

The neurologist in the emergency department. An Italian nationwide epidemiological survey

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Abstract A nationwide survey has been undertaken to evaluate the resources and the activities of Italian hospital neurology units (NU) in the emergency setting. NU are widely disseminated throughout the entire country and 220 (84%) are located in hospitals with an emergency room (ER). Complete data about hospital setting, struc-

tural and functional characteristics of each NU and clinical activities were obtained from 159 (72.3%). Each NU has, on average, 25 beds (7% bedside monitoring), 7 neurologists and 17 nurses. A neuroscience department is present in 25% of the hospitals. The ER is the source of 71% of the 148,040 annual admissions and of 57% of the 577,279 annual neurological consultations. Stroke is the most common cause of admission (29%), followed by epilepsy/headache and transient ischaemic attacks. Head trauma prevails in hospitals with no neurosurgical units. Cerebrovascular disorders are the main cause of neurological consultations (28%), followed by headache (22%), dizziness (13%), head trauma (13%), impairment of consciousness (12%) and epilepsy (9%). Only 36% of NU have a 24-h/day, 7 days/week on-duty neurologist and 28% have a stroke unit. The burden of neurological activities is unrelated to the geographical area and hospital's complexity (size, structural and functional context, ER organisation, presence of stroke units, neurosurgery units or 24/7 neurological service).

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Introduction

Acute neurological disorders, such as stroke, head trauma and seizures, are a common source of admission to Emergency Rooms (ER) and are frequently associated with high mortality and costs arising from acute management and long-term care. In many of these conditions, early management could be relevant for patient survival and outcome. In the UK, 10% of ER patients have a neurological complaint [1] and 10%–20% of acute admissions are for neurological diseases [2, 3]; 8%–15% of all patients

admitted to ERs require assessment by a neurologist [4, 5].

In Italy, hospital discharges for neurological diseases (ICD-9-CM, MDC 1) in the year 2003 were 639,151 (7.6% of the 8,433,471 total hospital discharges) [6]. Stroke, transient ischaemic attacks (TIA), headache and epilepsy (Diagnosis-Related Group (DRG) 14, 15, 24–26) accounted for 42.3% of all neurological discharges, and 49.8% with the inclusion of non-surgical CNS traumatic disorders (DRG 27–30). Many, often insidious, conditions require neurological assessment in the ER, including headache [7, 8], acute impairment of consciousness [9], dizziness [10] and head injury [11]. In all these conditions, neurological consultation is relevant to prompt and expert diagnosis, to decide the need for hospitalisation and to establish the treatment in the acute phase [12, 13]. In a remarkable proportion of cases (52.5%), neurological consultation in the ER may change the diagnosis made on admission [4]. Advances in neuroimaging and the introduction of new treatments to be started in the ER have changed the diagnostic and therapeutic approach to several neurological conditions [13, 14] and led to the implementation of ad hoc emergency departments (including stroke units) in several parts of Italy [15]. Nevertheless, as in other countries [16–18], neurologists are often not available in the ER and many acute neurological disorders are treated in general wards.

Very few data are available on the burden of neurological consultations in the ER [4, 5, 19] and the resources to meet this burden [18]. To assess the role of the neurologist in the emergency setting, we undertook a nationwide survey with the following aims: (1) to define the location, structural and functional characteristics of the neurological units (NU) in the 20 Italian administrative districts (Regions); and (2) to define the resources and the activities of each NU.

Materials and methods

The survey was endorsed by the two Italian neurological societies (Società Italiana di Neurologia and Società dei Neurologi, Neurochirurghi e Neuroradiologi Ospedalieri). Socio-economic and health organisation settings were compared by dividing the country into four major areas and appointing regional coordinators. In the first phase of the survey, all the hospitals with neurological facilities were identified, the hospitals with ER were selected and a referent neurologist within each NU was identified. In the second phase, a semi-structured questionnaire was used to collect information (year 2003) about hospital settings, structural and functional characteristics of each NU, and clinical activities. Each regional coordinator supervised the completeness and quality of the information provided.

The hospitals were differentiated in accordance with five categories:

- *location*: North-West (NW), North-East (NE), Central (C) and South/Islands (S/I);
- *size*: <300; 300–800; >800 beds;
- *functional context*: university hospital and scientific institutes vs. general or local hospitals (general hospitals have their own management, whereas local hospitals are managed by the local Health Care District);
- *structural context*: presence of a neuroscience or internal medicine department;
- *ER organisation*: classed according to the complexity of the emergency department (ED) as: structural, functional or First Aid Service.

The resources and activities of each NU were evaluated in function of a number of structural and functional indicators:

- *structure indicators*: structure of the NU (staff, number of beds and bedside monitors, on-duty and on-call neurologists) and hospital setting (presence of intensive care, neurosurgery and emergency medicine wards or departments and stroke unit; availability of EEG, CT scan, MRI);
- *activity indicators*: admissions to the NU (number, DRG, percent from the ER, admissions for stroke), neurological ER consultations (number and clinical diagnosis) and investigations performed in the ER;
- *efficiency indicators*: number of admissions per staff doctor; number of admissions/bed/year (turnaround index); number of ER admissions and ER consultations per staff doctor; percentage of admissions following neurological consultation (*admission index*, chosen as index of efficacy in avoiding unnecessary hospitalisation).

Admission data were obtained from hospital computerised databases (n=107), or transcribed from in-patient registries (n=41); the data source was not specified by 11 NU. The corresponding figures for consultations were 56, 71 and 32. NU with computerised databases prevailed in NE ($p<0.05$). The indicator values were grouped in categories defined by the median (above or below), and by tertiles and quartiles. The only exception was the number of beds, for which the category <10 was devised.

Responders were asked to list the 1st, 2nd, 3rd and 4th most frequent discharge DRG. These were then ranked as 4, 3, 2 and 1. The percentage of the summed ranks of each DRG over the total was calculated. The same procedure was applied for neurological consultations. Data for some variables were missing in only 10 NU (6%).

Statistics were analysed using the Student's *t*-test, the χ^2 test, the χ^2 test for trend and the Kruskal–Wallis test where applicable. The Pearson's coefficient was used to test correlations. Bonferroni's correction for multiple testing was used with $p=0.01$ for correlations with the five hospital categories (location, size, functional and structural context, and ER organisation) and $p=0.0025$ for correlations in Tables 1 and 2. All tests were per-

Table 1 Structure, activity and efficiency indicators by percentage of admission from ER (n=152)

		Percentage of ER admission			<i>p</i> *
		≤65% n (%)	66–85% n (%)	>85% n (%)	
Structure indicators of the NU					
No. beds (n=152)	≤10	6 (12.0)	4 (6.6)	3 (7.3)	n.s.
	11–30	34 (68.0)	42 (68.9)	30 (73.2)	8 (19.5)
	>30		10 (20.0)	15 (24.6)	
No. monitors (n=151)	0	31 (62.0)	31 (51.7)	23 (56.1)	
	1–4	14 (28.0)	20 (33.3)	11 (26.8)	n.s.
	>4	5 (10.0)	9 (15.0)	7 (17.1)	
No. neurologists (n=152)	<5	15 (30.0)	18 (29.5)	11 (26.8)	
	6–9	24 (48.0)	24 (39.4)	19 (46.3)	n.s.
	≥10	11 (22.0)	19 (31.2)	11 (26.8)	
No. beds/neurologist (n=152)	<3	21 (42.0)	22 (36.1)	14 (34.2)	
	3–4	9 (18.0)	16 (26.2)	17 (41.5)	n.s.
	>4	20 (40.0)	23 (37.7)	10 (24.4)	
On-duty neurologist (n=149)	<12 h	12 (24.5)	9 (15.3)	10 (24.4)	
	12 h	20 (40.8)	24 (40.7)	18 (43.9)	n.s.
	24 h	17 (34.7)	26 (44.1)	13 (31.7)	
Any neurologist available (on-duty+on-call) (n=149)	≤12 h	5 (10.2)	2 (3.4)	6 (14.6)	
	13–23 h	5 (10.2)	2 (3.4)	6 (14.6)	n.s.
	24 h	39 (79.6)	55 (93.2)	29 (70.7)	
EEG availability (n=152)	6 h	3 (6.0)	12 (19.7)	5 (12.2)	
	12 h	29 (19.7)	39 (63.9)	23 (56.1)	n.s.
	24 h	18 (12.2)	10 (16.4)	13 (31.7)	
Structure indicators of the hospital					
Intensive care unit (n=148)	No	1 (2.1)	3 (5.0)	2 (5.0)	
	Yes	47 (97.9)	57 (95.0)	38 (95.0)	n.s.
Neurosurgery (n=148)	No	21 (43.8)	37 (61.7)	20 (50.0)	
	Yes	27 (56.3)	23 (38.3)	20 (50.0)	n.s.
Emergency medicine (n=148)	No	21 (43.8)	27 (45.0)	16 (40.0)	
	Yes	27 (56.3)	33 (55.0)	24 (60.0)	n.s.
Stroke Unit (n=147)	No	35 (72.9)	43 (71.7)	28 (71.8)	
	Yes	13 (27.1)	17 (28.3)	11 (28.2)	n.s.
CT availability (n=151)	12 h	6 (12.0)	7 (11.5)	3 (7.5)	
	24 h	44 (88.0)	54 (88.5)	37 (92.5)	n.s.
MRI availability (n=152)	No	14 (28.0)	19 (31.2)	18 (43.9)	
	12 h	15 (30.0)	23 (37.7)	14 (34.1)	n.s.
	24 h	21 (42.0)	19 (31.1)	9 (22.0)	
Activity indicators					
NU admissions/year (n=152)	≤1000	36 (72.0)	44 (72.1)	23 (56.1)	
	>1000	14 (28.0)	17 (27.9)	18 (43.9)	n.s.
Neurological ER consultations/year (n=149)	≤2000	36 (75.0)	26 (44.3)	23 (56.1)	
	>2000	12 (25.0)	34 (56.7)	18 (43.9)	n.s.
Percent of CT in the ER (n=127)	≤50	25 (71.4)	32 (56.1)	14 (40.0)	
	>50	10 (28.6)	25 (43.9)	21 (60.0)	n.s.
Efficiency indicators					
No. ER admissions/neurologist/year (n=152)	≤40	18 (36.0)	3 (4.9)	1 (2.4)	<0.0001
	41–70	9 (18.0)	12 (19.7)	4 (9.8)	<0.0001*
	>70	23 (46.0)	46 (75.4)	36 (87.8)	
No. ER consultations/neurologist/year (n=147)	≤200	24 (52.2)	17 (28.3)	15 (36.6)	
	201–400	17 (37.0)	25 (41.7)	14 (34.2)	n.s.
	>400	5 (10.9)	18 (30.0)	12 (29.3)	
Turnaround index (n=152) (no. of admissions/bed/year)	≤30	14 (28.0)	15 (24.6)	10 (24.4)	
	31–45	24 (48.0)	38 (62.3)	18 (43.9)	n.s.
	>45	12 (24.0)	8 (13.1)	13 (31.7)	
Admission index (n=148)	<25%	17 (36.2)	19 (31.7)	9 (22.0)	
	25%–45%	13 (27.7)	22 (36.7)	12 (29.3)	n.s.
	45%	17 (36.2)	19 (31.7)	20 (48.8)	

* χ^2 for trend test. *EEG*, electroencephalography; *CT*, computerised tomography; *MRI*, magnetic resonance imaging

Table 2 Structure, activity and efficiency indicators by admission index (n=148)

		Admission index			<i>p</i> *
		≤25% n (%)	25–45% n (%)	>45% n (%)	
Structure indicators of the NU					
No. beds (n=148)	≤10	7 (15.6)	0 (–)	6 (10.7)	
	11–30	28 (62.2)	41 (87.2)	33 (58.9)	n.s.
	>30		10 (22.2)	6 (12.8)	17 (30.4)
No. monitors (n=147)	0	28 (62.2)	26 (55.3)	30 (54.6)	
	1–4	12 (26.7)	16 (34.0)	16 (29.1)	n.s.
	>4	5 (11.1)	5 (10.6)	9 (16.4)	
No. neurologists (n=148)	<5	8 (17.8)	12 (25.5)	22 (39.3)	
	6–9	21 (46.7)	23 (48.9)	21 (37.5)	n.s.
	≥10	16 (35.6)	12 (25.5)	13 (23.2)	
No. beds/neurologist (n=148)	<3	28 (62.2)	15 (31.9)	13 (23.2)	=0.0014
	3–4	9 (20.0)	13 (27.7)	20 (35.7)	<0.0005*
	>4	8 (17.8)	19 (40.4)	23 (41.1)	
On-duty neurologist (n=146)	<12 h	8 (17.8)	12 (26.1)	11 (20.0)	
	12 h	18 (40.0)	19 (41.3)	24 (43.6)	n.s.
	24 h	19 (42.2)	15 (32.6)	20 (36.4)	
Any neurologist available (on-duty+on-call) (n=146)	≤12 h	3 (6.7)	3 (6.5)	7 (12.7)	
	13–23 h	3 (6.7)	5 (10.9)	5 (9.1)	n.s.
	24 h	39 (86.7)	38 (82.6)	43 (78.2)	
EEG availability (n=148)	6 h	8 (17.8)	5 (10.6)	7 (12.5)	
	12 h	25 (55.6)	31 (66.0)	32 (57.1)	n.s.
	24 h	12 (26.7)	11 (23.4)	17 (30.4)	
Structure indicators of the hospital					
Intensive care unit (n=144)	No	1 (2.2)	1 (2.2)	3 (5.7)	
	Yes	44 (97.8)	45 (97.8)	50 (94.4)	n.s.
Neurosurgery (n=144)	No	24 (53.3)	28 (60.9)	24 (45.3)	
	Yes	21 (46.7)	18 (39.1)	29 (54.7)	n.s.
Emergency medicine (n=144)	No	21 (46.7)	14 (30.4)	26 (49.1)	
	Yes	24 (53.3)	32 (69.6)	27 (50.9)	n.s.
Stroke unit (n=143)	No	34 (75.6)	34 (73.9)	35 (67.3)	
	Yes	11 (24.4)	12 (26.1)	17 (32.7)	n.s.
CT availability (n=147)	12 h	5 (11.1)	3 (6.4)	6 (10.9)	n.s.
	24 h	40 (88.9)	44 (93.6)	49 (89.1)	
MRI availability (n=148)	No	14 (31.1)	16 (34.0)	20 (35.7)	
	12 h	17 (37.8)	20 (42.6)	13 (23.2)	n.s.
	24 h	14 (31.1)	11 (23.4)	23 (41.1)	
Activity indicators					
NU admissions/year (n=148)	≤1000	37 (82.2)	33 (70.2)	30 (53.6)	n.s.
	>1000	8 (17.8)	14 (29.8)	26 (46.4)	=0.0021*
No. ER consultations/year (n=148)	≤2000	8 (17.8)	24 (51.1)	52 (92.9)	<0.0001
	>2000	37 (82.2)	23 (48.9)	4 (7.1)	<0.0001*
Percent of CT in the ER (n=126)	≤50	21 (55.3)	21 (47.7)	28 (63.6)	n.s.
	>50	17 (44.7)	23 (52.3)	16 (36.4)	
Efficiency indicators					
No. ER admissions/year/neurologist (n=148)	≤40	10 (22.2)	4 (8.5)	7 (12.5)	
	41–70	17 (37.8)	7 (14.9)	1 (1.85)	<0.0001
	>70	18 (40.0)	36 (76.6)	48 (85.7)	<0.0005*
No. ER consultations/year/neurologist (n=147)	≤200	3 (6.7)	13 (27.7)	40 (72.7)	
	201–400	18 (40.0)	23 (48.9)	15 (27.3)	<0.0001
	>400	24 (53.3)	11 (23.4)	0 (–)	<0.0001*
	Turnaround index (n=148)	≤30	15 (33.3)	10 (21.3)	12 (21.4)
(No. of admissions/bed/year)	31–45	22 (48.9)	32 (68.1)	25 (44.6)	n.s.
	>45	8 (17.8)	5 (10.6)	19 (33.9)	

* χ^2 for trend test. EEG, electroencephalography; CT, computerised tomography; MRI, magnetic resonance imaging

formed with the statistical package SAS [20]. The role of the hospital categories and the other structural and functional indicators was assessed by calculating the odds ratios (OR), with 95% confidence limits (CL). To control for confounding and interactions, a multivariable analysis was done, using a stepwise binary logistic regression model (SAS/PROC LOGISTIC). For the purpose of the multivariate analysis, indicators were dichotomised around the median as follows: number of beds/neurologist <3.5 vs. ≥ 3.5 ; turnaround index ≤ 35 vs. >35 admissions/bed/year; consultations/year/neurologist ≤ 250 vs. >250; ER admissions/year/neurologist ≤ 70 vs. >70.

Results

Two hundred and sixty-four hospitals with NU were identified throughout Italy. Two hundred and twenty (84%) had an ER, accounting for 5518 neurological beds

(96/1,000,000 population) and 1623 staff neurologists (28/1,000,000 population). The distribution of beds and staff doctors by major area showed similar beds/neurologist ratios, but a higher incidence of beds/population and neurologists/population in NW and NE (Table 3). Of the 220 questionnaires delivered, 159 were returned (72.3%). There were no significant differences between responders and non-responders in the five hospital categories (data not shown). Structure, activity and efficiency indicators were calculated for the 159 responders.

Structure indicators

The mean number of beds in the 159 hospitals was 626 ($sd=411$, range 141–2650). Table 4 shows the characteristics of the 159 responders. The staff was composed of a mean of 7 neurologists ($sd=3$; range=2–18) and 17 nurses ($sd=6$; range=2–42). The number of beds per neurologist

Table 3 Number of staff doctors and neurology beds by geographic area. Data from all neurological units and for the responders are shown separately

Region	Population	Italian NU with access to the ER (n=220)						Responders (n=159)		
		n	Beds	Beds/1000 pop	Neurologists	Neurologists/1000 pop	Beds/neurologist	n	Neurologists	Beds
North-West ^a	6,218,976	34	890	0.14	262	0.042	3.4	26	202	726
North-East	19,291,198	85	2549	0.13	695	0.036	3.7	58	427	1641
Centre ^b	12,567,818	46	774	0.06	253	0.020	3.1	33	231	580
South/Islands ^a	19,430,753	55	1305	0.07	413	0.021	3.2	42	314	1050
Italy	57,508,745	220	5518	0.10	1623	0.028	3.4	159	1174	3997

^a Incomplete data for 1 NU

^b Unknown number of staff doctors in Tuscany and university hospitals in Lazio

Table 4 General characteristics of 159 hospitals with neurological units

	No.	%
Location		
North-West	26	16
North-East	42	26
Centre	45	28
South/Islands	46	29
Size		
≤ 300 beds	28	18
301–800 beds	99	62
>800 beds	32	20
Functional context		
University hospital	24	15
General hospital	62	39
Local hospital	73	46
Structural context		
Neuroscience dept	38	25
Internal medicine dept	72	47
No department	45	28
ER organisation		
Structural emergency department	70	47
Functional emergency department	53	36
First-aid service	26	17

was the highest in NE (4.3), followed by NW (3.6), S/I (3.6) and C (3.0) ($p<0.0001$). Each NU had on average 25 beds ($sd=12$, range 2–68). Seventy percent of NU had 11–30 beds. Bedside monitors were available for 7% of beds, 31% of NU having 1–4 monitored beds, unrelated to the five hospital categories or the other indicators. A neuroscience department (NSD) was present in only 25% of the hospitals, 47% of the NU being part of a medicine department and 38% not included in a department. A NSD prevailed in larger hospitals (>800 beds: 14 NU, 45%; 301–800: 21, 22%; ≤ 300 : 3, 11%) and university hospitals (9, 41%) compared to general (17, 27%) and local hospitals (12, 17%; $p<0.005$). An on-duty neurologist was present 24 h/day and 7 days/week (24/7) in 36% of hospitals and there was a 24/7 on-call neurologist in 83%. On-duty 24/7 neurologists correlated only with the hospital size (>800 beds: 22, 71%; 301–800: 30, 31%; ≤ 300 : 4, 15%; $p<0.0001$).

A 24/7 CT scanner was available in 90% of hospitals, and a 24/7 EEG in 27% of NU, virtually unrelated to the hospital characteristics. A 24/7 MRI was less frequent (32%) and was only correlated to the hospital size and structural context (data not shown; see [21] for a complete reference). An intensive care unit was present in 96% of hospitals (correlated only with the hospital size) and a neurosurgery unit in 46% (correlated to the hospital size, structural and functional context, and to the ER organisation). A stroke unit was present in 43/154 NU (28%); no correlation was found between the presence of a stroke unit and the five hospital characteristics, the number of hospitalised strokes or the presence of an NSD (data not shown).

Activity indicators

The total number of admissions in the 159 responding NU were 148 040 (mean 931/NU, $sd=428$; range=126–2595),

71% from the ER ($sd=22\%$; range=2–100%). Each staff doctor admitted 97 ER patients per year on average ($sd=53$; range=2–294). The percentage of ER admissions was correlated with the functional context, but not with area, hospital size, structural context and ER organisation; only 17% of NU in university hospitals ($n=4$) admitted >75% of patients from the ER, compared to 60% (36) of general hospitals and 53% (36) of local hospitals ($p<0.005$). When the NU were divided according to the percentage of ER admissions (Table 1), none of the structural and activity indicators were correlated to the ER admissions. Of the efficiency indicators, only ER admissions/doctor/year showed a significant correlation to the percentage of ER admissions.

Stroke admissions (available for 155 NU) accounted for 29% of total admissions (mean=273; $sd=164$, range=14–904). DRG 14 (stroke) was the most frequent hospital discharge diagnosis (HDD) in 80% of the NU, followed by DRG 24–26 (epilepsy/headache) and DRG 15 (TIA and anterior cerebral artery occlusions) (Fig. 1). Head trauma was among the four most frequent HDD in 33% of hospitals with no neurosurgery unit (27/82) compared to 14% (10/71) of those with a neurosurgery unit ($p<0.01$).

Data on the neurology consultations were available for 153 hospitals. There were 577 279 neurological consultations (mean 3773/NU; $DS=2738$; range 101–16 300); of these, 328 338 (mean 2146/NU ($DS=1810$; range 0–10 084) were performed in the ER (57%). Each staff doctor did, on average, 291 ER consultations per year ($sd=205$; range=1–1008). The number of ER consultations was correlated only with the geographic area: in NW 62% of NU provided >2000 ER consultations per year, compared to 53% for NE, 37% for S/I, and only 22% for C ($p<0.005$). Acute cerebrovascular disorders were the clinical conditions most commonly requiring an ER neurological consultation, followed by headache, vertigo and trauma, loss of consciousness and seizures (Fig. 2).

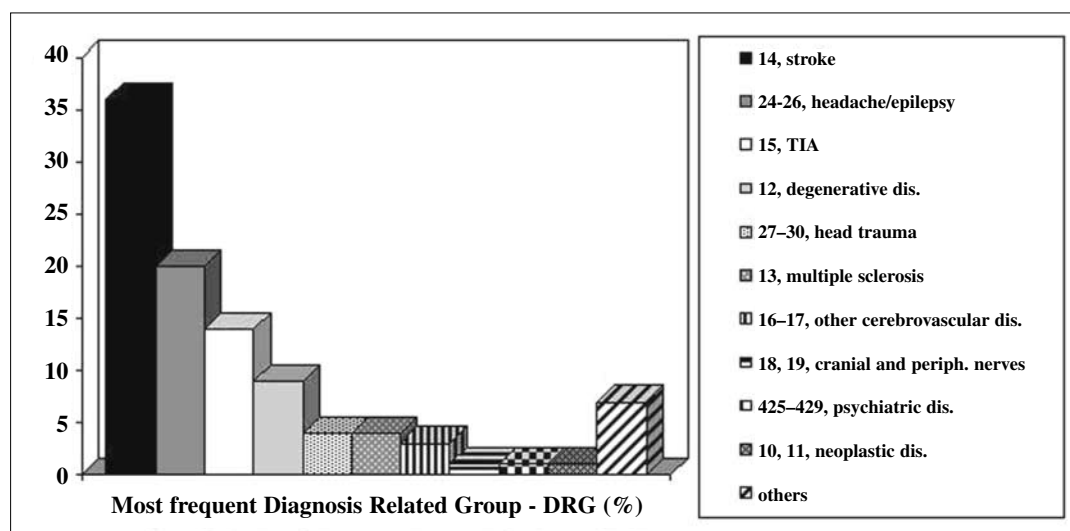


Fig. 1 Commonest discharge DRG in 159 Italian neurological units

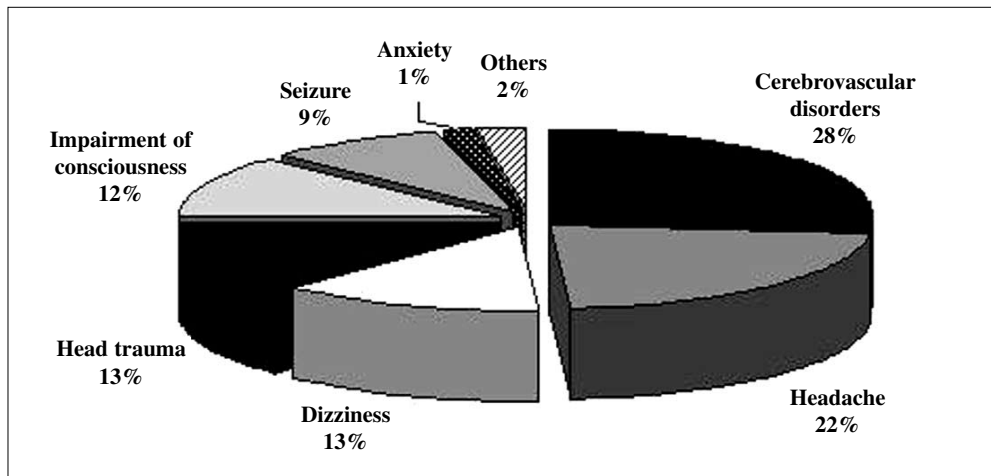


Fig. 2 Commonest clinical conditions requiring ER neurological consultation in 159 Italian neurological units

Efficiency indicators

The turnaround index was correlated to the number of admissions per neurologist ($p=0.32$; $p<0.0001$). The number of annual admissions from ER per neurologist (mean 97; $sd=53$; range=2–294), the turnaround index (mean 39; $sd=15$; range=15–138) and the mean number of ER consultations/year/neurologist (mean 291; $sd=205$; range=0–1008) all showed univariate correlation to the geographic area, but in different directions. The highest turnaround index was present in S/I: >45 admissions/bed/year in 50% of NU ($n=21$), compared to 22% (10) in C, 7% (3) in NE and 4% (1) in NW ($p<0.0001$). The highest number of ER admission per neurologist was also in the S/I: >70 admissions/neurologist in 78% of NU ($n=32$) compared to 78% (33) in NE, 59% (26) in C and 56% (14) in NW ($p<0.001$). The mean number of ER consultations/year/neurologist was highest in NW: >600 consultations/year/neurologist in 50% of NU ($n=13$), compared to 39% (16) in NE, 27% (12) in C and 21% (9) in S/I ($p=0.01$). After multivariate analysis considering hospital size, structural and functional context, and ER organisation, NW areas had a higher risk (compared to S/I) of a low turnaround index (OR 28.5; 95% CL=6.8–119.6 for an index of ≤ 35 admissions/bed/year) and of a higher number of consultations (OR 3.2; 95% CL=1.1–9.7 for >250 consultations/year/neurologist). The same trend was evident for NE vs. S/I: 8.4, 2.6–27.6 and 3.0, 1.1–7.9). The differences in the number of annual ER admissions per neurologist were no longer significant in multivariate analysis models.

The mean admission index, available for 148 NU, was 33% ($sd=18\%$; range=6–90). NU were arbitrarily grouped into three categories, according to the effectiveness of the admission index (Table 2). A good admission index (<25% of consultations followed by admission) was unrelated to the five hospital categories, but was directly correlated to the number of consultations/year and inversely correlated to the number of ER admis-

sions/year, in general and per single neurologist (Table 2). This index was also inversely correlated to the number of beds/neurologist (Table 2). In multivariate analysis, including the five hospital categories and the statistically significant indicators, the variables independently associated with a good admission index were a high number of consultations/year/neurologist (OR 26.1; 95% CL=7.5–91.0 for >250 consultations), a low number of ER admissions/year/neurologist (8.4; 2.7–26.5 for ≤ 70 admissions) and a low number of beds/neurologist (4.4; 1.5–13.2 for <3.5 beds).

Discussion

In Italy, NU are widely disseminated throughout the country and 220 (84%) are located in hospitals with ER. The mean index of neurological beds committed to emergencies was 0.10 per 1000 inhabitants and the mean numbers of beds was 3.4 per neurologist. The Italian NU are heavily involved in emergency activities and Italian neurologists are consistently engaged in the diagnosis and treatment of acute neurological disorders. More than half of the 577,000 annual consultations were performed in the ER (on average 291 per year per staff neurologist) and the most frequent neurological problems were acute cerebrovascular disorders (28%), headache (22%), dizziness (13%), head injury (13%), impairment of consciousness (12%) and epilepsy (9%). The high number of cranial CT scans performed in ER does not reflect the need to prevent avoidable hospitalisations (lack of correlation with the admission index), but rather the need to accelerate diagnostic assessment and reduce in-hospital costs. This concept was confirmed for stroke in the UK [22]. The engagement of neurologists in ERs is high in all the structures and the burden of ER consultations is unrelated to the size of the hospital, ED complexity and departmental organisation.

NU admissions are 33% of ER neurological consultations (mean admission index) and ER was the source of

71% of the total 148,000 NU admissions (on average 97 ER admissions per year per staff doctor). Stroke was by far the most common source of admissions to the NU (29% of all admissions) and the first discharge diagnosis in 80% of NU. In contrast, only 28% of NU, mostly in the largest hospitals, had neurological beds devoted to the management of stroke and the presence of stroke units was unrelated to the number of discharged strokes. The second and third most frequent discharge DRG (24–26, headache/epilepsy and 15, TIA) also follow emergency admissions. DRG 27–30 (head injury) are significantly more frequent in hospitals with no neurosurgery unit. Despite the high proportion of hospital admissions from the ER, the percentage of ER admissions was unrelated to area, hospital size, structural context and ER organisation. Only the functional context showed a correlation with ER admissions (fewer in university than in the other hospitals). These observations indicate that management of neurological acute disorders is largely unrelated to the hospital's efficiency and complexity. The burden of ER consultations, ER admissions and stroke management was unrelated to the presence of stroke units, neurosurgery units or staff doctors providing a 24/7 on-duty neurological service. Only 36% of hospitals had a 24/7 on-duty neurologist, mainly in the largest hospitals. The inadequate number of neuroscience departments and stroke units constitutes a serious problem in Italian hospitals. A competent approach to acute neurological disorders could be very important for early expert treatment and probably for the outcome of these clinical conditions [15, 23, 24]. This is even more important for ischaemic stroke, which requires prompt treatment [25].

This Italian survey has provided useful information concerning the burden of neurological acute diseases and the role of neurologists in emergency care. Owing to the widespread presence of NU in Italian ER hospitals, more neurological emergencies are managed by a neurologist in Italy than in the UK [16]. Nevertheless, as in other European countries, many neurological patients are treated in general wards and less than 50% of all strokes are admitted to a NU [6]. In Austria the majority of neurological patients are treated in non-neurological departments [26]. In France only 35% of strokes are treated in neurological wards and 4% have access to an intensive care stroke unit [27]. Data from the Executive Committee of the European Stroke Initiative (EUSI) confirm that more than 40% of stroke patients in Europe are treated in hospitals lacking even minimal structural, technological and human resources criteria [28].

Our study has some strengths and several limitations. The major strength is its coverage of the whole of Italy. The number of hospitals receiving the questionnaire was fairly high and the number of respondents was sufficient to obtain meaningful information. In addition, there were no major differences comparing responders to non-

responders. The first major limitation was the unverified validity of the information obtained from the local participants. Another limitation is the lack of comparative findings from hospitals with no NU, to assess the efficiency of the ER neurological consultation. However, our data are very similar to those from other European countries [4, 5, 19] and require the careful attention of healthcare administrators. A more efficient and comprehensive health policy is mandatory, to provide all Italian hospitals with a 24/7 active ER neurological consultation and neuroimaging, with beds dedicated to acute stroke and organised in structural departments.

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