS by hospital discharge data proved poorly **specific and insensitive, because of both inaccurate coding and lack of HDR for those who died in ED.** The sensitivity of ICD9-CM codes proved suboptimal with a substantial undercounting of HS. The reasons for the high rate of missed cases are reported, and most of them can benefit from ad-hoc guidelines, training and comprehensive databasing.

According to our findings, the main reasons for the undercount of HS are miscoding of HS in secondary positions and lack of HDR for those who died in ED.

Our findings could be easily translated into coding guidelines to **improve coding quality and, as a consequence, hospital discharge data reliability.**

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REFERENCES

1. Heckbert SR, Kooperberg C, Safford MM, et al. Comparison of self-report, hospital discharge codes, and adjudication of cardiovascular events in the Women's Health Initiative. Am J Epidemiol 2004;160:1152-8.
2. Haesebaert J, Termoz A, Polazzi S, et al. Can hospital discharge databases be used to follow ischemic stroke incidence? Stroke 2013;44:1770-4.
3. Asplund K, Bonita R, Kuulasmaa K, et al. Multinational comparisons of stroke epidemiology. Evaluation of case ascertainment in the WHO MONICA Stroke Study. World Health Organization Monitoring Trends and Determinants in Cardiovascular Disease. Stroke. 1995;26:355-60. Erratum in: Stroke 1995 Aug;26:1504.