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## The Influence of Patient Care Management on the Length of Hospital Stay for Stroke

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Patients' care pathways were analysed in this study through the link between the first phase of treatment of a stroke in an acute care hospital and downstream care in other health facilities, medical and social care facilities, or ambulatory healthcare structures. More precisely, we observed the variability of the length of the first hospital episode for a stroke in acute care. The nature of the stroke and the general health status of the patients played a key role, as well as the medical treatment, particularly treatment in stroke units (SU). But, beyond the criteria of clinical good practice, the availability of downstream care, particularly follow-up and rehabilitation care, made it possible to reduce the length of hospital stay while minimising stroke victims' inability to recover.

The 2010–2014 Stroke National Action Plan (Plan d'actions national AVC) was launched with the aim of "reducing the frequency and gravity of sequelae related to strokes". To achieve this, one of the Plan's specific aims was to "better coordinate the work of health professionals at the interface between health facilities, ambulatory healthcare structures, home care, and the medical and social care sector". Hence, the Plan aimed to establish treatment sectors and ad hoc information systems, by organising the structures and skills in such a way as to ensure, amongst others, the

availability and coordination of appropriate healthcare.

Strokes are a major public health concern, from a medical, social, and economic perspective. The healthcare received by patients varied greatly. An initial study carried out by the Institute for Research and Information in Health Economics (IRDES), which focused on victims of a first episode of stroke in 2012 and was based on data from the National Health Data System (Système National des Données de Santé or SNDS) [Com-Ruelle, 2018] highlighted –in addition to various

types of stroke and strokes of varying gravity–, a variability in the treatment in the acute phase and, in particular, in the length of the initial hospital stay in acute care. Other studies also suggest a marked heterogeneity in the length of hospital stay (LOS) that may have both medical and economic consequences (Le Barbier, 2008; Tuppin, 2013). From a medical perspective, the French National Authority for Health (Haute autorité de santé, HAS) recommends that the post-acute phase, devoted to re-education, should begin as early as possible and be adapted to the patient's condition. The bulletin issued on 6 March

2012 by the Directorate of Health Care Supply of the French Ministry of Health (Direction Générale de l'Offre de Soins, DGOS), relating to the organisation of regional treatment sectors for stroke victims, highlighted the need for early referral to a follow-up and rehabilitation care (FRC) unit. Hence, a prolongation of the LOS in an acute hospital could pose a risk to the patient in terms of the functional prognosis. From an economic perspective, as the cost of a short hospital stay is linked to its duration, the prolongation of the LOS may be an additional expense for the hospital and the local authority, which is not always justified from a medical point of view.

Many factors explain the variability in the LOS. The demographic and clinical characteristics are of course the primary factors to take into account. However, it is difficult to act on these elements, except through the prevention of stroke risk factors, which can reduce the incidence and gravity of strokes. The types of treatment received, such as treatment in a stroke unit, attesting the quality of care, may also affect the LOS. Lastly, the healthcare supply available after treatment in the acute phase may also play a role. Indeed, the prolongation of the LOS in the acute phase may be linked to a lack of available beds in downstream

## DEFINITIONS

**Local Potential Accessibility (LPA):** Measuring the spatial accessibility to healthcare, this indicator takes into account the activity levels of the doctors in order to measure the healthcare offering and the differentiated rate of care utilisation per age of the inhabitants to assess the demand. This is a local indicator, calculated for each commune, but which also takes into account the health care supply and demand of surrounding communes.

**Stroke:** Corresponds to the sudden disruption of blood flow to part of the brain, leading to the death of brain cells. The symptoms vary greatly, depending on the nature of the stroke, and whether it is ischemic (obstruction of a blood vessel) or haemorrhagic (rupture), and the location and size of the cerebral lesion. Their consequences can be divided schematically into physical problems (paralysis, loss of sensitivity), mental problems (decreased vigilance...) and speech difficulties.

**Full (or established) stroke:** The scope of the strokes corresponds to strokes of ischemic (PD I63), and haemorrhagic strokes (PD I60, I61, and I62), and unspecified strokes (I64: in the absence of exploration via MRI and CT scans).

**Haemorrhagic stroke:** The rupture of an artery that results in an intracerebral haemorrhage, or the rupture of an aneurism (congenital vascular malformation) that leads to a meningeal haemorrhage. The blood spreads into the neighbouring tissues, compressing and damaging them.

**Ischemic stroke:** An artery blocked by a blood clot that suddenly prevents the blood flow from irrigating part of the brain.

**A transient ischemic attack (TIA):** When the signs last for less than one hour and with no evidence of acute cerebral infarction detected on the imaging, this is identified as a TIA, when the obstruction of the cerebral artery heals on its own. But it can precede the occurrence of an established stroke, that is to say a full stroke.

**Primo-stroke:** The first stroke (full or TIA) occurred in year  $n$  (i.e. hospitalised in acute care for a stroke that occurred in year  $n$ ) and in the absence of a previous hospitalisation for an established stroke (full stroke) or TIA from Day -1 to Month -24.

**Thrombolysis:** The intravenous perfusion of a medicament that is able to dissolve a blood clot that is obstructing an artery.

structures, such as FRC units, and medical and social care facilities (nursing homes (Établissements d'hébergement pour personnes âgées dépendantes, EHPADs), medical centres (Foyers d'accueil médicalisé, FAMs), etc.), and also to the availability of re-education and

ambulatory healthcare (physiotherapists and nurses). Other factors are mentioned in certain studies, namely the organisation and coordination of the healthcare professionals in the various structures treating stroke victims throughout their care pathway.

## SOURCES

The study programme carried out by IRDES (the Institute for Research and Information in Health Economics) on the healthcare treatments of victims of a stroke was based on a series of stroke cohorts (Com-Ruelle, Nestrigue, 2018) based on the National Health Data System (Système National des Données de Santé or SNDS) and included all of the patients 'hospitalised for the first time' in an acute care facility (Medicine, Surgery and Obstetrics, MSO) for a full stroke (haemorrhagic or ischemic) or for a transient ischemic attack (TIA) that occurred between the years 2010 to 2019. Those considered to be hospitalised for the first time in year  $n$  were patients who had not been hospitalised for the same reasons during the 24 months leading up to the date of the hospital stay in year  $n$ .

This study focused on adult patients living in metropolitan France who were hospitalised for the first time in 2012, with a primary diagnosis (PD) of a full stroke (ICD-10: I60I64), i.e. at the age of 18 or older and living in metropolitan France. As the treatment of the TIA was specific, the hospitalised patients with this diagnosis were excluded from the scope of the study. When the hospital stay was contiguous with other subsequent stays due to a stroke, all of these stays were considered to be part of the same "hospitalisation episode". The individual record of the included patients' hospital visits and/or stays was compiled via the French National Hospital Database (PMSI) and included data relating to MSO, follow-up and rehabilitation care (FRC), and Home Care (HC), and data from the Medical Information Database for Psychiatry (Recueil d'Informations Médicalisé en Psychiatrie, or Rim-P). Individual data relating to the consumption of ambulatory healthcare before and after the hospitalisation episodes of the patients included in the cohort were provided by the French Health System's' inter-scheme consumption database (DCIR), thanks to the

data matching relating to included hospitalised patients within the National Health Data System (Système National des Données de Santé, SNDS). This data matching made it possible to identify all the treatments given to the patients in the various hospital facilities, and to verify the date and means of discharge, and precisely identify the patient's death, when appropriate.

The characteristics of the healthcare supply were based on various sources of information such as the French Annual Health Establishment Statistics (Statistique Annuelle des Établissements de Santé, SAE) in 2012. The Local Potential Accessibility (LPA) in 2013, the Eco-Santé 2012 software, and the 2012 French National Institute for Statistics and Economic Studies (INSEE) data census. This information was matched with the stroke 2012 cohort extracted from the National Health Data System (Système National des Données de Santé, SNDS).

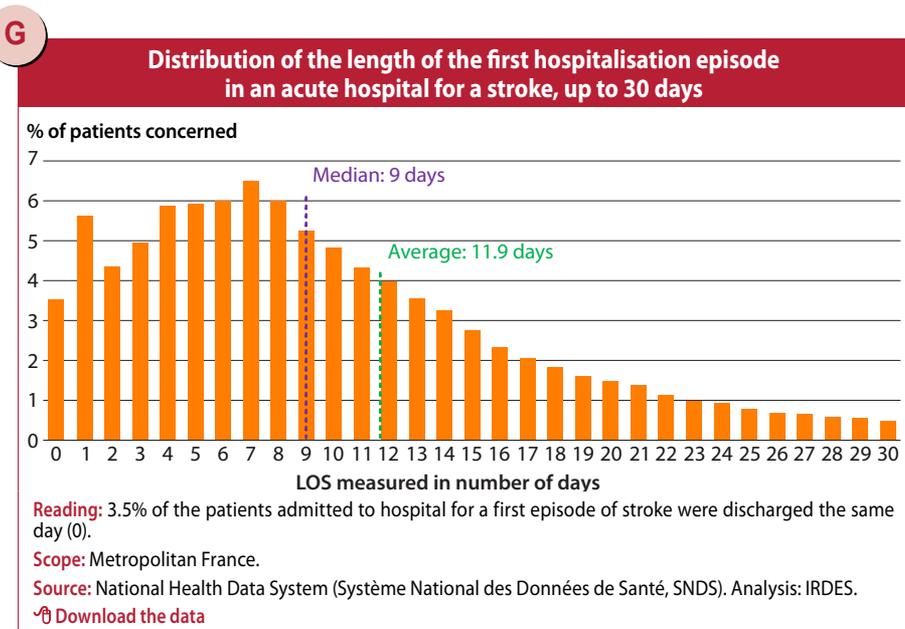
<sup>a</sup> Hospitalisation: a first stay in a Medicine, Surgery and Obstetrics (MSO) facility, i.e. a stay after an admission, with a primary diagnosis relating to a full stroke or a TIA, and in the absence of hospitalisation for a full stroke or TIA from Day-1 to Month-24.

<sup>b</sup> For each year  $n$ , a cohort was created that included all the patients who suffered an initial episode of full stroke that occurred that year, identified in an extract from the National Health Data System (Système National des Données de Santé, SNDS). Each cohort of patients included the data for ambulatory and hospital medical monitoring in all sectors (MSO, FRC, HC, and PSY) over the preceding 24 months (Day-1 to Month-24) and the 24 subsequent months (Day+1 to Month+24) for a full stroke. The ultimate objective was to accumulate 10 successive cohorts between 2010 and 2019.

The aim of this study was to assess the influence of the various potential factors of variability in the length of hospital stays of victims of a first episode of stroke in an acute hospital, based on National Health Data System (SNDS) data (see "Sources" inset).

**Nearly 100,000 people were hospitalised for a first episode of stroke**

In 2012, 96,146 patients were hospitalised in mainland France for a first episode of an established, full stroke\*<sup>1</sup> (without a hospital stay in acute care for a stroke or for a transient ischemic attack (TIA)\* in the preceding twenty-four months). 67 % of these patients were victims of an ischemic stroke\*, 26% a haemorrhagic stroke\*, and the remaining 7% were victims of an unspecified stroke. The proportion of men and women was equally distributed in the cohort and the average age was 73. More than 92% of the patients were treated in a public acute hospital and 15% of the intra-hospital deaths were observed during the first hospital stay for a stroke in acute care. Amongst the survivors at the end of this episode of hospitalisation, one in two patients returned to their homes and received ambulatory healthcare. The other survivors were mainly referred to FRC units (27%) or, to a lesser extent, to acute hospitals (5%), in the event of stroke-related complications or for a reason other than a stroke. Lastly, at the end of the acute phase, very few patients



were referred to a medical and social care structure facility (2%), home care (1%), or a long-term care facility (Unité de Soins de Longue Durée, USLD) [1%] (Com-Ruelle, Nestrigue et al., 2018).

**For more than three out of four patients, the first hospital stay in an acute hospital in the acute phase lasted less than fifteen days**

The average duration of the first hospital stay for a stroke in acute care was 11.9 days (see Graph) and the median length was 9 days, with a marked variability between individuals (standard deviation: 12.8 days; coefficient of variation: 108%).

The distribution of the LOS was asymmetrical and peaked at 7 days, and was characterised by a significant proportion of long and very long stays. Nevertheless, nearly 10% of the patients' stays were very short (less than two days), almost half of which (4%) were due to death shortly after admission. The durations of the first hospital stay were mostly (77%) less than fifteen days and 94% of the patients left the hospital on the thirtieth day. However, the first hospital stay lasted 60 days for 1% of the patients, and the maximum LOS was around 24 months.

**Higher LOS in the case of referral to downstream care facilities**

The average length of the first hospital episode varied significantly according to the type of discharge from an acute hospital (see Table 1). Patients were discharged home after 9 days on average. The intra-hospital deaths, when they occurred, occurred on average after 8.5 days and accounted for a significant proportion of the shortest stays. A transfer to another acute hospital department for a reason other than a stroke occurred on average after 8.4 days, and a transfer to a psychiatric unit occurred after 11.2. The highest average durations of the first hospital

**T1** **Descriptive statistics of the length of the first hospitalisation episode in acute care for a stroke, measured in days, according to the means of discharge**

	Average number of days	Difference type (days)
Stroke cohort – Metropolitan France	11.9	[12.8]
<b>Referral</b>		
<b>Actual means of discharge</b>		
Acute hospital	8.4	[12.9]
Intra-hospital death	8.5	[12.9]
Home	9.0	[9.0]
Psychiatry	11.2	[10.7]
Medical and social care facility	13.8	[12.8]
Follow-up and rehabilitation care (FRC)	18.9	[14.9]
Home Care (HC)	24.1	[18.2]
Long-term care facilities	24.4	[27.2]

Scope: Metropolitan France.  
Source: National Health Data System (Système National des Données de Santé, SNDS). Analysis: IRDES. [Download the data](#)

<sup>1</sup> The terms followed by an asterisk are defined in the glossary below (see Definition inset, p.2).

T2

**Descriptive statistics of the length of the first hospitalisation episode in acute care for a stroke according to various characteristics (excluding the means of discharge)**

	Average number of days	Standard deviation (days)		Average number of days	Standard deviation (days)
Stroke cohort – Metropolitan France	11.9	[12.8]	<b>Healthcare pathway/medical treatment variable</b>		
<b>Demographic variable</b>			<b>Admission/Origin</b>		
<b>Age group</b>			Admission via the emergency department	11.6	[11.8]
18 to 49 yrs	10.8	[13.2]	Home	12.6	[16.5]
50 to 64 yrs	11.9	[16.6]	Medical and social care facility	10.8	[8.3]
65 to 79 yrs	11.8	[12.5]	Others (in hospital)	13.0	[12.7]
≥ 80 yrs	12.1	[11.2]	<b>Status/size of the hospitalisation facility</b>		
<b>Gender</b>			Private for-profit < 100 beds	10.2	[10.9]
Male	11.5	[13.2]	Private for-profit ≥ 100 beds	10.6	[11.2]
Female	12.2	[12.4]	Regional Hospital (CHR)	12.7	[15.2]
<b>Clinical variable</b>			Public/ESPIC <sup>1</sup> ≥ 300 beds	11.6	[11.5]
<b>Type of stroke</b>			Public or ESPIC < 300 beds	11.4	[11.6]
Ischemic	11.6	[10.7]	<b>Recommended diagnostic imaging</b>		
Unknown	9.7	[11.2]	No declared imaging	9.4	[10.5]
Haemorrhagic	13.1	[17.5]	TDM <sup>2</sup> alone	12.0	[13.5]
<b>Charlson score</b>			MRI <sup>3</sup> alone	9.2	[8.4]
0	8.2	[9.0]	MRI and TDM	13.9	[13.6]
1 to 2	12.2	[12.7]	<b>Treatment in a stroke unit (SU)</b>		
3 to 4	15.8	[15.7]	Facility without SU nor in the NS <sup>4</sup>	9.6	[9.4]
> 4	16.8	[15.2]	Facility in the NS without SU	9.8	[9.8]
<b>Admission to the intensive care department/Proxy severity</b>			Facility with SU, Non-SU patient	9.9	[9.7]
Yes	21.2	[27.4]	Facility with SU, Patient treatment in SU	12.5	[11.2]
No	11.1	[10.5]	<b>Transfer during the episode</b>		
			Yes	19.0	[12.4]
			No	9.6	[9.3]

<sup>1</sup> ESPIC: Specialised non-profit private healthcare facility. <sup>2</sup> TDM: CT Scanner. <sup>3</sup> MRI: Magnetic resonance imaging. <sup>4</sup> NS: Neurovascular sector.

Scope: Metropolitan France.

Source: National Health Data System (Système National des Données de Santé, SNDS). Analysis: IRDES.

[Download the data](#)

episode were observed when patients were referred to downstream care facilities, such as a medical and social care facility (13.8 days), a FRC unit (18.9 days), home care (24.1 days), or a long-term care facility (24.4 days).

Several hypotheses may account for the prolongation of the first hospital episodes for stroke. It may be due to the patient’s clinical situation, which requires intensive acute care, as indicated by the descriptive statistics and depending, in particular, on the type of stroke and the level of comorbidity measured by the Charlson index, and also the patient’s age (see Table 2). It may also be linked to lack of beds in downstream care facilities.

What are the effects directly related to each of the characteristics on the length of the first hospital episode in acute care? In particular, what is the specific role of healthcare provision in downstream care facilities, and, in particular, that in FRC units? Modelling via a multilevel log-linear length model made it possible

to jointly take these determinants into account (see "Method" inset).

**The gravity of a stroke resulted in longer acute care**

All things being equal, the patients’ demographic and clinical characteristics had a significant impact on the length of the first hospital episode in acute care (see Table 3). The average duration of the first hospital episode increased with age and was shorter for men (-6,5%) than for women. In comparison with a haemorrhagic stroke, it was shorter in the event of an ischemic stroke (-9%). However, there was a very marked prolongation according to the Charlson Comorbidity Index (Quan, 2011), which transcribed the patient’s general health status, with a LOS that increased by 65% for a patient whose score was between 3 and 4 (significant comorbidity) and by 79% for a higher score (very significant comorbidity), compared with a patient without comorbidity.

The prolongation was indicative of more intensive monitoring and treatment by healthcare professionals. The gravity of the stroke episode, measured according to whether the patient was admitted to intensive care, was also associated with a longer first hospital episode in acute care. However, deaths during the first hospital episode in acute care were associated with shorter stays (see above).

**The stays were shorter when the acute care was administered in a SU or in a health care facility with a SU**

The treatment methods and the care pathway also had a direct impact on the length of the first hospital episode in acute care. All things being equal (see Table 3), acute care administered in a care facility with a SU or directly in a SU was associated with shorter stays (-15% and -4% respectively) than in the other care facilities. The legal status of the care facility in which the ini-

T3

**Estimation of the determinants of the length of the first hospitalisation episode in acute care for a stroke, expressed in days (Multilevel log linear length model)**

Explained variable: length (in days) of the first hospitalisation episode in acute care for stroke

Demographic variable		Treatment programme and medical treatment variable (continuation)	
<b>Gender</b>		Treatment in SU <sup>2</sup>	
Ref.: Female		Ref.: Establishment without SU nor in the neurovascular sector (NS)	
Male	-0.065 ***	Facility in the NS without SU	-0.007
Age (+ 1 yr)	0.008 ***	Facility with SU, non-SU Patient	-0.153 ***
<b>Clinical variable</b>		Facility with SU, Patient treatment in SU	-0.038 ***
<b>Type of stroke</b>		<b>Transfer during the episode</b>	
Ref.: Haemorrhagic		Ref.: No	
Ischemic	-0.086 ***	Yes	0.689 ***
Not specified	-0.288 ***	<b>Healthcare supply variable</b>	
<b>Charlson score</b>		<b>LPA of self-employed physiotherapists</b>	
Ref.: Score = 0		Ref.: 1 <sup>st</sup> quintile (< 41 FTE <sup>4</sup> for 100,000 habitants)	
Score of 1 to 2	0.397 ***	2 <sup>nd</sup> quintile (42-65)	-0.020
Score of 3 to 4	0.651 ***	3 <sup>rd</sup> quintile (66-85)	-0.017
Score > 4	0.788 ***	4 <sup>th</sup> quintile (86-110)	-0.023
<b>Admission to the intensive care department /Proxy severity</b>		5 <sup>th</sup> quintile (> 110)	-0.037 **
Ref.: No		<b>LPA of self-employed nurses</b>	
Yes	0.598 ***	Ref.: 1 <sup>st</sup> quintile (< 51 FTE for 100,000 inhabitants)	
<b>Intra-hospital deaths</b>		2 <sup>nd</sup> quintile (52-73)	0.000
Ref.: No		3 <sup>rd</sup> quintile (74-98)	0.014
Yes	-0.911 ***	4 <sup>th</sup> quintile (99-135)	0.032 **
<b>Treatment programme and medical treatment variable</b>		5 <sup>th</sup> quintile (> 135)	0.030 **
<b>Admission/Origin</b>		<b>Density of beds in specialised FRC<sup>5</sup></b>	
Ref.: Admission via the emergency department		Ref.: 1 <sup>st</sup> quintile (< 1.5 CH <sup>6</sup> adult beds/10,000 inhabitants ≥ 18 yrs old)	
Home	-0.008	2 <sup>nd</sup> quintile (1.6-2.5)	-0.133 ***
Medical and social care facility	0.004	3 <sup>rd</sup> quintile (2.6-3.6)	-0.101 **
Others (in hospital)	0.204 ***	4 <sup>th</sup> quintile (3.7-5.1)	-0.117 ***
<b>Status/size of the hospitalisation facility</b>		5 <sup>th</sup> quintile (> 5.1)	-0.182 ***
Ref.: Public/ESPIC <sup>1</sup> ≥ 300 beds		<b>Density of beds in non-specialised FRC</b>	
Private for-profit < 100 beds	0.006	Ref.: 1 <sup>st</sup> quintile (< 12.2 CH adult beds/10,000 habitants ≥ 18 yrs old)	
Private for-profit ≥ 100 beds	-0.038 **	2 <sup>nd</sup> quintile (12.3-14.6)	0.000
Regional Hospital (CHR)	0.010	3 <sup>rd</sup> quintile (14.7-16.6)	-0.008
Public or ESPIC < 300 beds	0.024 ***	4 <sup>th</sup> quintile (16.7-20.9)	-0.002
<b>Diagnostic imaging recommended</b>		5 <sup>th</sup> quintile (> 20.9)	-0.021
Ref.: No imaging declared		<b>Density of neurologists (self-employed + hospital-based)</b>	
Solely TDM = CT scanner	0.238 ***	Ref.: 1 <sup>st</sup> quintile (< 2.3 neurologists/100,000 inhabitants (RPPS7))	
Solely magnetic resonance imaging (MRI)	0.111 ***	2 <sup>nd</sup> quintile (2.4-3.4)	0.004
MRI and TDM	0.453 ***	3 <sup>rd</sup> quintile (3.5-4.3)	0.037
		4 <sup>th</sup> quintile (4.4-5.1)	0.000
		5 <sup>th</sup> quintile (> 5.1)	-0.043 *

<sup>1</sup> ESPIC: Specialised non-profit private healthcare facility. <sup>2</sup> SU: Stroke Unit. <sup>3</sup> LPA: Local Potential Accessibility. <sup>4</sup> FTE: Full-time equivalent.

<sup>5</sup> Follow-up and rehabilitation care (FRC). <sup>6</sup> CH: Complete hospitalisation. <sup>7</sup> Shared directory of health professionals.

Scope: Metropolitan France.

Source: National Health Data System (Système National des Données de Santé, SNDS). Analysis: IRDES.

[Download the data](#)

tial care was administered was also associated with the LOS, with shorter durations for hospitalisations initiated in a private for-profit care facility with more than 100 beds (3% of the patients), whereas the stays were longer in a public care facility and private non-profit care facilities (Établissements de Santé Privés d'Intérêt Collectif, ESPIC), exclusive of Regional Hospitals (CHR) with less than 300 beds (30% of the patients). It is important to note that 92% of the patients were hospitalised in the public sector and in private non-profit care facilities (ESPIC).

However, the mention of multiple recommended diagnostic imaging procedures, the number of contiguous stays that make up the first hospital episode, and the initiation of the episode following a hospital stay for another reason were associated with a longer LOS. This may reflect both a prolongation linked to the gravity of the stroke and the complexity of the patient's general health status (which were not captured by the intensive care variable and the Charlson index), and also an initial, much less organised care pathway, prior to hospitalisation in acute care.

**The impact of the regional context with longer stays in the départements in north-eastern France**

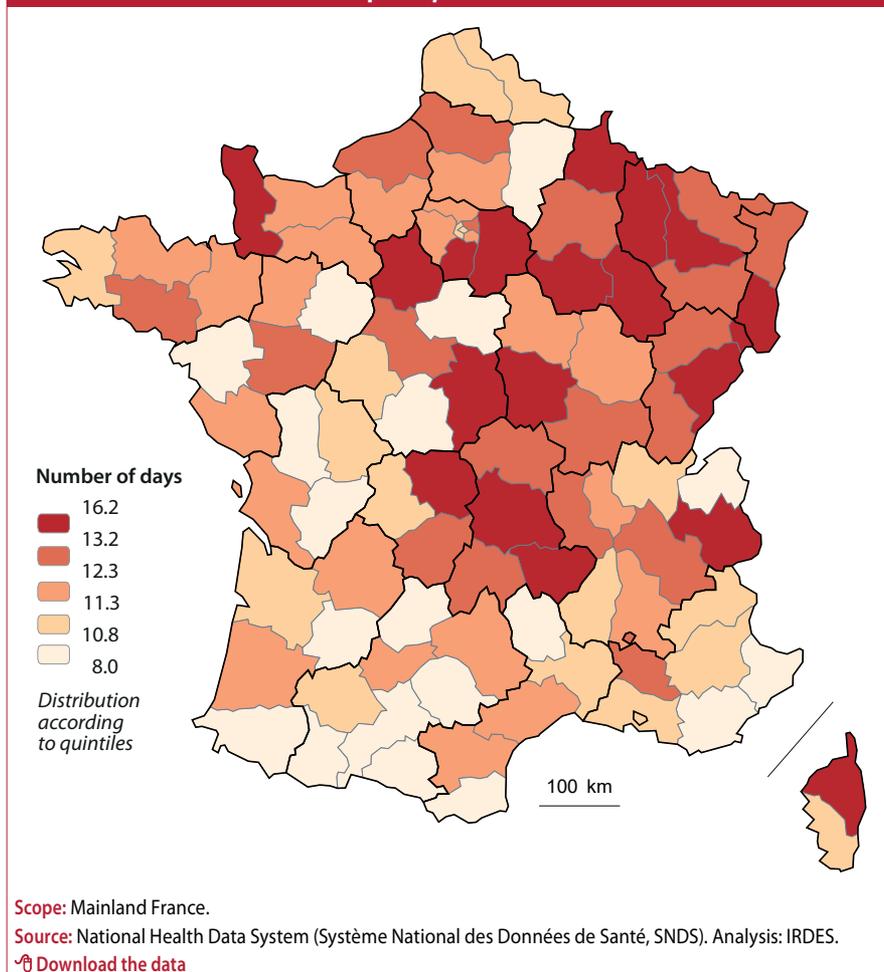
In descriptive terms, the length of the first hospital episode in acute care for a stroke also varied according to the regional context of the treatment and, in particular, between départements (standard deviation: 3.3 days), with an average length ranging from 8 days in the Indre to 14 days

in the Meuse, that is to say a ratio of 1 to 1.75 (see Map). The relatively long stays were concentrated in the north-east of France, whereas the shortest stays were observed in the *départements* in the south and on the west coast. This descriptive analysis justifies the utility of explaining these variations through the introduction of explained variables at this level in the models, particularly relating to downstream healthcare.

### The presence of FRC units specialised in the treatment of strokes tended to reduce the length of the first acute hospital episode

Downstream healthcare, particularly in FRC units, was assessed by distinguishing FRC units specialised in the treatment of stroke (FRC units specialising in the neurological system and FRC units specialising in locomotion) from those that did not. The multilevel regression results indicated that, all things being equal and in comparison with an absence of beds in specialist FRC units or a very low density (first quintile), the presence of beds in FRC units specialised in the treatment of stroke (see Table 3) was associated with a significant reduction in the length of the first hospital episode in acute care for stroke (the reduction was greater in the densest quintile: -18.2%). However, neither the presence of other FRC units nor their bed density had an impact on the length of hospitalisation.

## C Average of the first hospital episode in acute care for stroke, expressed in days and per *département*



The reeducation care provided by ambulatory professionals, particularly that of self-employed physiotherapists in terms of Local Potential Accessibility (LPA)\*, was associated with a shorter stay during

the first hospitalisation episode in acute care for a stroke, but only in the densest quintile (-3.7%), compared with the first quintile. The density of healthcare offered by ambulatory and hospital-based neuro-

## METHOD

A multilevel log linear length model was used to explain the variability of the length of the first hospitalisation episodes<sup>a</sup> for a stroke in acute care, by taking into account variables on the individual and departmental levels. Four major dimensions that potentially explain the variability of the length of the acute hospitalisation episode were chosen, based on a review of the literature and within the limits of the available data (Debals-Gonthier, 2015; Perronin, 2003; and Woimant, 2003). The first three dimensions corresponded to characteristics on an individual level, such as demographic characteristics (age and gender), clinical characteristics, medical treatment, and the treatment programme. The clinical information defined the type of stroke and its severity (an approach via admission to the intensive care department), as well as the patient's overall health (Charlson score). The Charlson score was established using the main diagnoses associated with the episode of treatment in an acute hospital for a stroke. This score is an index of 17 comorbidities with increasing weightings (1, 2, 3, or 6) according to their severity (Quan, 2011). Several variables defined the medical treatment and the patient's treatment programme during the acute phase, that is to say the means of admission (origin), the type of hospital facility, its involvement in the neurovascular sector (NS), the presence of a stroke unit (SU), the admission to the SU, the declared recommended diagnostic imaging procedures, the multi-

plication of stays during the first hospitalisation episode, the means of discharge, including any eventual intra-hospital death or a transfer to another hospital establishment during the episode.

The fourth dimension took into account the specific local healthcare for the treatment of stroke, including on the one hand the presence and the density of follow-up and rehabilitation care (FRC) facilities specialising in the treatment of nervous system conditions (the recommended downstream treatment in the event of stroke: we selected the facilities in nervous system departments and those in orthopaedics that require similar resources) and, on the other hand, amongst ambulatory professionals, the number of nurses, GPs, and physiotherapists (measured via the Local Potential Accessibility (LPA)\*), as well as the number of self-employed and hospital neurologists (measured in terms of density). These variables were introduced into the model in the form of quintiles.

<sup>a</sup> A first hospitalisation episode comprises all of the hospital stays that were contiguous with the hospital stay and which included a primary diagnosis of a full stroke or TIA. The first episode ends with a discharge from a Medicine, Surgery and Obstetrics (MSO) facility or with a stay with a different diagnosis of full stroke or TIA.

ogists, was also associated with a reduction in this LOS, solely for the densest quintile (- 4.3%), compared with the first quintile, while there was no significant effect on the intermediary quintiles. In contrast, healthcare delivered by self-employed nurses in terms of LPA was associated with a longer stay for the two densest quintiles. Denser local healthcare provided by ambulatory nurses may meet a greater general populational demand due to age and the issue of comorbidities and enable victims of a stroke requiring their intervention to be treated by ambulatory professionals (Nestrigue and al., to be published). Lastly, the GP offering (LPA) had no effect.

Hence, the availability of follow-up and rehabilitation care (FRC) services specialised in the treatment of the stroke significantly reduced the length of the hospital stays during the acute phase.

The influence of downstream healthcare was also highlighted via ambulatory healthcare professionals (physiotherapists and neurologists) who specialised in the re-education of stroke victims. This study could not measure all of the

relevant elements solely via the medical-administrative data, because this did not include information relating to the cooperation between acute hospitals and downstream care facilities, nor the various forms of collaboration with liberal health professionals.

The patient's demographic and clinical characteristics naturally play a crucial role in explaining the variability of the length of the first hospital episode for a stroke in acute care. Although socio-economic characteristics and, in particular, social isolation (Yilmaz, 2010), may play a crucial role in its prolongation, this factor cannot be taken into account here, due to a lack of specific information on an individual level in the National Health Data System (Système National des Données de Santé, SNDS). This constitutes a limitation in the interpretation of the results relating to our study. The clinical state was partly conditioned by the pre-hospital treatment (delays in treatment by the SAMU (emergency medical assistance) and any delays in carrying out thrombolysis\* for patients who suffered an ischemic stroke), but no related information was collected in the National Health Data System (SNDS) in

2012. The characteristics of the medical treatment and the hospital treatment also played a role. The coding of the diagnostic imaging examinations still appears to be incomplete in the National Health Data System (SNDS), but other studies have demonstrated that the multiplication of examinations and difficulty in accessing them increased the length of the hospitalisation episode (Woimant, 2003). Lastly, the type of establishment and, above all, the presence or not of a stroke unit (SU) also had an impact on the length of the hospitalisation episode, underlining the need for their deployment in every region, as proposed by the 2010–2014 Stroke National Action Plan (Plan d'actions national AVC).

Although the type of stroke and the global condition of the patients' health were decisive factors in the treatment of those who suffered a first episode of stroke, the fluidity of their care pathway depended not only on treatments that followed the recommendations of good medical practices, but also on the reduction of long, unjustified stays in acute hospitals. The availability of specialised downstream healthcare leads to better treatment. ♦

## FOR FURTHER INFORMATION

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