



## ORIGINAL ARTICLE

# Characteristics of stroke units and stroke teams in Spain in 2018. Pre2Ictus project<sup>☆</sup>



M. Alonso de Leciñana<sup>a,\*</sup>, A. Morales<sup>b</sup>,  
M. Martínez-Zabaleta<sup>c</sup>, Ó. Ayo-Martín<sup>d</sup>, L. Lizán<sup>e,f</sup>, M. Castellanos<sup>g</sup>,  
on behalf of the researchers from Ictus Project GEECV-SEN,

<sup>a</sup> Servicio de Neurología, Centro de Ictus, Hospital Universitario La Paz, IdiPAZ, Universidad Autónoma de Madrid, Madrid, Spain

<sup>b</sup> Servicio de Neurología, Hospital Clínico Universitario Virgen de la Arrixaca, Murcia, Spain

<sup>c</sup> Servicio de Neurología, Hospital Universitario de Donostia, San Sebastián, Spain

<sup>d</sup> Servicio de Neurología, Complejo Hospitalario Universitario de Albacete, Albacete, Spain

<sup>e</sup> Outcomes'10 SLU, Castellón, Spain

<sup>f</sup> Departamento de Medicina, Universitat Jaume I, Castellón, Spain

<sup>g</sup> Servicio de Neurología, Hospital Universitario e Instituto de Investigación Biomédica, La Coruña, Spain

Received 18 February 2020; accepted 12 June 2020

Available online 30 June 2022

## KEYWORDS

Stroke;  
Service organisation;  
Equipment;  
Resources;  
Care quality;  
Telemedicine

## Abstract

**Introduction:** The aim of this work is to describe the characteristics of stroke units and stroke teams in Spain.

**Methods:** We performed a cross-sectional study based on an ad-hoc questionnaire designed by 5 experts and addressed to neurologists leading stroke units/teams that had been operational for  $\geq 1$  year.

**Results:** The survey was completed by 43 stroke units (61% of units in Spain) and 14 stroke teams. A mean (standard deviation) of 4 (3) neurologists were assigned to each stroke unit/team; 98% of stroke units (and 38% of stroke teams) have an on-call neurologist available 24 hours a day, 98% of units (79% of stroke teams) included specialised nurses, 86% of units (71% of stroke teams) included a social worker, and 81% of units (71% of stroke teams) included a rehabilitation physician. Most stroke units (80%) had 4–6 beds with continuous non-invasive monitoring. The mean number of unmonitored beds was 14 (8) for stroke units and 12 (7) for stroke teams. The mean duration of non-invasive monitoring was 3 (1) days. All stroke units and 86% of stroke teams had intravenous thrombolysis available, and

<sup>☆</sup> Please cite this article as: Alonso de Leciñana M, Morales A, Martínez-Zabaleta M, Ayo-Martín Ó, Lizán L, Castellanos M, et al. Características de las unidades de ictus y equipos de ictus en España en el año 2018. Proyecto Pre2Ictus. Neurología. 2020. <https://doi.org/10.1016/j.nrl.2020.06.012>

\* Corresponding author.

E-mail address: [malecinanacases@salud.madrid.org](mailto:malecinanacases@salud.madrid.org) (M. Alonso de Leciñana).

**PALABRAS CLAVE**

Ictus;  
Organización;  
Dotación;  
Recursos;  
Calidad asistencial;  
Telemedicina

81% of stroke units and 21% of stroke teams were able to perform mechanical thrombectomy, whereas the remaining centres had referral pathways in place. Telestroke systems were in place at 44% of stroke units, providing support to a mean of 4 (3) centres. Activity is recorded in clinical registries by 77% of stroke units and 50% of stroke teams, but less than 75% of data is completed in 25% of cases.

**Conclusions:** Most stroke units/teams comply with the current recommendations. The systematic use of clinical registries should be improved to further improve patient care.

© 2022 Published by Elsevier España, S.L.U. on behalf of Sociedad Española de Neurología. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Características de las unidades de ictus y equipos de ictus en España en el año 2018. Proyecto Pre2Ictus

**Resumen**

**Introducción:** El objetivo del trabajo es describir las características de las unidades (UI) y equipos (EI) de ictus en España.

**Método:** Estudio transversal basado en un cuestionario ad-hoc, diseñado por 5 expertos y dirigido a los neurólogos responsables de las UI/EI con al menos un año de funcionamiento.

**Resultados:** Participaron 43 UI (61% del total) y 14 EI. La media ( $\pm$ DE) de neurólogos adscritos a las UI/EI es de  $4 \pm 3$ . 98% de las UI frente a 38% de EI cuentan con neurólogo de guardia 24 h/7d. Disponen de enfermería especializada 98% de las UI frente a 79% de los EI, de médico rehabilitador 81% frente a 71% y de trabajador social 86% frente a 71%. La mayoría de UI (80%) tienen 4-6 camas con monitorización continua no invasiva. El número medio de camas no monitorizadas de las UI es de  $14 \pm 8$  y de  $12 \pm 7$  en los EI. La estancia media de los pacientes en las camas monitorizadas de las UI es de  $3 \pm 1$  días. Todas las UI y el 86% de EI pueden realizar trombólisis intravenosa; el 81% de UI y 21% de EI trombectomía mecánica; el resto de los centros tiene posibilidad de derivación. El 44% de UI dispone del sistema teleictus, dando soporte a  $4 \pm 3$  centros. La actividad se recoge sistemáticamente en el 77% de UI y 50% de EI, pero su cumplimentación es  $< 75\%$  en un 25% de los casos.

**Conclusiones:** La mayoría de las UI y de los EI cumple las recomendaciones actuales. Para seguir mejorando la atención del paciente, resulta necesario optimizar el registro sistemático de su actividad.

© 2022 Publicado por Elsevier España, S.L.U. en nombre de Sociedad Española de Neurología. Este es un artículo Open Access bajo la licencia CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

**Introduction**

In Spain, stroke is the second leading cause of death: the first among women and the third among men.<sup>1</sup> Stroke is also the leading cause of disability in the adult population and the second leading cause of dementia; it has a severe impact on the lives of patients and their families and represents a significant healthcare and social burden.<sup>2,3</sup> According to data from the Iberictus study, stroke incidence in Spain is 187 cases per 100 000 person-years,<sup>4</sup> although other studies, based on data from Spain's National Statistics Institute, report rates of up to 252 cases per 100 000 person-years.<sup>5</sup>

New advances in the diagnosis and treatment of stroke in the past decades have enabled improvements in patient care. In Spain, the National Health System's Stroke Strategy<sup>6</sup> and, specifically, the regional plans of the autonomous communities establish organisational systems adapted to implement these advances in clinical practice, based on recommendations from scientific societies.<sup>2,7-9</sup> Thus, these plans consider the implementation of stroke units (SU) as

the most effective and efficient healthcare measure for the treatment of stroke, as it benefits a larger population of patients, and reduces mortality, dependence and the need for hospitalisation<sup>8,10-13</sup>; the creation of stroke teams (ST) at smaller centres is also recommended.<sup>14</sup> Furthermore, the development of code stroke protocols has increased the number of patients benefiting from specific treatments and reduced time to treatment, which leads to better progression and consequently to a significant decrease in the overall impact of the disease.<sup>15,16</sup>

However, there are considerable disparities between autonomous communities in the degree of implementation of stroke care plans and, despite being an efficient and efficacious healthcare resource, the implementation of SUs has been slow and uneven in Spain.<sup>16,17</sup> As it is in these units that diagnostic studies are performed and secondary prevention measures are implemented, it is important to know their characteristics and actions. This study aims to describe the characteristics of SUs and STs in Spain, the resources allo-

**Table 1** Distribution of stroke units and stroke teams participating in the survey, per autonomous community.

Autonomous community	SU (N)	% of participating SUs with regard to the total number of SUs in each autonomous community <sup>a</sup>	ST (N)	% of participating SUs and STs per autonomous community with regard to the total number of responses
Andalusia	4	67% (4/6)	2	11% (6)
Aragon	2	100% (2/2)	—	3% (2)
Asturias	1	50% (1/2)	1	3% (2)
Balearic Islands	1	50% (1/2)	1	3% (2)
Canary Islands	1	33% (1/3)	—	2% (1)
Cantabria	1	100% (1/1)	—	2% (1)
Castile-Leon	3	60% (3/5)	—	5% (3)
Castile-La Mancha	2	100% (2/2)	2	7% (4)
Catalonia	6	46% (6/13)	4	18% (10)
Valencian Community	2	33% (2/6)	3	9% (5)
Extremadura	2	100% (2/2)	—	3% (2)
Galicia	3	100% (3/3)	—	5% (3)
La Rioja	1	100% (1/1)	—	2% (1)
Madrid	7	58% (7/12)	1	14% (8)
Murcia	1	50% (1/2)	—	2% (1)
Navarre	1	50% (1/2)	—	2% (1)
Basque Country	5	83% (5/6)	—	9% (5)

ST: stroke team; SU: stroke unit.

<sup>a</sup> Data from the GEECV-SEN census of SUs at the time of distribution of the questionnaire.

cated to them, the professionals involved, and their action protocols.

## Material and methods

We administered a structured questionnaire designed by a scientific committee including 5 members of the Spanish Society of Neurology's (SEN) Stroke Study Group (GEECV-SEN, for its Spanish initials). The questionnaire was distributed by the SEN's administrative offices, together with a letter explaining the aim of the study and inviting the participation of all members of GEECV-SEN working mainly at SUs or in STs of Spanish hospitals. To avoid duplicate responses, participants were asked to complete only one questionnaire per SU or ST. The project was presented within GEECV-SEN's Project Stroke collaborative research network.

The questionnaire included 17 questions on (1) location and characteristics of the SU/ST (3 items); (2) equipment, healthcare resources, and treatments available (9 items); and (3) healthcare quality indicators (5 items). This questionnaire is part of a wider survey that also includes a series of questions on the degree of knowledge and application of recommendations on risk factors in the secondary prevention of stroke; the results of this survey will be analysed in a future study.

In order to participate in the study, each SU or ST had to have been operational for at least one year, to ensure reliability of the data. Participation and completion of the questionnaire were completely voluntary, and answers were submitted anonymously (participant and hospital). The classification of the healthcare resource as SU or ST was established according to participants' responses.

**Table 2** Distribution of stroke units and stroke teams according to the size of the participating hospital.

Number of beds	Stroke units n (%)	Stroke teams n (%)
< 200	2 (5%)	3 (21%)
200-500	5 (12%)	6 (43%)
501-1000	23 (53%)	5 (36%)
> 1000	13 (30%)	0 (0%)
Total	43 (100%)	14 (100%)

For the descriptive analysis of the sample, we calculated relative and absolute frequencies, in the case of qualitative variables, and measures of central tendency and dispersion (mean [SD], or median and range), for quantitative variables. All results were calculated according to the number of valid responses to each of the questions; we provide the number of responses (N) used for the calculations in each case.

## Results

The study was conducted between January and June 2018. We obtained 57 responses: 43 from SUs and 14 from STs, from all 17 autonomous communities (Table 1).

The results suggest that most SUs belonged to larger hospitals (from 501 to more than 1000 beds), whereas STs were available at smaller hospitals (Table 2).

**Table 3** Management of patients attending the emergency department with transient ischaemic attack by stroke units and stroke teams.

Response	Stroke unit n (%)	Stroke team n (%)
All or the great majority admitted to hospital	24 (56%)	10 (71%)
All or the great majority treated in a TIA clinic	7 (16%)	0 (0%)
Treated in a TIA clinic or admitted to hospital according to risk, estimated using scales (ABCD <sup>2</sup> , ABCD <sup>3</sup> , ABCD <sup>3</sup> -I, other)	11 (26%)	4 (29%)
Assessment at outpatient neurology clinics	1 (2%)	0 (0%)
Only the emergency assessment is performed, with no subsequent follow-up	0 (0%)	0 (0%)
Total	43 (100%)	14 (100%)

TIA: transient ischaemic attack.

The mean (SD) operational time at the time of completing the questionnaire was 11 (6) years (range, 2-26) for SUs and 11 (6) years (range, 2-28) for STs.

### Equipment, healthcare resources, and treatments available

Most SUs (80%) had 4-6 beds (median, 5) with non-invasive continuous monitoring equipment. One SU reported having only 2 monitored beds, another had 7, 2 had 8, and one hospital reported having 10. Five STs (36%) reported having monitored beds for the treatment of patients with stroke (range, 2-5 beds). The mean number of unmonitored beds was 14 (8) for SUs and 12 (7) for STs.

With regard to human resources, the mean number of neurologists assigned to SUs and STs was 4 (3) in both cases. An on-call neurologist was available 24 hours a day, 7 days a week at 98% of SUs but only 38% of STs. Specialised nursing staff were available at 98% of SUs and 79% of STs. A mean of 4 (4) specialised nurses were assigned to SUs, and 3 (2) to STs. Most SUs (95%) had nursing assistants assigned to the unit, with a mean of 4 (3), whereas 71% of STs had this type of staff, with a mean of 4 (2). With regard to rehabilitation staff, 81% of SUs reported having a physiatrist and physiotherapist, and 86% had a social worker. However, in the case of STs, these percentages were 71%, 86%, and 71%, respectively.

In terms of treatment, all SUs and 12 (86%) STs reported having the means to perform intravenous thrombolysis in patients with ischaemic stroke. One of the 2 STs where intravenous thrombolysis could be performed reported having a transfer protocol for referring patients to another hospital for thrombolysis. Mechanical thrombectomy was available at 81% of SUs and 21% of STs; all centres where this procedure could not be performed had a protocol for referring patients to other hospitals for thrombectomy.

Of the SUs completing the questionnaire, 19 (44%) reported having a telestroke system for providing assistance to centres in their healthcare district with no on-call neurologist. These units were located in the autonomous communities of Andalusia (n = 1), Aragón (n = 2), the Balearic Islands (n = 1), Castile-Leon (n = 1), Catalonia (n = 3), the Valencian Community (n = 1), Extremadura (n = 2), Galicia (n = 2), La Rioja (n = 1), and Madrid (n = 2). The mean number

**Table 4** Mean stay from admission to the emergency department to hospital discharge, rate of nosocomial infection, and in-hospital mortality.

	Stroke unit	Stroke team
Hospitalisation time, days <sup>a</sup>	7 (1)	6 (2)
Nosocomial infection rate (%) <sup>b</sup>	12 (7)	14 (10)
In-hospital mortality rate (%) <sup>c</sup>	7 (4)	7 (4)

Data are expressed as mean (standard deviation).

<sup>a</sup> Data from 38 stroke units and 13 stroke teams.<sup>b</sup> Data from 27 stroke units and 8 stroke teams.<sup>c</sup> Data from 30 stroke units and 8 stroke teams.

of centres to which they provided telecare was 4 (3) (range, 1-12). Only 3 (21%) STs received telecare from a hospital with a SU of reference as part of a telestroke system.

The questionnaire included a specific question on the management of patients with transient ischaemic attack (TIA). Of the participating centres, 18 (42%) SUs and 5 (36%) STs had a high-resolution centre or clinic for treating these patients after initial assessment at the emergency department. Table 3 presents the different management guidelines for TIA.

Thirty-three (77%) SUs had a clinical record for the systematic collection of the unit's activity, as well as characteristics and clinical outcomes of the patients attended, whereas only 7 (50%) STs had this type of record. In SUs keeping these records, the degree of completion was above 90% at most centres (73%), 75%-90% in 18% of the cases, and 25%-50% in the remaining units. However, only 2 (28%) STs reported a degree of completion above 90%, 75%-90% in 3, 50%--75% in one, and 25%-50% in another.

### Healthcare quality indicators

Regarding healthcare quality indicators, we included questions on the mean stay, mortality, nosocomial infections, and destination at discharge.

The mean stay of patients in monitored beds at SUs was 3 (1) days (range, 1-4). Two SUs (5%) did not provide this information.

Table 4 shows data on mean hospital stay (from admission to discharge), rate of nosocomial infection, and in-hospital

**Table 5** Destination at discharge (% of the total number of surviving patients).

	Stroke unit	Stroke team
Home with no rehabilitation	39 (15.5)	38 (21)
Home with outpatient rehabilitation	29 (17)	30.5 (16.5)
In-hospital rehabilitation	16.5 (12)	11 (9)
Social health centre/nursing home/assisted-living facility	15 (9)	19 (13)

Data are expressed as mean (standard deviation). Data from 33 stroke units and 9 stroke teams.

mortality. The response rate to these questions was variable. Five (12%) SUs and one (7%) ST did not provide data on mean stay. Sixteen (37%) SUs and 6 (43%) STs did not provide answers on the rate of infections, and 13 (30%) SUs and 6 (43%) STs did not report on mortality.

Table 5 presents the destination of patients at hospital discharge. Ten (23%) SUs and 5 (36%) STs did not respond to this question.

## Discussion

This study provides an overview of the organisational and healthcare characteristics of SUs and STs in Spain.

At the time of distribution of the questionnaire, according to data from the GEECV-SEN, there were 75 SUs in Spain, 70 of which had been operational for more than one year. A total of 43 SUs participated in our project, representing 61% of the total. All autonomous communities (with the exception of the autonomous cities of Ceuta and Melilla) were represented by at least one SU; therefore, our sample may be considered representative of the whole Spanish territory, although the response rate was below the mean in some autonomous communities. We do not have data on the number of STs operating in Spain, and therefore are unable to estimate whether our sample is representative of their characteristics.

Although not all SUs completed the questionnaire, the data obtained revealed a largely uneven geographical distribution of SUs. Units are better equipped in the autonomous communities with higher gross domestic product per capita, such as Madrid, Catalonia, and the Basque Country,<sup>18</sup> whereas communities with lower gross domestic product but covering larger geographical areas, such as Castile-Leon, Castile-La Mancha, or Andalusia, have fewer SUs, not achieving the minimum level of one per province. This means that a considerable percentage of the Spanish population, especially in autonomous communities with lower incomes, lives far from a SU, leading to greater delays and difficulty accessing this effective, efficient healthcare resource.<sup>8,10–13</sup> This inequality has already been shown by previous GEECV-SEN surveys<sup>16,17</sup> and, although the situation has improved, current data suggest that we are still far from achieving the standards recommended by the National Stroke Plan<sup>6</sup> and international guidelines.<sup>9</sup> The shift that has occurred since the 2010 and 2012 surveys<sup>16,17</sup> demonstrates the increasing efforts of regional governments, in collaboration with expert neurologists, in drafting and establishing regional strategic plans aimed at organising and optimising the care provided

to stroke patients with a view to achieving the recommended objectives. With the data presented, we hope to demonstrate that this effort should be maintained to create more SUs and establish care pathways to make the latest advances in stroke treatment available to all patients.

Our results show that allocation of the technical resources and staff to SUs is generally in line with the recommendations.<sup>19–21</sup> However, some participating SUs do not meet these criteria: one lacked a 24-h on-call neurology service, another lacked specialised nursing staff, and 8 lacked a physiatrist or physiotherapist. The effectiveness of SUs resides not only in the availability of complex treatments and monitored beds in a specific area of the hospital, but also in the use of diagnostic protocols, specific treatments, and early detection and management of complications on a continuous basis by a multidisciplinary team. The lack of such essential elements as specialised nursing staff, a 24-h on-call neurology service, or rehabilitation specialists may reduce this effectiveness. Therefore, all SU coordinators should aim to achieve the recommended objectives.

Despite the recommendation that all patients with stroke should be attended at a SU and that different healthcare organisational systems should aim to adopt this model, STs have been described as an alternative to SUs in smaller centres with insufficient equipment, providing care to areas with smaller populations, and attending patients with stroke.<sup>6</sup> The survey seems to corroborate this situation, as it shows how SUs in Spain mainly belong to larger hospitals, with smaller centres having STs. STs constitute the basic team needed to assess stroke patients and determine a therapeutic approach at hospitals lacking a SU. This initial management should be protocolised and coordinated by trained professionals to favour good outcomes. By definition, both human and material and technical resources in STs are more limited than in SUs,<sup>6,14,15</sup> as shown by the results of our survey. Furthermore, the design of the survey prevents us from analysing the effective working time of the staff assigned to SUs and STs; therefore, the data we present may overestimate these resources. ST management protocols should include patient transfer to centres with SUs when requested and if more complex treatments are needed. Therefore, STs should have well-established transfer protocols<sup>22</sup> and telemedicine-enabled systems for monitoring by more specialised centres, when on-call expert neurologists are not available on a 24-h basis.<sup>6,10,15,16,23</sup> Most STs that completed the questionnaire reported having transfer protocols; however, due to the limited participation of STs, we do not know whether this is the case for all STs in Spain.

The National Stroke Plan and the different regional stroke care plans recommend the use of telemedicine to provide specialised care at centres where this type of care is not available every day on a 24-h basis.<sup>15</sup> Its implementation improves access to specific treatments and therefore contributes to health equity<sup>23</sup>; it is especially beneficial in those health districts whose characteristics make it difficult for the patient to arrive promptly at a hospital with a SU. In Spain, this healthcare resource is expanding significantly. This is demonstrated by our survey data, with 19 SUs reporting that they had a telestroke system to support other centres; this represents a substantial increase with regard to the 2012 survey, in which only 5 centres with SUs reported having a telestroke system.<sup>17</sup> Furthermore, according to unpublished data from the GEECV-SEN from 2018, a telestroke system was established at 25 stroke centres in 12 autonomous communities (Andalusia, Aragon, Asturias, Balearic Islands, Castile-Leon, Catalonia, Extremadura, Galicia, Madrid, Navarre, La Rioja, Valencian Community); this shows how telemedicine is increasingly becoming a reality in stroke care in Spain. According to the same data, the number of hospitals supported by each stroke centre ranges from 1 to 7, with a total of 65 hospitals supported by telestroke systems; this is broadly in line with our data in the present study.

Our survey analysed the different ways of managing patients with TIA. In most of the participating SUs and STs, patients with TIA were hospitalised; in a considerable percentage of cases (almost 50% of hospitals with SUs), these patients are treated in high-resolution centres. Guidelines recommend urgent assessment of these patients, especially those at higher risk of recurrence in the short term, with the aim of establishing an aetiological diagnosis and applying the appropriate secondary preventive treatment as soon as possible. An alternative to hospital admission is urgent outpatient assessment at high-resolution clinics where diagnostic and treatment protocols may be applied effectively and efficiently, without delay and without need for hospitalisation.<sup>24–27</sup> This type of management of TIA in Spain seems to be more common in SUs, possibly because STs do not have the necessary resources to ensure this urgent care. However, rapid assessment of TIA symptoms may be a useful strategy for STs to ensure that these patients receive specialised care.<sup>28</sup>

Another aim of the survey was to provide outcome indicators: mean stay, mortality, infection rates, and destination at discharge. Although our results show lower rates of mortality and nosocomial infection than those reported in the literature,<sup>4,29</sup> these may be underestimated as a very high percentage of the participating SUs and STs, especially the latter, did not provide data on this. This is probably associated with the fact, shown by the survey results, that in many cases activity and outcomes are not systematically gathered in a clinical record. The lack of response on such strong indicators as mortality or destination at discharge and mean stay makes it difficult to monitor care quality in these healthcare units. The recording of activity for healthcare

quality monitoring is essential for the proper functioning of SUs and STs.<sup>6,10</sup> This study reveals a lack of homogeneity in the records kept and the degree of completion in Spain, and therefore the need to improve on this point. This is the only way to identify strengths and weaknesses with a view to ensuring quality care and designing strategies for improvement.

Our study presents some limitations, which are mentioned in the analysis of results. Firstly, we only have data from 61% of Spanish SUs; although this represents a high level of participation, results may be biased. In the case of STs, we do not know the number of operational STs in Spain, and therefore the representativeness of the sample is difficult to estimate. The data obtained on the organisation and available resources of STs may be overestimating the reality in Spain, as responses were more likely received from those with better organisation and equipment. Secondly, as answers were anonymised, we could not associate the characteristics of SUs or STs with the sociodemographic and healthcare characteristics of their reference area. Lastly, it should be noted that, at centres lacking systematic records of their activity, the responses to the questions on healthcare quality indicators may not be accurate. Despite these limitations, our study provides useful information on the characteristics of Spanish SUs and STs.

## Conclusions

Resources dedicated to the care of patients with stroke in Spain have increased over the years. Although we remain far from achieving the optimal level, organisational plans including healthcare networks are being implemented in the autonomous communities with increasing numbers of SUs, and including support to remote centres through telestroke systems. It is essential to continue this work, which also requires monitoring care activity through a systematic record, with the aim of analysing outcomes and designing both local and regional strategies for improvement.

## Funding

This study received financial support from Amgen, S.A.

## Conflicts of interest

The authors have no conflicts of interest to declare.

## Acknowledgements

The authors would like to thank all participating neurologists from the GEECV-SEN for their collaboration.

This project has the scientific endorsement of the Spanish Society of Neurology.

## References

1. Instituto Nacional de Estadística. Defunciones según la causa de muerte 2017. [Accessed 18 April 2019]. Available from: <http://www.ine.es/>.
2. Álvarez-Sabín J, Quintana M, Masjuan J, Oliva-Moreno J, Mar J, Gonzalez-Rojas N, et al. Economic impact of patients admitted to stroke units in Spain. *Eur J Heal Econ*. 2017;18:449–58, <http://dx.doi.org/10.1007/s10198-016-0799-9>.
3. Kotseva K, Gerlier L, Sidelnikov E, Kutikova L, Lamotte M, Amarenco P, et al. Patient and caregiver productivity loss and indirect costs associated with cardiovascular events in Europe. *Eur J Prev Cardiol*. 2019;26(11):1150–7, <http://dx.doi.org/10.1177/2047487319834770>.
4. Díaz-Guzmán J, Egido J-A, Gabriel-Sánchez R, Barberá-Comes G, Fuentes-Gimeno B, Fernández-Pérez C. Stroke and transient ischemic attack incidence rate in Spain: the IBERICTUS study. *Cerebrovasc Dis*. 2012;34:272–81, <http://dx.doi.org/10.1159/000342652>.
5. Brea A, Laclaustra M, Martorell E, Pedragosa À. Epidemiología de la enfermedad vascular cerebral en España. *Clin Investig Arterioscler*. 2013;25:211–7, <http://dx.doi.org/10.1016/j.arteri.2013.10.006>.
6. Ministerio de Sanidad y Consumo. Estrategia en ictus del Sistema Nacional de Salud. [Accessed 29 April 2019]. Available from: [http://www.semg.es/doc/documentos\\_SEMG/estrategias\\_ictus\\_SNS.pdf](http://www.semg.es/doc/documentos_SEMG/estrategias_ictus_SNS.pdf).
7. Alonso de Leciñana M, Egido JA, Casado I, Ribó M, Dávalos A, Masjuan J, et al. Guía para el tratamiento del infarto cerebral agudo. *Neurología*. 2014;29:102–22, <http://dx.doi.org/10.1016/j.nrl.2011.09.012>.
8. Kalra L, Evans A, Perez I, Knapp M, Swift C, Donaldson N. A randomised controlled comparison of alternative strategies in stroke care. *Health Technol Assess (Rockv)*. 2005;9:1–79, <http://dx.doi.org/10.3310/hta9180>.
9. Norrving B, Barrick J, Dávalos A, Dichgans M, Cordonnier C, Guekht A, et al. Action plan for stroke in Europe 2018–2030. *Eur Stroke J*. 2018;3:309–36, <http://dx.doi.org/10.1177/2396987318808719>.
10. Masjuan J, Gállego Culleré J, Ignacio García E, Mira Solves J, Ollero Ortiz A, Vidal de Francisco D, et al. Resultados en el tratamiento del ictus en hospitales con y sin Unidad de Ictus. *Neurología*. 2020;35(1):16–23, <http://dx.doi.org/10.1016/j.jascer.2016.05.001>.
11. Alonso De Leciñana-Cases M, Gil-Núñez A, Díez-Tejedor E. Relevance of stroke code, stroke unit and stroke networks in organization of acute stroke care - the Madrid acute stroke care program. *Cerebrovasc Dis*. 2009;27 Suppl 1:140–7, <http://dx.doi.org/10.1159/000200452>.
12. Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. *Cochrane Database Syst Rev*. 2007;17(4):CD000197, <http://dx.doi.org/10.1002/14651858.CD000197.pub2>.
13. Fuentes B, Díez Tejedor E. Unidades de ictus: una necesidad asistencial coste-efectiva. *Neurología*. 2007;22:456–66.
14. Álvarez-Sabín J, Alonso De Leciñana M, Gállego J, Gil-Peralta A, Casado I, Castillo J, et al. Plan de atención sanitaria al ictus. *Neurología*. 2006;21:717–26.
15. Masjuan J, Álvarez-Sabín J, Arenillas J, Calleja S, Castillo J, Dávalos A, et al. Plan de asistencia sanitaria al ICTUS II. 2010. *Neurología*. 2011;26:383–96, <http://dx.doi.org/10.1016/j.nrl.2010.05.008>.
16. López Fernández JC, Masjuan Vallejo J, Arenillas Lara J, Blanco González M, Botia Paniagua E, Casado Naranjo I, et al. Análisis de recursos asistenciales para el ictus en España en 2012: ¿beneficios de la Estrategia del Ictus del Sistema Nacional de Salud? *Neurología*. 2014;29:387–96, <http://dx.doi.org/10.1016/j.nrl.2013.06.017>.
17. López Fernández JC, Arenillas Lara J, Calleja Puerta S, Botia Paniagua E, Casado Naranjo I, Deyá Arbona E, et al. Recursos asistenciales en ictus en España 2010: análisis de una encuesta nacional del Grupo de Estudio de Enfermedades Cerebrovasculares. *Neurología*. 2011;26:449–54, <http://dx.doi.org/10.1016/j.nrl.2010.10.014>.
18. Instituto Nacional de Estadística. Contabilidad regional de España. [Accessed 9 December 2019]. Available from: [https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica\\_C&cid=1254736167628&menu=ultiDatos&idp=1254735576581](https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736167628&menu=ultiDatos&idp=1254735576581).
19. Álvarez-Sabín J, Masjuan J, Alonso de Leciñana M, Lago A, Gállego J, Arenillas J, et al. Componentes necesarios en los hospitales que atienden a pacientes con ictus: resultados de una encuesta de expertos españoles. *Neurología*. 2009;24:373–8.
20. Ringelstein EB, Chamorro A, Kaste M, Langhorne P, Leys D, Lyrer P, et al. European stroke organisation recommendations to establish a stroke unit and stroke center. *Stroke*. 2013;44:828–40, <http://dx.doi.org/10.1161/STROKEAHA.112.670430>.
21. Leys D, Ringelstein EB, Kaste M, Hacke W, European Stroke Initiative Executive Committee. The main components of stroke unit care: results of a European expert survey. *Cerebrovasc Dis*. 2007;23(5–6):344–52, <http://dx.doi.org/10.1159/000099133>.
22. Gropen T, Magdon-Ismael Z, Day D, Melluzzo S, Schwamm LH, NECC Advisory Group. Regional implementation of the stroke systems of care model. *Stroke*. 2009;40:1793–802, <http://dx.doi.org/10.1161/STROKEAHA.108.531053>.
23. Wechsler LR, Demaerschalk BM, Schwamm LH, Adeoye OM, Audebert HJ, Fanale CV, et al. Telemedicine quality and outcomes in stroke: a scientific statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2017;48:e3–25, <http://dx.doi.org/10.1161/STR.0000000000000114>.
24. Johnston SC, Albers GW, Gorelick PB, Cumbler E, Klingman J, Ross MA, et al. National stroke association recommendations for systems of care for transient ischemic attack. *Ann Neurol*. 2011;69:872–7, <http://dx.doi.org/10.1002/ana.22332>.
25. Martínez-Martínez MM, Martínez-Sánchez P, Fuentes B, Cazorla-García R, Ruiz-Ares G, Correas-Callero E, et al. Transient ischaemic attacks clinics provide equivalent and more efficient care than early in-hospital assessment. *Eur J Neurol*. 2013;20:338–43, <http://dx.doi.org/10.1111/j.1468-1331.2012.03858.x>.
26. Wasserman J, Perry J, Dowlathshahi D, Stotts G, Stiell I, Sutherland J, et al. Stratified, urgent care for transient ischemic attack results in low stroke rates. *Stroke*. 2010;41:2601–5, <http://dx.doi.org/10.1161/STROKEAHA.110.586842>.
27. Hörer S, Schulte-Altdorneburg G, Haberl RL. Management of patients with transient ischemic attack is safe in an outpatient clinic based on rapid diagnosis and risk stratification. *Cerebrovasc Dis*. 2011;32:504–10, <http://dx.doi.org/10.1159/000331919>.

28. Palomeras Soler E, Fossas Felip P, Cano Orgaz AT, Sanz Cartagena P, Casado Ruiz V, Muriana Batista D. Evaluación rápida del ataque isquémico transitorio en un hospital sin guardias de neurología. *Neurología*. 2015;30:325–30, <http://dx.doi.org/10.1016/j.nrl.2013.12.021>.
29. Boehme AK, Kulick ER, Canning M, Alvord T, Khaksari B, Omran S, et al. Infections increase the risk of 30-day readmissions among stroke survivors. *Stroke*. 2018;49:2999–3005, <http://dx.doi.org/10.1161/STROKEAHA.118.022837>.