A Community-Based Study of Stroke Code Users in Northern Portugal

Avaliação da Via Verde do Acidente Vascular Cerebral no Norte de Portugal: Caracterização e Prognóstico dos Utilizadores

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ABSTRACT

Introduction: By 2002 Portugal had one of the highest mortality rates due to cerebrovascular diseases among the European Countries. Meanwhile, several strategies have been adopted to improve prevention and treatment in the acute phase, amongst which the Stroke Code. This system is called Via Verde AVC (VVAVC)*. The purpose of this study is to describe how this measure has been used and its outcome as part of a prospective community based study of stroke/TIA incidence in Northern Portugal.

Materials and Methods: Between 1st October 2009 and 30th September 2010 all strokes occurred in patients registered at Western Porto, Mirandela and Vila Pouca de Aguiar health centres have been recorded. For cases ascertainment multiple sources of information were used, including the WEB, letter, e-mail and Alert P1, as well as systematic searches on databases provided by the entities involved in this study: hospital emergency, discharge records, diagnosis procedures, death certificates, Stroke Code admissions and health centre emergency records.

Results: Six hundred strokes were recorded in a population of 241 000 (incidence rate of 250 / 100 000 person-years) and 434 were first-ever-in-the-lifetime (180 / 100 000). There were 72 Stroke Code calls and in 66.7% of them a stroke was confirmed. Considering the criteria for Stroke Code call (age ≤ 80 years, functional independency, the stroke signs/symptoms, and time after episode ≤ 3 hours), only 15.9% patients "could" have access to it. Of those who used the Stroke Code, only 56.3% fulfilled the criteria. Considering all patients fulfilling Stroke Code criteria, 96.3% that used prehospital Stroke Code were inpatients, as well as 83.3% that used intra/interhospital Stroke Code and 64.0% of the remainder; this trend is also present in patients with ischaemic stroke submitted to fibrinolysis, 77.3%, 36.4% and 17.4%, respectively. A high post-stroke Rankin was more frequent among Stroke Code users (70.3% vs. 35.3%), but they exhibit more often the three stroke signs/symptoms (44.0% vs. 16.2%). After adjusting for age, sex and number of signs, the risk of a more severe post-stroke Rankin is not significantly different among patients using the prehospital Stroke Code (OR = 2.9, 95% CI: 0.8 - 10.2).

Conclusions: The criteria for accessing the Stroke Code are currently restrictive. Though the Stroke Code is accessed in case of more severe patient's conditions, the proportion of patients treated with fibrinolysis is relatively high in comparison with other studies.

Keywords: Stroke; Portugal; Emergency Medical Services.

RESUMO

Introdução: Em 2002 Portugal detinha uma das mais altas taxas de mortalidade por doenças cerebrovasculares entre os países europeus. Várias estratégias foram adoptadas para melhorar a prevenção da doença e o seu tratamento na fase aguda, entre as quais a criação da Via Verde do Acidente Vascular Cerebral. O objectivo deste trabalho é descrever a utilização e resultados desta estratégia no contexto de um registo prospectivo comunitário na Região Norte de Portugal.

Material e Métodos: Foram registados todos os AVCs ocorridos entre 1 de Outubro de 2009 e 30 de Setembro de 2010 nos utentes inscritos no agrupamento de centros de saúde do Porto Ocidental e nos de Mirandela e Vila Pouca de Aguiar. Para a detecção de casos utilizaram-se múltiplas fontes de informação: notificação via WEB, *e-mail*, Alerta P1 e pesquisas sistemáticas em registos disponibilizados pelas entidades envolvidas - urgências hospitalares, listas de altas, procedimentos de diagnóstico, óbitos, Via Verde do Acidente Vascular Cerebral e serviço de atendimento de situações urgentes.

Resultados: Ocorreram 600 AVCs em 241 000 habitantes (taxa de incidência de 250 / 100 000), dos quais 434 foram primeiros na vida (180 / 100 000). Foram registados 72 acessos à Via Verde do Acidente Vascular Cerebral, dos quais 66,7% foram diagnosticados como AVC. Considerando os quatro critérios de activação (idade ≤ 80 anos, independência funcional, sinais/sintomas do AVC e tempo após episódio ≤ 3 horas), só 15,9% dos doentes a poderiam utilizar e, dos utilizadores, apenas 56,3% satisfaziam esses critérios. Dos doentes com critérios de activação, foram internados 96,3% pela VV pré-hospitalar, 83,3% pela VV intra/inter-hospitalar e 64,0% dos restantes; a fibrinólise foi realizada em 77,3%, 36,4% e 17,4% dos doentes com enfarte cerebral, respectivamente. O Rankin pós-AVC é mais grave nos utilizadores da VV pré-hospitalar (70,3% vs. 35,3%), mas estes apresentam mais assiduamente os três sinais/sintomas de AVC (44,4% vs. 16,2%). Ajustando para a idade, sexo e número de sinais, o risco de incapacidade grave pós-AVC não é significativamente diferente no acesso pela VV pré-hospitalar (RP = 2,9; IC 95%: 0,8 - 10,2), bem como a taxa de letalidade.

Conclusões: Os critérios para activação da Via Verde do Acidente Vascular Cerebral são muito restritivos. Embora esta seja mais vezes accionada em situações clínicas graves, a proporção de doentes que realizou fibrinólise é relativamente alta em comparação com outros estudos.

Palavras-chave: Acidente Vascular Cerebral; Portugal.

*TN: Via Verde AVC. The name Via Verde is used as an analogy to the name given to a national electronic highway system of payment that does not require a vehicle to stop at the tollbooth.

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INTRODUCTION

The first Portuguese community-based prospective study of neurological events (ACINrpc) was carried out ten years ago[1] and followed the optimal methodological criteria for assessment of first-ever-in-a-lifetime stroke incidence and mortality rate.[2] It concluded that in Portugal, especially in the Northern Region, stroke incidence was one of the highest in European countries, both in rural and urban areas. The incidences of stroke were, respectively, 305 and 269 per 100,000 person-years (the stroke incidence rate normalised to the European population runs between 202 and 173 per 100,000 person-years). Although in the official statistics from *Direcção Geral de Saúde***, the standardized mortality rate is 154 / 100,000 person-years), one of the highest in Western European countries,[3] in the ACINrpc study, the mortality rate at 28 days, placed at 16.1%, was similar to that reported in other countries.

According to World Health Organization (WHO) 2002 data, Portugal had one of the highest mortality rates among group A countries (characterized by very low infant and adult mortality rates) with an annual variation rate, for the period of 1990 to 2006, estimated to be one of the lowest.[4] Accordingly, in the same period, Portugal had an extremely high mortality rate and the highest Disability Adjusted Life Years (DALYs) due to cerebrovascular disease among high-income countries.[5]

Recent substantial improvements have been achieved for stroke management, reflected in reductions in incidence, mortality indicators and in DALYs and resulting in a lower burden to the community. The downward trend of mortality rates in Portugal and particularly in the Northern Region,[6] which in 2006 were 80.7 and 81.4 per 100,000 respectively, may be attributed to a reduction in stroke incidence, to a therapeutic intervention with an impact on mortality rate or to both. The efficacy of such an intervention would depend on healthcare service organisation and accessibility, as well as on population awareness of stroke signs/symptoms, in order to meet the 3-hour therapeutic window.[7] In Portugal, one of the adopted strategies at pre, intra and inter-hospital phases, was the implementation of a Code Stroke system, nationally called *Via Verde do AVC (VVAVC)* .[7] Its main objective was to reach a precise and timely diagnosis and was based on (i) pre and (ii) intra-hospital emergency organisation and population awareness of severe stroke signs/symptoms. In this sense, in 2008, the campaign *Seja mais rápido que o AVC* ("Be quicker than Stroke") was started in Portugal, focusing on the sudden onset of three stroke signs/symptoms (loss of strength in one arm, drooping mouth and speech impairment) as well as on the correct procedure to follow – to immediately contact the *Instituto Nacional de Emergência Médica* (National Institute of Medical Emergency -INEM) and subsequent external or pre-hospital Via Verde activation (VVE – *Via Verde Externa*). [8]

One decade after the first ACINrpc study, the ACIN2

**TN: Direcção Geral de Saúde is the Directorate-General for Health

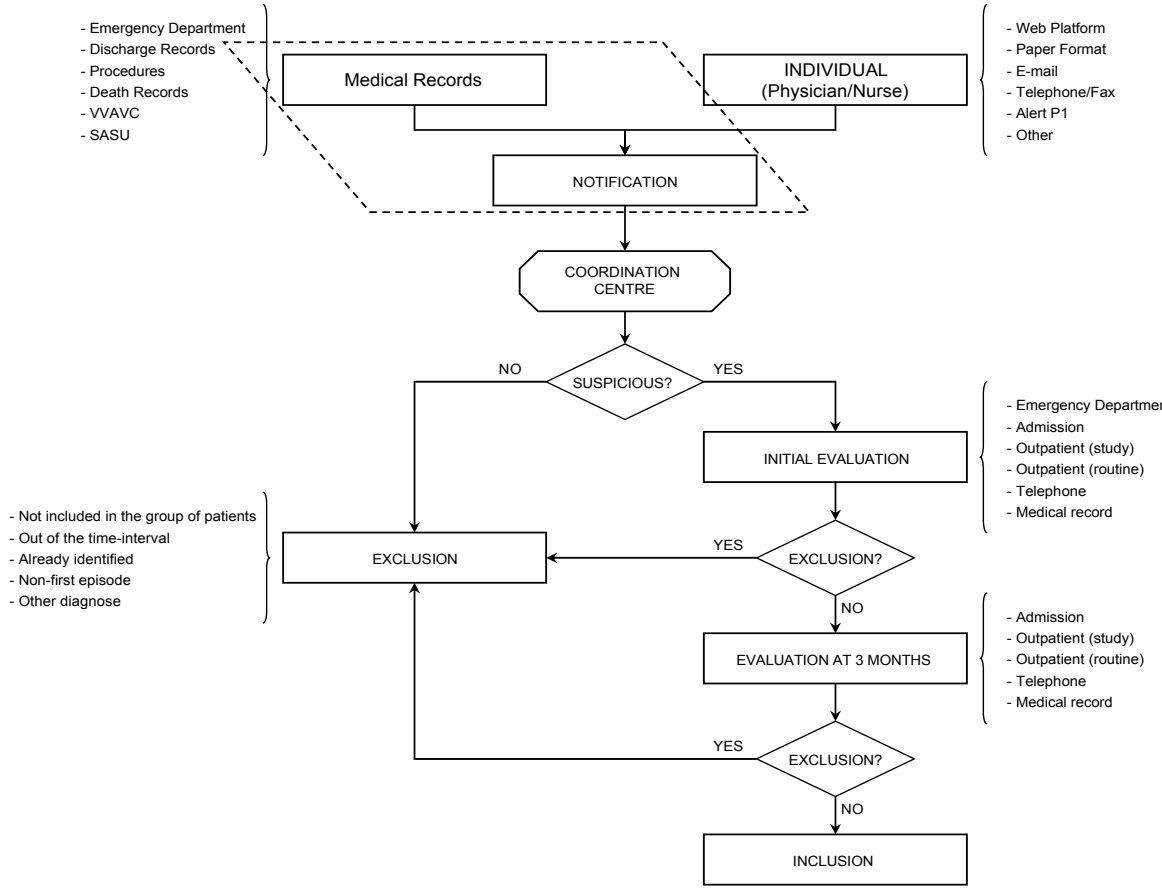

Figure 1 - Methodology of detection and inclusion of case reports.

project is currently underway in the Northern Region of Portugal – (Trends in the incidence and prognosis of neurological events - PIC/IC/82858/2007)***, a study in which neurological events occurring between the 1st of October 2009 and the 30th September 2011 are recorded (http://www.acin2.com). Using first year data from this study, the objective of this work is to identify patient characteristics and circumstances of VVAVC use in the Northern Region of Portugal and particularly to identify the socio-demographic and clinical profile associated to this use as well as the patient prognosis.

MATERIAL AND METHODS

We compare baseline characteristics and healthcare accessibility of the patients included in the ACIN2 study of stroke incidence, following the optimal methodological criteria defined by Sudlow and Warlow[2] and updated by Feigin and Carter.[9] This prospective study is based in an extensive search of cases using multiple information sources in enumerable and stable groups of patients with an adequate dimension and it includes mortality data at one month post event.

The community base of this study includes the population registered in September 2009 in the Health Centre Group (ACES) from Western Porto and in the Health Centres of Vila Pouca de Aguiar and Mirandela. The Northern Health Regional Administration (*Administração Regional de Saúde do Norte*) gave its consent and cooperation, allowing access to the population-based register. Thereafter the study was presented to every Health Centre Director allowing familiarization with the use of the study site http://www.acin2.com where all physicians and nurses could complete a simple anonymous notification form of every *suspicious* patient, after obtaining informed consent. The study was disclosed to physicians, as well as to the population involved, using the media and scientific meetings.

Neurological event detection

The web platform is the main information source providing the means for rapid medical assessment and response by the Neurology team assigned to the project in all the involved hospitals. However, notification could also be submitted by letter, telephone/fax, e-mail or through the Alert P1 (Fig. 1).

For suspicious case identification, a systematic review of the different record types provided by the involved entities was used – hospital A&E units, discharge records (430 - 438, 342 and 781 codes), death records, *VVAVC* activation, an existing Call-Service for Urgent Situations (*Serviço de Atendimento de Situações Urgentes (SASU)*) and diagnostic records. The aim was to reduce the possibility of losing cases that had been notified through alternative methods (Fig. 2).

Information regarding the episodes in which VVE was activated was obtained by a monthly report issued by INEM. VVE represents an optimized path in terms of treatment accessibility and speed of response, which is based on a citizen based approach through a telephone call to the national medical emergency centre (dial 112). In order for VVE to be activated, it is necessary that a patient meets the following criteria: (a) less than 80 years old, (b) sudden presentation of at least one of the symptoms (i) *drooping mouth*, (ii) *loss of strength* and (iii) *speech impairment*, (c) signs or symptoms with less than three hour's duration and (d) absence of previous dependency for daily life activities.[7] Whenever a patient fulfills these criteria, the VVE protocol is activated, transmitting instructions for the patient's transportation via INEM, directly involving this entity in diagnosis, possible pre-hospital treatment and adequate referral to a hospital centre equipped for the best possible diagnostic confirmation, subsequent treatment and logistic availability to receive the patient. VVE episodes/patients data were integrated with the studied population. When the patient directly seeks the hospital, the intra/inter-hospital *Via Verde* (VVI) is activated, an intra-hospital healthcare system that is capable of delivering early fibrinolytic therapy, reducing the *door-to-needle-time*.[7] We considered that VVI was activated when this information was included in the emergency record.

Inclusion criteria

All stroke events that occurred between the 1st October 2009 and the 30th September 2010 were included, according to the WHO stroke definition.[10] Transient events (deficits that remained for less than 24 hours) and asymptomatic lesions or *silent infarctions* detected by imagiology were excluded. Stroke was classified as: cerebral infarction when CT (computer tomography) or MRI (magnetic resonance imaging) scan performed until 30 days after the episode shows an infarction or there is no relevant lesion upon imaging but it becomes apparent through autopsy; primary intracerebral haemorrhage (PICH) when CT and/or MRI scan performed until 30 days after stroke shows a haemorrhage and/or an autopsy shows a lesion; subarachnoid haemorrhage (SAH) when there is an appropriate clinical record and/or a brain CT or MRI scan showing the presence of subarachnoid blood and/or the lumbar puncture showing subarachnoid blood and/or an autopsy showing subarachnoid haemorrhage, with or without a SAH source.[11] A recurrent stroke was considered when it occurred 28 days after the initial event or before this period of time when it involves a different vascular or anatomic territory, a cerebral infarction or a PICH.

All patients considered as possible stroke victims were observed by the neurology team as soon as possible after the episode and a protocol form had to specifically be filled in for the patients included in the study, with information regarding socio-demographic aspects, way of access (VVE, VVI or other), access type (transportation), clinical presentation of the event, diagnostic procedures and subsequent treatments. Pre and post-stroke modified Rankin Scale score was recorded,[12,13] as well as the date/

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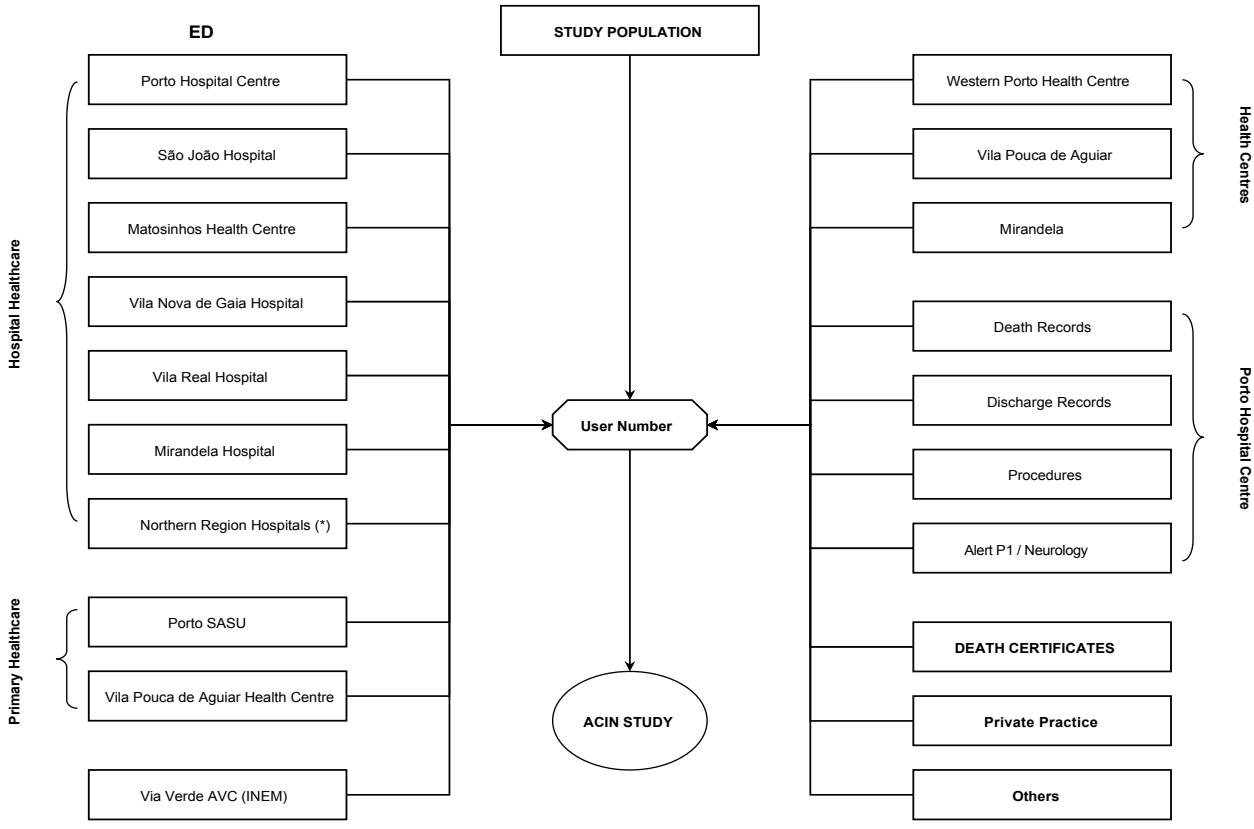

(*) In particular hospitals belonging to Northern Region Hospital Trusts (including Vila Real and Mirandela Hospital Trusts)

Figure 2 - Information sources with records of suspect cases.

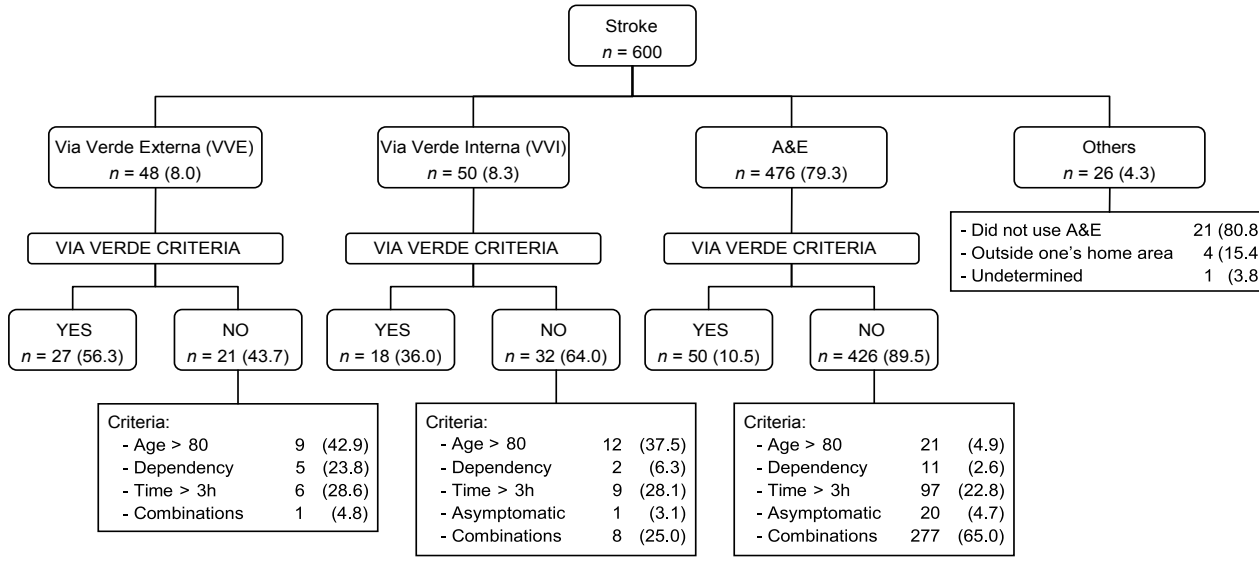

Figure 3 - Use of *VVAVC* system according to the activation criteria (%).

hour of all procedures. The information was provided by the patient and/or is included in the clinical record. The study was approved by the Ethics Committee of the health institutions where the study was carried out, with an informed consent signed by all participants and, in case of the patient's disability, consent was provided by a family member present at the time when the event occurred.

Statistical methods

Stroke events presented by VVAVC users and non-users were compared using the chi-square test or the exact Fisher test for categorical variables, the Student's *t* test for continuous variables, after which the characteristics of VVAVC users were determined, described by odds ratio (OR) and its 95% confidence interval (95% CI). Criteria

Table 1 - Characteristics of the 72 users of *external Via Verde* (VVE) system

Average age (sd), years	65.2	(16.2)
Average time interval (sd) for ED access, minutes†	82.3	(44.5)
	n	**%**
Men	38	52.8
Northern Region Hospitals		
Porto Hospital Centre	43	59.7
São João Hospital	11	15.3
Pedro Hispano Hospital	3	4.2
Vila Nova de Gaia/Espinho Hospital Centre	3	4.2
Northeast Hospital Centre	5	6.9
Trás-os-Montes and Alto Douro Hospital Centre	7	9.7
Clinical signs		
"Loss of strength in one member"	50	69.4
"Drooping mouth"	30	41.7
"Speech impairment"	36	50.0
Without criteria	26	36.1
Previous dependency	1	3.8
Time > 3h	2	7.7
Age > 80	8	30.8
None of the signs	13	50.0
Two or more signs	2	7.7
Diagnosis at admission		
Stroke/TIA	49	68.0
Altered state of consciousness	5	6.9
Epileptic seizures/fits	4	5.6
Migraine with aura	1	1.4
Others	13	18.1

†Average and standard deviation; ‡Recorded by the CODU (Centro de Orientação de Doentes Urgentes - Urgent Patients Orientation Center); § Two users did not meet two of the criteria.

for VVAVC activation were described as well as VVE user characteristics and prognosis; VVI and remaining patients with activation criteria were compared, eliminating by restriction the effect of confounding variables. Logistic regression was used to evaluate prognosis regarding post-stroke Rankin score grouped in moderate (1 - 3) and severe disability (4 - 5) for VVE users and non-users, adjusting for age, gender and diagnosis. A $p < 0.05$ value was adopted as type I error limit.

RESULTS

This study population included 241,000 healthcare users registered in September 2009 in the Western Porto ACES (n = 194,200), in the Health Centres of Vila Pouca de Aguiar (n = 16,200) and Mirandela (n = 30,600). During the study period, 600 stroke events were included, of which 434 (72.3%) were first-in-a-lifetime, resulting in an incidence rate of 250 per 100,000 persons-year. Considering the first-stroke-in-a-lifetime, this rate is of 180 / 100,000, 175 in urban and 203 in rural areas. During the same period, 1,380 events were recorded, attended through the Northern Region VVE, from which 72 were included in the study population, resulting in an activation rate of 30 / 100,000 individuals. The average age of users was 65.2 and 52.8% were male; 59.7% were referred to Santo António Hospital, 16.6% to the hospitals serving the rural population (Northeast Hospital Centre and Trás-os-Montes and Alto Douro Hospital Centre) and the remaining to other hospitals in the northern region (Table 1). The most common symptom was *loss of strength* (69.4%), followed by *speech impairment* and *drooping mouth* (41.7%); the time gap between symptom presentation and the arrival to the Emergency Department (A&E) was, on average, 82 minutes. VVE activation criteria were absent in 36.1% of the patients and at A&E 68% were diagnosed as stroke / transient ischaemic attack (TIA).

In the ACIN record, 48 of these patients with a definite stroke diagnosis were included and, in Table 2, we compare their characteristics with those of the remaining patients. The average age of the recorded patients was 72.8, 47.3% were male and 78% lived in an urban area; these characteristics were not significantly different from those of VVE users. Most patients that presented through VVE were asymptomatic or with non-disabling symptoms before the event, in contrast with the remaining patients (85.4% *vs*. 58.2%). Overall, ambulance transportation was used by 50% of the patients; 85.4% of the VVE users arrived within the therapeutic window, decreasing this proportion to 34.8% in the remaining patients.

Differentiation between VVE users and the remaining patients is reflected in the proportion that shows cumulatively the three signs of stroke, 47.9% *vs*. 13.6% and more than

Table 2 - Characterisation of patients with a stroke. *External Via Verde* (VVE) users and non-users

	VVE		Others		Total		
	(*n* = 48)		(*n* = 552)		(*n* = 600)		*P*
Average age (sd), years	68.2	(11.8)	73.2	(13.8)	**72.8**	**(13.7)**	0.014
	n	%	*n*	%	***n***	**%**	
Men	27	56.3	257	46.6	**284**	**47.3**	0.2
Urban setting	41	85.4	427	77.4	**468**	**78.0**	0.2
Previous Rankin score							0.005
Asymptomatic	34	70.8	227	43.0	**261**	**45.3**	
Non-disabling symptoms	7	14.6	80	15.2	**87**	**15.1**	
Mild disability	4	8.3	83	15.7	**87**	**15.1**	
Moderate disability	1	2.1	93	17.6	**94**	**16.3**	
Moderately severe disability	1	2.1	32	6.1	**33**	**5.7**	
Severe disability	1	2.1	13	2.5	**14**	**2.4**	
Undetermined			24				
Ambulance transportation	48	100.0	252	45.7	**300**	**50.0**	
Time interval between the event and ED < 3h	41	85.4	192	34.8	**233**	**38.9**	0.001
Signs							
“loss of strength”	46	95.8	323	58.5	**369**	**61.5**	0.001
“drooping mouth”	47	97.9	312	56.5	**359**	**59.9**	0.001
“speech impairment”	24	50.0	116	21.0	**140**	**23.3**	0.001
With the three signs	23	47.9	75	13.6	**98**	**16.3**	0.001
First-stroke-in-a-lifetime	40	83.3	394	71.4	**434**	**72.3**	0.08†
Ischaemic	29	72.5	333	84.5	**362**	**83.4**	0.08‡
Haemorrhagic	11	27.5	58	14.7	**69**	**15.9**	
Undetermined	-		3	0.8	**3**	**0.7**	
Recurrent stroke	8	16.7	158	28.6	**166**	**27.7**	
Ischaemic	5	62.5	130	82.3	**135**	**81.3**	0.2‡
Haemorrhagic	2	25.0	24	15.2	**26**	**15.7**	
Undetermined	1	12.5	4	2.5	**5**	**3.0**	
Hospitalisations	45	93.8	316	57.2	**361**	**60.2**	0.001
Ischaemic stroke§	32	94.1	246	53.1	**278**	**55.9**	0.001
Haemorrhagic stroke§	12	92.3	66	80.5	**78**	**82.1**	0.3

†Average and standard deviation; ‡Comparison of first-strike-in-a-lifetime with recurrent strike; §Comparison of diagnosis; ¶Percentage over the total of this type’s stroke.

95% of the users presented the most characteristic signs – *loss of strength* and/or *drooping mouth*. Globally, 72.3% of the patients presented a first-stroke-in-a-lifetime, with an ischaemic stroke proportion slightly higher in these patients (83.4% *vs*. 81.3%), regardless of VVE access. The VVE hospitalised patients proportion is far higher (93.8%) than the one from the remaining patients (57.2%), particularly in the case of an ischaemic stroke (94.1% *vs*. 53.1%). It should be mentioned that 26.3% of the hospitalised patients used *Via Verde* access (45 through VVE and 50 through VVI). The determinants of VVE use within socio-demographic characteristics and symptomatology were age and number of symptoms, with a 4% reduction for each year increase in age (OR = 0.96; 95% CI: 0.94 - 0.98) and with a five times increase for each additional symptom (OR = 5.0; 95% CI: 3.0 - 8.4). (Table 2).

In Fig. 3 we present healthcare access upon a stroke, namely VVE or VVI activation, A&E without VVAVC or other. Cumulatively considering the four VVAVC use criteria, only 95 (15.9%) patients should have used it and from those who used VVE (8%), only 56.3% fulfilled these criteria. In all, the therapeutic window (112 / 574 = 19.5%) and more than 80 years of age (42 / 574 = 7.3%) were the criteria that individually could prevent more frequent VVAVC use.

From non-VVAVC users, 426 (89.5%) did not meet activation criteria and from these 97 (22.8%) could not be possible candidates because they could not arrive within the therapeutic window or in the case of 21 patients (4.9%) due to age criteria.

When limiting the comparison to patients meeting VVAVC activation criteria, we conclude, as indicated in Table 3, that the socio-demographic characteristics, treatment period and

access medium time are not significantly different between VVE, VVI users and non-users. *Loss of strength* is the most common symptom (87.4%), followed by *drooping mouth* (83.2%) and *speech impairment* (31.6%). No VVI patient presented the three symptoms cumulatively, in comparison with 22.0% of non-users and 44.4% of VVE users. About 76.8% of the patients were hospitalised, with a much higher proportion (96.3%) in the VVE group, decreasing in VVI (83.3%) and non-users (64.0%). This trend also occurs in ischaemic stroke patients submitted to fibrinolytic therapy (77.3%, 36.4% and 17.4%, respectively). In the group of VVE users, it is possible to calculate an underestimate of 41.2% (14 in 34) as a proportion of ischaemic stroke patients submitted to fibrinolytic therapy. Post-stroke Rankin score is more severe in VVE users: 70.3% with a severe or moderately severe dependency, compared with 38.9% in VVI users and 34.0% in non-users. Adjusting for age, gender and number of symptoms, severe post-stroke disability is not significantly increased (OR = 2.9; 95% CI: 0.8 - 10.2) in the VVE access group, although it is increased in men (OR = 4.2; 95% CI: 1.1 - 15.6) and as the number of symptoms increases (OR = 24.4; 95% CI: 5.2 - 114).

Table 3 - Characterisation and prognosis of patients with *VVAVC* system activation criteria

	VVE		**VVI**		**Non-VV users**		**Total**		
	(*n* = 27)		**(*n* = 18)**		**(*n* = 50)**		**(*n* = 95)**		***P***
Characterisation									
Average age (sd), years	64.2	(9.6)	61.9	(11.6)	64.4	(9.9)	**63.9**	**(10.1)**	0.7
Average time interval (sd) for ED access, minutes	82	(44)	93	(43)	91	(47)	**89**	**(45)**	0.7
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**	
Men	16	59.3	12	66.7	29	58.0	**57**	**60.0**	0.8
Urban setting	23	85.2	16	88.9	38	76.0	**77**	**81.1**	0.4
Ambulance transportation	27	100.0	13	72.2	28	56.0	**68**	**71.6**	
Period of the day									0.4
00 - 08h	3	11.1	1	5.6	7	14.0	**11**	**11.6**	
08 - 16h	15	55.6	7	38.9	28	56.0	**50**	**52.6**	
16 - 24h	9	33.3	10	55.6	15	30.0	**3**	**35.8**	
Symptom									
"loss of strength"	26	96.3	15	83.3	42	84.0	**83**	**87.4**	0.3
"drooping mouth"	26	96.3	14	77.8	39	78.0	**79**	**83.2**	0.1
"speech impairment"	12	44.4	3	16.7	15	30.0	**30**	**31.6**	0.1
Number of symptoms									0.004
1	2	7.4	4	22.2	15	30.0	**21**	**22.1**	
2	13	48.1	14	77.8	24	48.0	**51**	**53.7**	
3	12	44.4	-		11	22.0	**23**	**2.2**	
First-stroke-in-a-lifetime	21	77.8	14	77.8	38	76.0	**73**	**76.8**	1.0
Stroke type: Ischaemic	20	71.4	14	77.8	41	82.0	**75**	**78.9**	0.7
Treatment and prognosis									
Hospitalised	26	96.3	15	83.3	32	64.0	**73**	**76.8**	0.005
Ischaemic	19	73.1	11	73.3	23	71.9	**53**	**72.6**	1.0
Fibrinolytic therapy	14	77.3	4	36.4	4	17.4	**22**	**41.5**	0.001
Post-stroke Rankin score									0.027†
Non-disabling symptoms	-		2	11.1	1	2.0	**3**	**3.2**	
Mild disability	3	11.1	1	5.6	10	20.0	**14**	**14.7**	
Moderate disability	5	18.5	8	44.4	22	44.0	**35**	**36.8**	
Moderately severe disability	8	29.6	5	27.8	10	20.0	**23**	**2.2**	
Severe disability	11	40.7	2	11.1	7	14.0	**20**	**21.1**	
Mortality rate at 28 days	3	11.1	2	11.1	3	6.0	**8**	**8.4**	0.7

†Average and standard deviation; ‡Fisher exact test

DISCUSSION

Based on a community prospective record in the North of Portugal between October 2009 and September 2011, this is the first population-based study addressing the use of the VVAVC system, enabling the identification of constraints and effect on general population, of a program oriented to reduce stroke consequences. Several comprehensive sources of information were used, according to internationally established criteria[14] and we emphasize information received from INEM regarding the use of VVE. Importantly we conclude that stroke incidence is decreasing from 245 / 100,000 in 1999[1] to 180 / 100,000 over a ten year period. VVE activation rate occurred in the order of 30 / 100,000 individuals, effectively including 8% of the total of patients with a stroke, although only 56.3% of these met activation criteria. The restriction imposed by the current criteria would allow only 95 (15.8%) of the stroke cases to have regular access to the VVAVC system. Even considering this fact, only 27 (28.4% of those who met the criteria) were referred to the hospital through VVE.

Prompt arrival at the Emergency Department (ED) and subsequent treatment have been described as major factors related to VVE and this is one of its major objectives.[7] In this study, the time spent between clinical presentation and the ED arrival was, on average, 82 minutes. Even though this delay was inferior by nine minutes to that described in an Australian study by Quain *et al*[15] we feel that this delay is still excessive. Factors judged responsible for this delay include unawareness of both the most common symptoms in stroke and the procedures to obtain the prompt help (by dialing 112). These were already described in several international studies[16-18] referring the crucial role of population alert campaigns as well as the need for adequate interaction/ communication between the *Centro de Orientação de Doentes Urgentes* (Urgent Patients Orientation Center) (CODU) and the INEM. At the ED, 68% of the events were classified as stroke/TIA, a frequency similar to the 70% obtained through correct patient screening for VVE[7] as well as in other international studies.[19] On the other hand, in this study, the false positive proportion is almost six times higher than the one obtained by Robert *et al*[20] in a similar study carried out in Barcelona. This fact is probably due to the concern about delaying the access in case of a possible stroke and, once more, due to difficulties in pre-hospital patient screening. The most common symptom in VVE activation was the *loss of strength in one member*, followed by *speech impairment* and *drooping mouth*, similar to other studies.[21,22] This may be explained by the fact that loss of strength may be a more perceptible change for the witness who observes the patient for the first time and subsequently contacts the CODU. However, the analysis of stroke events reveals that *speech impairment* is more common in VVE users[23] when compared with the remaining patients, perhaps due to the fact that it is a more recognized symptom by the patients as it is characteristic of a left lobe disorder, allowing the patient to theoretically better recognize his disability (comparing with a right lobe disorder) and therefore to seek help more promptly. On the other hand, *loss of strength in one member* seems to be a commoner symptom in the stroke differential diagnosis.

The VVE system had an activation rate of 8%, lower than the 17.9% obtained by Robert *et al*.[20] However, this higher value was obtained in a more restrictive situation, excluding the patients in whom the event occurred in the hospital and in those transferred from other hospitals. On the other hand, in 2010, the VVAVC report[24] mentions a national value of 26% for the percentage of patients hospitalised in stroke units in whom the VVAVC system (external or internal) was activated, a similar value to that obtained in our study (26.3%). As expected, the Rankin score was lower in VVE users a fact that may be explained by the frequency of *previous independence* as one of the inclusion criteria. Most VVE users arrived within the therapeutic window, in contrast with slightly over one third of non-users, as described in other studies;[23,25,26] but in a higher frequency than the one observed by Derex *et al,* in France[27] and by Kleindorfer *et al* in the USA.[22] The differentiation between VVE users and the remaining patients was reflected in the proportion of patients who cumulatively presented the three signs of stroke, and may indeed be related with a more florid clinical presentation, reflected in a subsequent call to 112. The lower average age of VVE users compared to the remaining users may not only relate to the age limit criteria, but also to the fact that older patients tend to present more comorbidities and therefore an increasing level of dependency, once again limiting VVAVC activation. Similar results have been obtained in the study by Robert *et al*.[20] Although it might be expected that patients with a recurrent stroke would be able to better recognize their symptoms and therefore be more frequent callers of 112, VVE was more often used by patients with a first-in-a-lifetime stroke. This trend was also described by other authors[21] and may be due to the remaining cognitive changes after the first stroke or to a dependency for daily life activities that does not allow patients with a recurrent stroke to meet the activation VVE criteria.

Less than one fifth of all stroke cases met the VVE criteria and, even in VVE users, slightly less than half met these criteria, decreasing this value to approximately one third in VVI. The current VVAVC protocol covers a reduced percentage of all stroke events recorded in the general population, not reaching the value mentioned in the VVAVC reports[7] in which the denominator only includes hospitalised patients. The *therapeutic window* and *more than 80 years of age* were the criteria which could individually prevent more frequent VVAVC use. It should be mentioned that the population alert campaign *Seja mais rápido que* o AVC (Be faster than stroke) is not yet obtaining the desired effect, because the population still does not recognize the major stroke signs/symptoms or, even when recognition is accomplished it does not prompt an adequate action. This issue is also addressed in one study carried out in Viana do Castelo district, drawing attention to the fact that old age and/or a low level of education represent deterrents for the

correct functioning of this alert system.[28] Even in patients meeting VVAVC criteria, the activation rate (external) was only 28.4%. In little more than half or these patients, neither the VVE system nor the intra-hospital alert was activated, with the aggravating circumstance that 56.0% of these patients used the ambulance transportation to arrive at the ED. We lack important information regarding the patients with stroke that used CODU but for whom VVE was not activated, data which will be the object of future analysis in association with a patient enquiry. On the other hand, the issue of lack of VVI system activation still has to be considered, and possibly occurred due to the fact that the patient did not meet the more restrictive clinical criteria for fibrinolytic therapy, the lack of safety/experience of some professionals with this therapy or even due to the lack of training of the hospital screening team. In the patients with VVAVC access criteria, the average time between symptoms presentation and ED admission was not significantly different between VVE, VVI users and non-users, with similar results to those obtained by Robert *et al*.[20] The proportion of admitted patients and of patients with an ischaemic stroke arriving through the VVAVC system that are submitted to fibrinolytic therapy largely justifies the VVAVC system, as that proportion is much higher in these patients. Similar results have been obtained in other studies, although the proportion obtained in our study is higher than reported, mainly in those performed in Spain.[15,20,22,25,29,30] As regards short-term prognosis, the post-stroke Rankin score was more severe in VVE users, as in other studies.[20,31] Nevertheless, it should be mentioned that, after adjustment for socio-demographic characteristics and clinical signs/symptoms, this fact is not explained by VVE access but rather by a higher number of symptoms and male gender.

As a possible limitation to this study we should mention the lack of more detailed analysis of the other criteria included in VVE recommendations[7]: time (i) between the access to the ED and the evaluation by a neurologist, to (ii) CT-scan evaluation and to (iii) fibrinolytic therapy, among others. As there are no differences between VVE users (with criteria) in comparison with the remaining patients, between the time from clinical presentation until the ED admission, such as in other studies,[20] a more detailed analysis could suggest shorter and more adequate intra-hospital time intervals when VVAVC is used. A possible information bias may result from the lack of VVI recording in the emergency room. However, this is unlikely because VVI activation numbers are higher than VVE's and, furthermore, it has even been mentioned in more patients that did not meet the activation criteria (64.0% in VVI *vs.* 43.7%). It will be necessary to carry out more population-based studies to assess the real risks of using a fibrinolytic therapy in patients over 80 years old, as well as to study a possible extension of the *therapeutic window*.[32] Another important aspect is the fact that VVE is more frequently used in more severe strokes, preventing possible fibrinolytic therapy due to clinical contraindications. Due to a high rate of stroke occurrence after a TIA,[1] criteria regarding the symptom type could be more comprehensive following, for example, the American campaign *Suddens*,[33] namely adding the sudden loss of vision, as it happens in the *Código Ictus* (Ictus Code) in Spain.[34] In this way, it may be possible to increase or even erase the age cut-off, as it has been suggested in other studies,[32,34] or to increase the *therapeutic window* for at least four and a half hours, considering the results of more recent studies.[32,35-37]

It may also be suggested that an increase in population campaigns would be an effective measure already positively evaluated in several studies.[16,18,38,39] These should be addressed to several public audiences using appropriate lay terms, at least when addressing symptoms of stroke and VVAVC system activation. An alternative approach, already observed in some studies[40-42] would include the health professionals responsible for patient screening, in order to convey the adequate clinical presentation required for VVAVC system activation, as well as promoting an adequate communication between them.

CONCLUSION

Although for a decade stroke incidence has decreased, this study shows that the effects of a Portuguese national program reducing stroke consequences at community level, namely the VVAVC system, could have been more comprehensive in what concerns accessibility criteria, which currently only covers an estimated 16% of all stroke patients. Considering the patients who meet criteria, we conclude that VVAVC users have more severe symptoms/clinical presentation, but are also more frequently hospitalised and submitted to fibrinolytic therapy, comparing to the remaining patients. Even so, upon adjustment for these characteristics, post-stroke disability is not significantly different in VVAVC system users.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the writing of this manuscript.

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