Stroke in neurological services in Italy

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Abstract

To assess the stroke workload of Italian neurological services and to correlate it with indicators of each hospital's emergency setting. A semi-structured questionnaire was sent to the 220 neurology units (NU) located in hospitals with an emergency room (ER) (155 responders, 71%). Stroke was the most common discharge diagnosis (29%) (273 patients/year/NU on average) and condition requiring consultation in ER (28%). A stroke unit was available in 28% of NU, bedside monitors in 45%, a 24 hour/day and 7 day/week (24/7) CT scan in 90%, a 24/7-MRI in 32%, a 24/7 on-duty neurologist in 36%. The stroke workload was correlated only with the number of ER consultations per year, and marginally to the presence of stroke units and the number of monitored beds in the univariate, but not in the multivariate analysis. The stroke workload in Italian NU is very high, but is largely unrelated to their structural and functional characteristics, in contrast with the international indications requiring several essential criteria for the best hospital management of all stroke patients.

Introduction

Stroke is a clinical emergency that commonly results in admission to an emergency room (ER), and is frequently associated with high mortality and the costs imposed by acute management and long-term care. Advances in neuroimaging and the introduction of new treatments to be started in the ER, have changed the diagnostic and therapeutic approach to acute cerebrovascular diseases^{1,2} and led to the establishment of stroke units in several parts of Italy.³

Stroke is the most frequent cause of neurological admission to an ER.^{4,6} In Italy, hospital discharges for neurological non-surgical diseases [(Diagnosis Related Groups (DRG) 9-35)] were 554,872 (7% of the total) in 2003.⁷

Stroke (DRG 14) accounted for 22% of all neurological discharges, and was the sixth most common hospital discharge diagnosis (HDD) (n=123,310), even more common than acute myocardial infarction (n=114,632). In 2005, hospital discharges for stroke were 129,203.⁸

According to a WHO/WFN survey, acute cerebrovascular diseases are a main cause of neurological workload in primary care worldwide, but the resources available to cope with this burden are very often inadequate.⁹ In Europe, hospital services admitting acute stroke patients have been classed by an expert panel as: Comprehensive Stroke Centers (CSC), Primary Stroke Centers (PSC) and Any Hospital Wards (AHW) in terms of their structural, technological and human resources.¹⁰ A survey of 886 European hospitals treating stroke patients found that only 14% of strokes were treated in CSC or PSC, 44% in AHW, and 42% in facilities not even meeting minimal criteria.¹¹ Only 30% of the hospitals with at least one neurologist have a stroke unit in France.¹² Only 30% of all strokes are treated in stroke units in Germany,¹³ and 27% in the UK, even though stroke units have been established in 75% of the hospitals that treat stroke patients in that country.¹⁴ In the same surveys, only 11% of the French hospitals have a 24-hour/day and 7 day/week (24/7) coverage by on-duty neurologists, and a neurologist was available on average twice a week in the UK.

In the years 2001-2003, we undertook a nationwide survey to determine the extent of involvement of Italian neurologists in ER activities.¹⁵ This paper reviews our stroke data for the purpose of: 1) calculating the stroke workload for neurologists, and 2) assessing whether and to what extent stroke workload is correlated with a number of indicators of each hospital's emergency setting.

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 organization settings were compared by dividing the country into four major areas and appointing regional coordinators. In the first phase of the survey (September 2001 to September 2002), all the hospitals with neurological facilities were identified, those with an ER were selected, and a neurologist in each Neurology Unit (NU) was identified as a contact. NU were defined as wards dedicated to the care of neurological patients; in Italy they are managed only by neurologists. In the second phase (October 2002 to June 2003), a semi-structured questionnaire was sent to selected NUs to collect

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information about hospital settings, structural 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, North-East, Central, and South/Islands;
  - *size*: ≤300; 301-800; >800 beds;
  - *functional context*: university hospital and scientific institutes vs. general and local hospitals (general hospitals have their own management, whereas local hospitals are part of the local Health Care District);
  - *structural context*: presence of a neuroscience or internal medicine department;
  - *ER organization*: classed according to the complexity of the emergency department (ED) as: structural (ED-II), functional (ED-I) or First Aid Service (FAS). ED-II are autonomous structures with their own beds and medical and nursing staff; ED-I do not have dedicated beds and share medical staff with other departments; FAS are non-autonomous services in small hospitals with rotation of medical and nursing hospital staff.
- The resources and activities of each NU were evaluated on the basis of a number of structural and activity indicators:
- *structure indicators*: structure of the NU (staff, number of beds and bedside monitors, on-duty and on-call neurologist) and hospital setting (presence of intensive care,

neurosurgery and emergency medicine wards or departments and stroke unit i.e. a structurally defined area of the NU for care of stroke patients by a dedicated team; availability of EEG, CT scan, MRI)

- *activity indicators*: ER admissions to the NU (number and DRG, admissions for stroke) and neurological ER consultations (number and clinical diagnosis)

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.

The *stroke burden* was defined as the number of hospitalized strokes (ischemic and hemorrhagic) per year; as this number may depend on the hospital size and the total number of admissions, the *relative stroke workload* was calculated as (number of strokes/year)/(number of total admissions/year)*100, and assigned to three categories, $\leq 20\%$, 21–40%, and $>40\%$. Admission data were obtained from hospital computerized databases ($n=107$), or transcribed from inpatient registries ($n=41$); the data source was not specified by 11 hospitals. Statistics were elaborated with Student's test, χ^2 test, χ^2 test for trend and Pearson's correlation coefficient where applicable. Bonferroni's correction for multiple testing was used, setting the p at 0.01 for correlations with the five main hospital categories (location, size, functional and structural context, and ER organization) and at 0.005 for the correlations with the other indicators. All the tests were performed with the statistical package SAS.¹⁶ A multivariable analysis with a binary logistic regression model was used to control for confounders and interactions (SAS/PROC Logistic). The relative stroke workload was the response variable and location, size, functional and structural context, ER organization, and the structure and activity indicators were used as covariates.

Results

Two hundred and sixty-four hospitals with an NU were identified in the entire country. All but two were general, acute-care public hospital funded by the National Health Care System. Two hundred and twenty (84%) had an ER; they had a total of 5,518 neurological beds (96/1,000,000 population) and 1,623 staff neurologists (28/1,000,000 population). Of the 220 questionnaires sent out, 159 were returned, and the number of stroke admissions/year was available for 155 (71%). Data for some variables were not supplied by ten NU (6%) (Tables 1 and 2). There were no significant differences in the hospital categories between the 155 with and the 65 without available

information (*data not shown*). The mean catchment area of the 155 hospitals was 270,000 population (range 50,000–1,500,000), and the mean number of beds was 627 (SD=411, range 141–2,650). Each NU had an average of 25 beds (SD=12; range =2–68); monitoring was available for 7% of the total number of beds; the average number of neurologists per NU was 7 (SD=3; range =2–18) and that of nurses 17 (SD=6; range =2–42). The total number of admissions was 144,261 (mean 931, SD=430; range =126–2,595), 71% from the ER (range 18–100). A 24/7 CT-scan was available for 140/155 NU (90%), a 24/7 MRI for 49/155 (32%), a 24/7 on-duty neurologist in 56/154 (36%) and a 24/7 neurologist (either on-duty or on-call) in 128/154 (83%).

Stroke burden and relative stroke workload

Stroke was the commonest DRG in 124 NU (80%) and the most frequent cause of neurological consultation to ER in 46% of the 145 NU supplying data for this variable. The total number of stroke patients/year admitted by NU (*stroke burden*) was 42,361 (29% of total admissions) with a mean of 273 (SD=164, range=14–904). Sixteen NU (10%) admitted ≤ 100 strokes, 45 (29%) 101–200 strokes, 41 (27%) 201–300, 28 (18%) 301–400, 25 (16%) >400 strokes. The *relative stroke workload* ranged from 2% to 82% of total admissions (median 26%). Thirty-six NU (23%) had a relative stroke workload of $\leq 20\%$, 88 (57%) 21–40%, and 31 (20%) $>40\%$.

Correlation with structural and activity indicators

A stroke unit was present in 42/150 NU (28%), and 69/155 NU (45%) had monitored beds with no correlation with the area, the size of the hospital, the structural and functional context and the ER organization. An intensive care unit was present in 149/155 hospitals (96%), and correlated only with the hospital size (>800 beds: 29 NU, 100%; 301–800: 95, 100%; ≤ 300 : 21, 78%; $p<0.0001$). The burden of stroke was correlated only to the number of hospital beds, neurologists, NU admissions, and ER consultations (Table 1). The *relative stroke workload* was correlated only with the number of ER consultations/year and marginally in the trend analysis to the presence of stroke units and the number of monitored beds (Table 2). However, these variables lost statistical significance in the multivariate model after adjusting for the five hospital categories. The Odds Ratio (95% Confidence Limits) of a relative stroke workload ≤ 40 versus $>40\%$ was 1.8 (0.6–5.7) for ≤ 2.000 ER consultations/year versus >2.000 ; 1.8 (0.5–7.2) for NU without a stroke unit; 4.1 (0.7–25.6) for no monitored beds versus >4 ; 1.2 (0.3–5.81) for 1–4 moni-

tored bed versus >4 . These results were virtually unchanged when models with a different cut-off (20%) or addition of the other indicators were used.

Discussion

Eighty-four percent of Italian NU are located in hospitals with ER, where stroke is the commonest reason for ER neurological admission (almost 30% of total admissions in the NU providing data for our survey). In other European countries, admissions for stroke ranged from 25–33%.^{4,6} DRG14 was the first discharge diagnosis in 80% of NU, and stroke was the most frequent reason for ER consultation in 46% of NU. Thus, stroke accounts for roughly one third of the workload of an Italian NU (see ref. 15 for the frequency of other neurological diseases).

We looked to see whether specific structural and activity, hospital or NU characteristics were correlated with the stroke burden and whether the higher relative stroke workload corresponded to a specific NU organization. However, except for the number of beds, neurologists, NU admissions, and ER consultations (all these variables being linked to the size and the general workload of each NU), there was no correlation between the hospital (and NU) structural and functional organization and the number of hospitalizations for stroke. In addition, the relative stroke workload was correlated only to the number of ER consultations and, marginally, to the presence of stroke units and the number of monitored beds in the univariate but not in the multivariate analysis.

Our observations indicate that the stroke workload is largely unrelated to a hospital's efficiency and sophistication, in contrast with the indications given by a panel of European experts, who advocated several essential components of organized acute stroke care, including personnel, diagnostic procedures, monitoring, and *ad hoc* protocols and procedures.¹⁰ However, our data are in keeping with the EUSI survey of 886 European hospitals showing that 42% of strokes were treated in facilities not even meeting the minimal criteria¹¹ and with a survey of acute stroke care in Europe, which showed no difference between Eastern and Western Europe in a number of quality indicators, with the exception of technological standards in some countries.¹⁷

Some aspects of our survey suggest ways to improve the quality of stroke care in Italy. First, 10% of NU still do not have CT scan 24/7 coverage which is considered an important requirement even for general (non-neurological) wards and an essential requirement for PSC.¹¹ Indeed, CT 24/7 was most frequently unavail-

Table 1. Hospital categories and structure-activity indicators by stroke burden (number of admissions for stroke/year to each NU) (N=155).

			N. of stroke admissions			
			≤100 N (%)	101-300 N (%)	> 300 N (%)	p*
Hospital categories						
Location	(N=155)	North-West	2 (12.5)	15 (17.4)	9 (17.0)	n.s.
		North-East	2 (12.5)	30 (34.9)	13 (24.5)	
		Center	9 (56.3)	23 (26.7)	10 (18.9)	
		South/Islands	3 (18.8)	18 (20.9)	21 (39.6)	
Size	(N=155)	≤300 beds	1 (6.3)	13 (15.1)	13 (24.5)	n.s.
		301-800 beds	11 (68.8)	60 (69.8)	26 (49.1)	
		>800 beds	4 (25.0)	13 (15.1)	14 (26.4)	
Functional context	(N=155)	Local Hospital	6 (37.5)	45 (52.3)	21 (39.6)	
		General Hospital	5 (31.3)	29 (33.7)	25 (47.2)	
		University Hospital	5 (31.3)	12 (14.0)	7 (13.2)	
Structural context	(N=151)	Neuroscience Dept.	2 (12.5)	19 (22.9)	16 (30.8)	n.s.
		Internal Med. Dept.	10 (62.5)	39 (47.0)	21 (40.4)	
		No Dept.	4 (25.0)	25 (30.1)	15 (28.9)	
ER Organization	(N=145)	Structural ED	8 (50.0)	32 (40.0)	27 (55.1)	n.s.
		Functional ED	7 (43.8)	36 (45.0)	10 (20.4)	
		First-aid Dept.	1 (6.3)	12 (15.0)	12 (24.5)	
Structure indicators of the NU						
N. beds	(N=155)	≤10	7 (43.8)	3 (3.5)	2 (3.8)	<0.0001
		11-30	9 (56.3)	71 (82.6)	30 (56.6)	<0.0001*
		>30	0 (-)	12 (14.0)	21 (39.6)	
N. neurologists	(N=155)	≤5	9 (56.3)	28 (32.6)	12 (22.6)	n.s.
		6-9	7 (43.8)	38 (44.2)	21 (39.6)	
		≥10	0 (-)	20 (23.3)	20 (37.7)	
N. monitors	(N=153)	0	10 (62.5)	50 (59.5)	24 (45.3)	n.s
		1-4	6 (37.5)	24 (28.6)	19 (35.8)	
		> 4	0 (-)	10 (11.9)	10 (18.9)	
On-duty neurologist (n. hours/day)	(N=154)	< 12	4 (25.0)	23 (26.7)	8 (15.4)	n.s.
		12	9 (56.3)	38 (44.2)	16 (30.8)	<0.005*
		24	3 (18.8)	25 (29.1)	28 (53.8)	
Any neurologist available (on-duty + on-call) (n. hours/day)	(N=154)	≤12	2 (12.5)	8 (9.3)	3 (5.8)	n.s
		13-23	2 (12.5)	5 (5.8)	6 (11.5)	
		24	12 (75.0)	73 (84.9)	43 (82.7)	
EEG availability + (n. hours/day)	(N=155)	6	2 (12.5)	11 (12.8)	8 (15.1)	n.s
		12	9 (56.3)	50 (58.1)	33 (62.3)	
		24	5 (31.3)	25 (29.1)	12 (22.6)	
Structure indicators of the hospital						
Intensive Care Unit	(N=151)	no	0 (-)	2 (2.4)	4 (7.7)	n.s.
		yes	15 (100.0)	82 (97.6)	48 (92.3)	
Neurosurgery Department	(N=151)	no	7 (46.7)	54 (64.3)	20 (38.5)	n.s.
		yes	8 (53.3)	30 (35.7)	32 (61.5)	
Emergency Medicine	(N=151)	no	6 (40.0)	40 (47.6)	18 (34.6)	n.s.
		yes	9 (60.0)	44 (52.4)	34 (65.4)	
Stroke Unit	(N=150)	no	12 (80.0)	65 (78.3)	31 (59.6)	n.s.
		yes	3 (20.0)	18 (21.7)	21 (40.4)	
CT availability	(N=155)	12 hours	1 (16.3)	6 (7.0)	8 (15.1)	n.s.
		24 hours	15 (93.8)	80 (93.0)	45 (84.9)	
MRI availability	(N=155)	not available	7 (43.8)	33 (38.4)	12 (22.6)	n.s.
		12 hours	4 (25.0)	28 (32.6)	22 (41.5)	
		24 hours	5 (31.3)	25 (29.1)	19 (35.8)	
Activity indicators						
NU admissions/year	(N=155)	≤ 1000	16 (100.0)	69 (80.2)	21 (39.6)	<0.0001
		> 1000	0 (-)	17 (19.8)	32 (60.4)	<0.0001*
ER consultations/year	(N=152)	≤ 2000	15 (93.8)	47 (54.7)	27 (54.0)	< 0.005
		> 2000	1 (6.3)	39 (45.3)	23 (46.0)	

CT, Computerized Tomography; ED, Emergency Department; EEG, Electroencephalography; ER, Emergency Room; MRI, Magnetic Resonance Imaging; NU, Neurological Unit
 X² test and X² for trend test (*).

Table 2. Hospital categories and structure-activity indicators by relative stroke workload (percentage of admissions for stroke per year/total admissions to each NU per year) (N=155).

≤			Relative stroke workload			p*
			≤20 N (%)	21-40 N (%)	> 40 N (%)	
Hospital categories						
Location	(N=155)	North-West	3 (8.3)	15 (17.1)	8 (25.8)	n.s.
		North-East	11 (30.6)	28 (31.8)	6 (19.4)	
		Center	12 (33.3)	20 (22.7)	10 (32.3)	
		South/Islands	10 (27.8)	25 (28.4)	7 (22.6)	
Size	(N=155)	≤300 beds	3 (8.3)	15 (17.1)	9 (29.0)	n.s.
		301-800 beds	24 (66.7)	55 (62.5)	18 (58.1)	
		> 800 beds	9 (25.0)	18 (20.5)	4 (12.9)	
Functional context	(N=155)	Local Hospital		13 (36.1)	42 (47.7)	17 (54.8)
		General Hospital	13 (36.1)	35 (39.8)	11 (35.5)	n.s.
		University Hospital	10 (27.8)	11 (12.5)	3 (9.7)	
Structural context	(N=151)	Neuroscience Dept.	11 (32.4)	15 (17.2)	11 (23.9)	n.s.
		Internal Med. Dept.	12 (35.3)	49 (56.3)	9 (30.0)	
		No Dept.	11 (32.4)	23 (26.4)	10 (33.3)	
ER Organization	(N=145)	Structural ED	18 (54.6)	33 (40.2)	16 (53.3)	n.s.
		Functional ED	11 (33.3)	34 (41.5)	8 (26.7)	
		First-aid Dept.	4 (12.1)	8 (26.7)	6 (20.0)	
Structure indicators of the NU						
N. beds	(N=155)	≤10	4 (11.1)	4 (5.6)	4 (12.9)	n.s.
		11-30	24 (66.7)	61 (69.3)	25 (80.7)	
		>30	8 (22.2)	23 (26.1)	2 (6.5)	
N. monitored beds	(N=153)	0	25 (71.4)	48 (55.2)	11 (35.5)	n.s.
		1-4	7 (20.0)	28 (32.2)	14 (45.2)	=0.008*
		>4	3 (8.6)	11 (12.6)	6 (19.4)	
N. neurologists	(N=155)	≤5	10 (27.8)	29 (33.0)	10 (32.3)	n.s.
		6-9	17 (47.2)	37 (42.1)	12 (38.7)	
		≥10	9 (25.0)	22 (25.0)	9 (29.0)	
On-duty neurologist (n. hours/day)	(N=154)	<12	8 (22.2)	22 (25.3)	5 (16.1)	n.s.
		12	16 (44.4)	36 (41.4)	11 (35.5)	
		24	12 (33.3)	29 (33.3)	15 (48.4)	
Any neurologist available (on-duty or on-call)	(N=154)	≤12	3 (8.3)	9 (10.3)	1 (3.2)	n.s.
		13-23	2 (5.6)	8 (9.2)	3 (9.7)	
		24	31 (86.1)	70 (80.5)	27 (87.1)	
EEG availability (n. hours/day)	(N=155)	6	4 (11.1)	10 (11.4)	7 (22.6)	n.s.
		12	19 (52.8)	54 (61.4)	19 (61.3)	
		24	13 (36.1)	24 (27.3)	5 (16.1)	
Structure indicators of the Hospital						
Intensive Care Unit	(N=151)	no	1 (2.9)	3 (3.5)	2 (6.5)	n.s.
		yes	33 (97.1)	83 (96.5)	29 (93.6)	
Neurosurgery Department	(N=151)	no	16 (47.1)	49 (57.0)	16 (51.6)	n.s.
		yes	18 (52.9)	37 (43.1)	15 (48.4)	
Emergency Medicine	(N=151)	no	14 (41.2)	40 (46.5)	10 (32.3)	n.s.
		yes	20 (58.8)	46 (53.5)	21 (67.7)	
Stroke Unit	(N=150)	no	30 (88.2)	60 (70.6)	18 (58.1)	n.s.
		yes	4 (11.8)	25 (29.4)	13 (41.9)	=0.007*
CT availability	(N=155)	12 hours	2 (5.6)	9 (10.2)	4 (12.9)	n.s.
		24 hours	34 (94.4)	79 (89.8)	27 (87.1)	
MRI availability	(N=155)	not available	11 (30.6)	33 (37.5)	8 (25.8)	n.s.
		12 hours	10 (27.8)	30 (34.1)	14 (45.2)	
		24 hours	15 (41.7)	25 (28.4)	9 (29.0)	
Activity indicators						
NU admissions/year	(N=152)	≤1000	23 (63.9)	60 (68.2)	23 (74.2)	n.s.
		> 1000	13 (36.1)	28 (31.8)	8 (25.8)	
ER consultations/year	(N=152)	≤2000	28 (77.8)	48 (55.8)	13 (43.3)	n.s.
		>2000	8 (22.2)	38 (44.2)	17 (56.7)	< 0.005*

CT, Computerized Tomography; ED, Emergency Department; EEG, Electroencephalography; ER, Emergency Room; MRI, Magnetic Resonance Imaging; NU, Neurological Unit
 X² test and X² for trend test (*).

able in NU admitting larger numbers of stroke patients. Second, two other requirements for PSC are widely lacking in Italy: bed monitoring (55% of NU), and 24/7 on-duty or on-call neurologists (17%). Surprisingly, in 13 NU (8%) a neurologist was available for less than 12 hours per day. Third, the paucity of neuroscience departments and stroke units represents a serious limitation for Italian NU activities, though the same is found in France, where only 30% of hospitals with NU had a stroke unit.¹² A recent Italian survey found only 9% of wards admitting >50 stroke patients/year equipped with a stroke unit,³ which is less than in many other countries.¹⁸ This is even more remarkable when considering that acute clinical conditions like ischemic stroke require timely treatments.¹ This is a prerequisite to devise more efficient and comprehensive programs aimed at providing all Italian hospitals with a 24-hour active ER neurological consultation and neuroimaging, hopefully organized in structural departments.

Our study has some strengths and several limitations. The major strength is the extensive coverage of the whole of Italy. The number of respondents was sufficient to obtain meaningful information, and there were no major differences in the responders compared to the non-responders. The first major limitation is the unknown validity of the information obtained from the local participants. Although the regional coordinators had frequent contacts with the neurologists in charge from each participating hospital and made an effort to have fairly complete and high quality data, no formal measure was taken to verify the validity and reliability of the sources. The second limitation is the lack of comparative findings from the hospitals with no NU. In fact, more than 50% of stroke patients in Italy are still admitted to general medical wards; only 42,361 of the 123,310 stroke patients discharged in a year from the Italian hospitals

were discharged from the NU responders in our survey (corresponding to 71% of all the Italian NU). The third limitation is that our data were collected for the year 2002; however, we think that hospital neurological resources for stroke have changed little over recent years in Italy. The EUSI survey reports that in 2006 only 6% of 112 Italian hospitals admitting more than 50 acute stroke patients per year met the criteria for Comprehensive or Primary Stroke Center, and in 53% even the minimum level was not available.¹¹

In conclusion, this survey shows that stroke management in Italy is largely unrelated to several structural and functional indicators of hospital efficiency.

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