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## Care Pathways of Patients Hospitalised for Stroke Initial Findings

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A stroke involves the loss of one or more brain functions due to the sudden disruption of blood flow to the brain. It is the primary cause of death amongst women and the third cause amongst men, and results in a number of disabilities. The 2010–2014 French Stroke National Action Plan (Plan d'Actions National AVC) was set out specifically to improve the treatment of patients during the acute phase by facilitating their access to diagnostic imaging (MRI and CT scans) and the development of specialised hospital units —Stroke units (SU)—, and subsequently during the re-education and rehabilitation phase, to avoid death and an inability to recover from sequelae.

Due to the data matching from the French National Hospital Database (PMSI) with French National Health Insurance (NHI) data between 2010 and 2014, the characteristics of the adult victims of a stroke and their treatment have been observed more comprehensively than ever before. In 2012, of the 134,000 patients aged 18 or over who were hospitalised for a first episode of stroke, 99,000 had suffered from an established, full stroke, within the scope of this study. The patients were mainly admitted to hospital via the emergency department, and men and women were affected equally, except that men suffered strokes at an earlier age than women. Half of the victims of a stroke also suffered from one or several chronic diseases. Despite the development of diagnostic imaging techniques between 2010 and 2014, they appeared to be insufficient and only one patient in three was treated in a stroke unit (SU). One out of seven died during the initial acute episode. A third of the survivors were subsequently admitted to a follow-up and rehabilitation care unit (FRC), an acknowledged way of limiting sequelae. Lastly, regional disparities in stroke incidence and variations in the various modalities of treatment remained marked.

**A** stroke involves the immediate loss of one or more brain functions due to the sudden disruption of blood flow. The symptoms vary considerably depending on the nature of the stroke —it may be an ischemic stroke (resulting from an artery blocked by a blood clot— or a haemor-

rhagic stroke (resulting from a ruptured artery or an aneurysm), and the size and location of the brain lesion.

In response to the high mortality rate and the effects of sequelae of strokes, and the alarming increase in stroke incidence amongst persons under the age of 65, the

2010–2014 Stroke National Action Plan (Plan d'Actions National AVC) primarily focused on the establishment of specialised hospital units —Stroke units (SU)— in hospitals. The aim was to reduce the death rate and improve treatment, within a maximum of 4.5 hours, in order to increase patients' chances of recovery. There are

more than 130,000 new cases of stroke per year in France and in a given year around 800,000 persons have already suffered from a stroke, over half of whom suffer sequelae (Féry-Lemonnier, 2009). Strokes caused more than 32,000 deaths in 2013, representing 6% of the annual deaths (Lecoffre, 2017), and are the primary cause of death in women and the third in men. The treatment of strokes cost the French health system 3.5 billion euros in 2013, representing 2.5% of its total reimbursements (Tuppin, 2016). But the total expenditure funded by the community is three times higher and includes post-stroke costs, including medical and social costs related to disabilities (de Pourville, 2016).

The cohorts used in the study, which originated from the data matching from the French National Hospital Database (PMSI) with French National Health Insurance (NHI) data between 2010 and 2014 (see "Sources and Method" inset), enriched the results of previous studies (Lecoffre, 2017; de Peretti, 2017). They made it possible to define a first episode of stroke more precisely and calculate the fatality rate in the longer term, taking into account reported deaths in and out-

## SOURCES AND METHOD

**Identification of the patients.** The patients were extracted from the Programme for the French National Hospital Database in the fields of Medicine, Surgery, and Gynaecology/Obstetrics (Programme de Médicalisation des Systèmes d'Information en Médecine, Chirurgie, Obstétrique, PMSI-MCO) for each year N studied (in this case 2010 to 2014), based on the primary diagnosis (PD). The PDs were sought in anonymised data (Résumé Standardisé Anonymisé, RSA) and included the following codes from the tenth revision of the International Classification of Diseases (ICD-10): I60 (subarachnoid haemorrhage), I61 (intracerebral haemorrhage), I62 (other non-traumatic intracranial haemorrhages), I63 (cerebral infarction), I64 (unspecified stroke), and G45 (transient cerebral ischemic attacks and related symptoms). The patients identified were included in the sample on the day of their first admission in MSO for a stroke in year N, on condition that they had not been hospitalised for a full stroke (I60, I61, I62, I63, or I64) or TIA (G45) during the preceding consecutive 24-month period (D-1 to M-24).

**Linking hospital and ambulatory data.** Administrative data (e.g. chronic conditions (Affections de longue durée, ALD)) and medical consumption data relating to the two years preceding their hospitalisation (D-1 to M-24) and the following two years (D+1 to M+24) was extracted from individual-level data linking combining information from the French National Health Insurance system's inter-scheme consumption database (DCIR) with information

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### Glossary

- **Stroke:** A stroke involves a sudden disruption of blood flow in part of the brain, causing the death of brain cells. The symptoms vary considerably depending on the type of stroke —ischemic (resulting from a blocked artery) or haemorrhagic (resulting from a ruptured artery or aneurysm) — and the location and size of the brain lesion. Their consequences can be divided schematically into physical (paralysis, loss of feeling, etc.), mental (problems of alertness, etc.), and language problems.
- **Transient ischemic attack (TIA):** When the symptoms last less than an hour and without any signs of acute cerebral infarction in diagnostic imaging, it is called a transient ischemic attack, as the obstruction of the cerebral artery heals on its own. But it may be the precursor to a full stroke, that is to say established stroke.
- **Ischemic stroke or cerebral infarction:** An artery blocked by a blood clot that suddenly disrupts blood flow to part of the brain.
- **Haemorrhagic stroke:** Results from a ruptured artery causing an intracranial haemorrhage, or a ruptured aneurysm (congenital vascular malformation) causing a subarachnoid haemorrhage. Blood spreads into adjacent brain tissue, compressing and damaging it.
- **Intracerebral haemorrhage (ICH):** A stroke caused by a ruptured artery in the brain causing a haemorrhage in the parenchyma that causes a haematoma that dilacerates the brain tissue.
- **Subarachnoid haemorrhage (SAH):** A stroke caused by blood flowing into the cerebrospinal fluid (CSF) contained in the arachnoidian cavities at the base of the brain and the cerebral convexity; it includes a ruptured aneurysm in a cerebral artery.
- **Thrombolysis:** Cerebral ischemia causes the death of surrounding nerve cells due to a lack of oxygen, causing functional losses. To avoid cerebral ischemia, the affected artery has to be unblocked as quickly as possible after the onset of symptoms (in less than four and half hours) via an intravenous thrombolysis (the infusion of agents designed to dissolve the clot).
- **Thrombectomy:** In the event of a blocked cerebral artery, the removal of a thrombus by thrombectomy, carried out in less than 6 hours after the onset of symptoms, achieves the recanalisation of the artery by inserting a tube into the artery.

side hospitals. In this study we describe the characteristics of patients aged 18 years or over who suffered a first episode of full stroke (established stroke) in 2012 and their hospital treatment between 2010

and 2014, and their regional disparities. A first episode of full stroke is defined as an established stroke, for which the patients are admitted to hospital for a short stay, without previous history of stroke in the 24 months preceding admission, whether an ischemic, haemorrhagic, or unspecified stroke. The medical consumption of patients who suffered a stroke was observed two years before and after the admission date, which determined the date of inclusion in the cohort.

### High stroke incidence rates and a considerable proportion of ischemic strokes\*<sup>1</sup>

In 2012, patients who suffered a first episode of stroke presented different characteristics on the national level, both in clinical (type of stroke) and sociodemographic terms, and in terms of their treatment.

According to data from the French National Hospital Database (PMSI) for Medicine, Surgery, and Obstetrics (MSO), matched with the French Health Insurance's inter-scheme consumption

<sup>1</sup> The terms followed by an asterisk are defined in the glossary below (see Inset 1).

## CONTEXT

This study is part of the IRDES research programme PaSoV-AVC, which adopts a spatial and temporal approach to the healthcare received by victims of a first episode of stroke. Other studies will result from the programme, such as an analysis of the risk factors, a study of the determinants of treatment in an intensive care unit, and so on.

data (DCIR), 133,824 patients aged 18 or over were hospitalised for a first episode of stroke (see "Sources and Method" Inset), that is to say a crude stroke incidence rate of 263/100,000 adult inhabitants (1 out of 380 persons). Three quarters of the adults suffered a full stroke, that is to say 98,853 cases and a crude stroke incidence rate of 195/100,000 inhabitants (1 out of 514 persons); they fell within the scope of this study. They were complemented by a quarter of the recorded cases of transient ischemic attacks (TIA)\*, that is to say 34,971 cases and a crude stroke incidence rate of 69/100,000 inhabitants (1 out of 1,449 persons) [see Inset 2].

The full strokes were mainly comprised of ischemic strokes (IS) [66,269 cases, representing 67% of the full strokes] and a small proportion of unspecified strokes (US) [7,090 cases, 7%] (see "Sources and Method" Inset). To simplify the study, they were assimilated with the ischemic stroke cases. Haemorrhagic strokes\* (HS) afflicted one out of four patients (25,494 cases, 26%), a fifth of whom suffered a subarachnoid haemorrhage\*<sup>2</sup> (SAH: 5,149 cases, 5.2%).

These findings represent all the public and private hospitals in mainland France and the overseas regions and départements (DROM). Overall, the crude stroke incidence rates per 100,000 inhabitants were as follows: 195 full strokes, 130 of which were IS and 14 recorded as US, and 50 of which were HS, including 10 subarachnoid haemorrhages (SAH) [see the "Portrait des AVC" ("Stroke analysis") table, available on the IRDES website].

<sup>2</sup> The haemorrhagic strokes sous-arachnoïdiens\* will be excluded from certain later analyses because their courses of care present characteristics distinct from those of the other types of strokes.

### Overall, strokes affected men and women equally, but there were distinct types of full stroke and men suffered strokes earlier than women

In the 2012 cohort, adult men and women suffered full strokes in equal numbers. However, a higher proportion of men suffered haemorrhagic strokes defined as "other non-traumatic intracranial haemorrhages"\* (61%), whereas women were more often the victims of SAH\* (58%) and unspecified full strokes (55%).

The average age of full stroke onset was 73, and men suffered strokes at an earlier age than women (70 compared with 76). Subarachnoid haemorrhages (SAH) were characterised by an average age of onset of 59 and a narrower age gap between men and women (57 and 61 respectively).

The distribution by age revealed that three-quarters of those who suffered a full stroke were the oldest people: 31% of patients were between the ages of 65 and

79 and 43% were 80 or over (men and women combined). Women were predominantly afflicted from age 80 onwards (55%) and men between the age of 65 and 79 (36%). However, there was an alarming proportion of full strokes below these ages, notably 23% among men aged 50–64. This is linked to subarachnoid haemorrhages (SAH), which occur from the age of 18 (almost 32% between the ages of 18 and 49 and a similar proportion between the ages of 50 and 64) and afflict men slightly more often than women, and also to full ischemic strokes among men (23% between the ages of 50 and 64) (see the "Portrait des AVC" ("Stroke analysis") table, available on the IRDES website).

### Half of the victims of a first episode of stroke had several long-term diseases, but very few had a history of stroke of over two years

The global health status of the adult stroke patients was measured using the Charlson score, based on the number of long-term diseases (Quan, 2011) identified in the

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#### The characteristics of transient ischemic attacks (TIA)

Recognising and quickly treating a transient ischemic attack (TIA) is crucial, because 20 to 30% of strokes are preceded by a TIA. Hence, according to a recent study (Amarencu, 2018), better treatment could reduce the number of strokes by 25% and therefore avoid between 15 and 25,000 strokes each year in France.

In the cohorts in this study, the number of TIAs increased from 33,626 in 2010 to 35,427 in 2014. In 2012, more than a quarter of the patients included in the study had suffered a TIA, or at least it was recorded as such in the Programme for the French National Hospital Database (PMSI) [34,971 cases], as the quality of the coding probably varied according to the hospitals. Men (54%) are affected by TIAs more commonly than women. They occur slightly earlier than full strokes (70 years), with a smaller gap between men and women (68 years old compared with 72 years old respectively). The average Charlson score of the reported cases of TIA was half that of full strokes (0.8). Forty-five per cent of the victims of a TIA also had a chronic condition (ALD) unrelated to the stroke upon their admission for stroke. Furthermore, only 5% of the victims of a TIA had previously been recognised as having a chronic condition relating to stroke or hemiplegia/sequelae from a stroke (5.6% of men and 5% of women).

Nine out of ten patients who were victims of a TIA (91%) were admitted to a public hospital and 81% to an Emergency Department. The reported rate of magnetic resonance imaging (MRI) was close to that estimated for full strokes (31%). However, despite the transient nature of TIAs, the proportion of victims of a TIA treated in stroke units (SU) during the first episode of treatment in the acute phase was 28%. The average duration of the first episode of treatment was 5 days.

The episode of treatment in MSO (Medicine, Surgery, and Obstetrics) ended with an intrahospital death in less than 1% of the cases of TIA. In nine out of ten cases, the patient returned home. Although follow-up and rehabilitation care (FRC) is inappropriate in cases of TIA, 4.6% of the patients were referred to FRC units. In terms of spatial variability, the age- and gender-standardised hospitalisation rates for TIA varied from 20 per 100,000 inhabitants in Martinique to 86 per 100,000 inhabitants in Indre. The regions Nord-Pas-de-Calais, Brittany, and Corsica, as well as the départements in the Centre region had high rates of initial hospitalisation for TIA. The reported rates of MRI utilisation in cases of TIA differed little on the level of the départements from those reported in cases of full stroke, except in the overseas regions and départements (DROM) in the Réunion and Martinique (-26 and -18 points respectively) and, in mainland France, notably the Vosges (-20), the Gard (-20), the Pyrénées-Orientales (-18), Haute-Marne (-17), Calvados (-16), and the Cher (+13).

<sup>a</sup> See the calculation method on p. 4 (first column).

French National Hospital Database (PMSI) and the French National Health Insurance's inter-scheme consumption database (DCIR) (see "Sources and Method" Inset). The average score was 1.7, and was higher in the case of ischemic strokes (including strokes recorded as unspecified) (1.8) in contrast with haemorrhagic strokes (1.4). Its distribution highlights the fact that, although a third of the patients had no comorbidities, almost half of them suffered from several diseases at the time of their admission, slightly more often in the case of ischemic strokes in contrast with haemorrhagic strokes (51% and 47% respectively). Admission to the chronic conditions scheme (the Dispositif des Affections de Longue Durée, or ALD), registered with the French NHI, provides 100% coverage of the costs for all the healthcare relating to the illness recognised as a chronic condition. However, few patients in the 2012 cohort benefitted from valid ALD coverage for stroke before their admission<sup>3</sup> (4%), and even fewer had coverage for hemiplegia or other sequelae from a previous stroke (3%). Some patients had both types of ALD coverage—a total of 6% had one of the types of coverage—, attesting to a history of stroke before the 24 months observed in the cohort. Furthermore, a minority of patients had benefitted from ALD coverage for stroke but it was invalid at the time of the current episode (0.4% for strokes and 0.2% hemiplegia or other sequelae), attesting to an established history of stroke. All the patients with ALD coverage for stroke will be excluded from certain subsequent analyses to further clarify the definition of a first episode of stroke.

**Eight out of ten patients were admitted via an Accident and Emergency Department and diagnostic imaging techniques appeared to be insufficient despite the advances made between 2010 and 2014**

More than nine out of ten victims of a full stroke (93%) were treated in a public hospital upon admission; more than a third (34%) were treated in a Regional Hospital (CHR). Seventy-nine per cent of the patients were admitted via an Accident and Emergency Department (AED). The rate was lower for haemorrhagic strokes than ischemic strokes (74% and 80% respectively), due to subarachnoid haemorrhages, or SAH (I60) [66%] and other non-traumatic intracranial haemorrhages (I62) [64%].

The number of patients with a first episode of full stroke hospitalised during the acute phase, which was relatively stable between 2010 and 2012, increased by 5,000 cases between 2012 and 2014, increasing from 98,060 cases in 2010 to 103,030 in 2014, representing an overall increase of 5% over four years. This may be the result of better hospital referral of stroke patients as well as a real increase in stroke incidence.

Since 2009, the National Health Authority (Haute Autorité de Santé, HAS) has recommended that patients with a suspected acute stroke be given priority access to brain imaging facilities 24 hours a day and

7 days a week, giving as much priority as possible to magnetic resonance imaging (MRI). The aim of this initiative is to confirm the diagnosis, the etiological diagnosis and the therapeutic indication. If the MRI excludes brain haemorrhage and it is a cerebral infarction (ischemic stroke), intravenous thrombolysis\* is recommended up to 4.5 hours after the onset of the first symptoms and must be carried out as soon as possible in order to avoid death and minimise the sequelae. In the absence of MRI in emergency care, CT scans are the favoured technique in many hospitals.

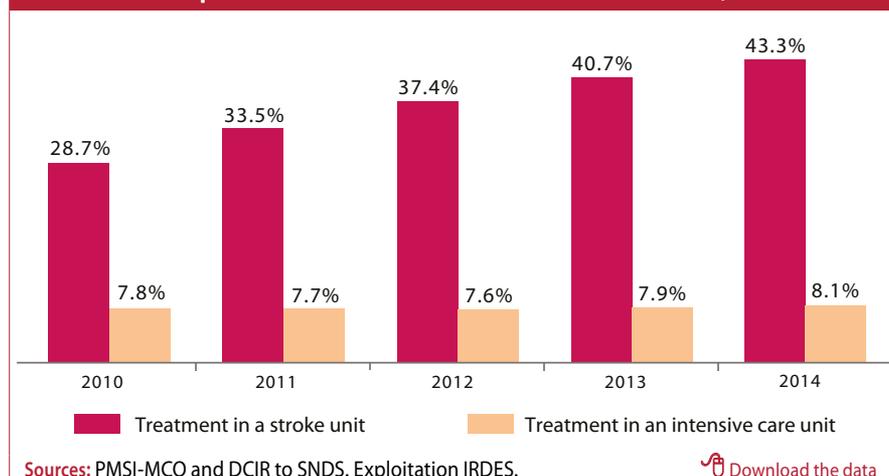
The data from the French National Hospital Database (PMSI) for Medicine, Surgery, and Obstetrics (MSO) provides information on whether or not a MRI or CT scan was carried out during hospitalisation, but not on when they were carried out. Hence, during their first episode of full stroke, 51% of the patients had a CT scan, 26% a MRI and a CT scan, 8% had a MRI, and 15% underwent no diagnostic imaging. Certain periods of hospitalisation for stroke comprised several contiguous stays, but almost all the medical acts were carried out during the first stay. Overall, a little over a third of the victims of a full stroke (34%) had a MRI, and more men than women underwent this procedure (38% compared with 30%). The rate was significantly higher in the case of established ischemia than in the case of haemorrhages (39% compared with 19%). However, these findings must be viewed in perspective, given that the absence of the financial valorisation of these medical acts during a stay in a public hospital is not conducive to exhaustive record keeping.

Furthermore, the proportion of patients who had a brain MRI increased by 11 points between 2010 and 2014, rising from 29% to 40%, that is to say +2.7 points per year. CT scans of the brain increased by 1.4 points in four years (from 77% to 78%), almost all of which were carried out during the first hospitalisation.

<sup>3</sup> Recognition in Long-term illness (ALD) former to one month preceding the admission and always into force but without to be hospitalized for a stroke in the last 24 months.

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**Evolution of the rates of treatment of adult patients hospitalised in MSO in the acute phase of full stroke in SUs and intensive care units, 2010–2014**



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**Only a third of the victims of a full stroke were treated in a stroke unit (SU), and their health status was poorer than that of patients who were not treated in a SU**

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Six out of ten victims of a full stroke (61%) were hospitalised in a hospital with a SU (63% of men and 59% of women). However, only 35% were actually treated in a SU (39% of men and 31% of women), and this was twice more likely in the case of ischemic strokes than haemorrhagic strokes (40% of ischemic strokes and 20% of haemorrhagic strokes). These patients were younger than those who were not hospitalised in a SU (their average age was 70 years, compared with 73 and 77 years for patients who were not hospitalised in a SU, depending on whether or not the hospital had a SU). They lived closer to a hospital with a SU (36 minutes compared with 38 minutes and 46 minutes respectively by road during off-peak times), and were more likely to have a MRI (33%, compared with 22% and 17% respectively). Furthermore, these patients had a poorer health status (average Charlson score of 1.94 compared with 1.46 and 1.55 respectively). Their crude mortality rate was significantly lower (6% compared with 21% and 17% respectively).

Between 2010 and 2014, the proportion of patients treated in a SU increased by 15 points (see Graph), increasing from 29% in 2010 to 43% in 2014, that is to say +4 points per year, and almost all the patients ( $\approx 96.5\%$ ) were treated there upon admission. But, as we shall see below, the development of SUs varies widely depending on the region.

A small proportion of patients (8%) in 2012 (a little more men than women) were admitted to the intensive care unit during their hospitalisation, an indicator used to assess the severity of the case. This was particularly true of victims of haemorrhagic strokes in contrast with ischemic strokes (22% and 3% respectively). Between 2010 and 2014, the proportion of patients admitted to an intensive care unit was around 8%; these patients were also very often

( $\approx 95\%$ ) admitted there upon admission (see Graph).

The duration of the first episode of treatment in the acute phase was on average 12 days in 2012; this was longer in the case of haemorrhagic strokes in contrast with ischemic strokes (13 and 11 days respectively), due in particular to subarachnoid haemorrhages (16 days) and intracranial haemorrhages (13 days). Overall, 14% of patients hospitalised for a full stroke stayed in hospital for a period that did not exceed 2 days (including patients who died during initial MSO hospitalisation); nearly 57% of the stays exceeded 7 days and 23% exceeded 15 days.

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**One in seven patients died during the first episode of full stroke, and one in eleven patients died in the six months after stroke onset**

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According to the French National health system's inter-scheme consumption data (DCIR), one out of seven victims of a full stroke (15%) died during the first episode of stroke (see "Sources and Method" inset). Women, who were on average older than the male patients, were more likely to die in a hospital (16% and 13% respectively). But, after age standardisation, the gap dropped to 0.7 points. Haemorrhagic strokes were three times more likely to cause death than ischemic strokes in the acute phase (34% and 10% respectively) and, in particular, intracranial haemorrhages (34%), as ischemic strokes can be treated with life-saving therapy, such as thrombolysis\* and/or thrombectomy\*.

After the first episode of stroke, deaths, all causes combined, increased in line with the following age-standardised rates: 18% within one month, 24% within 6 months, 28% within 12 months, and 33% within 24 months. The relative gap between men and women increased and levelled off at 1.1 points between 1 and 6 months and subsequently decreased; it was only 0.3 points within 24 months. The prognosis for haemorrhagic strokes was much worse over time (mortality factor of 1.7 within 24 months). In the absence

of information on the medical cause of death of patients who survived a first episode of stroke, one could speculate that most of the deaths that occurred in the first three months were linked to the stroke, whereas subsequent deaths may also have been linked to another illness in these patients, who often had multiple illnesses.

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**Only a third of victims who survived a full stroke were referred to a follow-up and rehabilitation care (FRC) unit upon discharge**

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Treatment in follow-up and rehabilitation care (FRC) units is recommended by scholarly societies (the French Physical and Rehabilitation Medicine Society (SOFMER) and the French Federation of PRM (FEDMER), 2011). The earlier patients receive re-education, the higher their likelihood is of recovery from sequelae, particularly aphasia, hemiplegia, and tetraplegia. Most of the recovery occurs in the first three months following stroke onset.

In the 2012 cohort, half of the victims of a full stroke returned home or to an institution after their first hospital stay; this was most often the case with men than women (55% and 45% respectively), and more likely in the case of ischemic strokes than in the case of haemorrhagic strokes (55% and 36% respectively).

Only 27% of patients were referred to and hospitalised in a FRC unit (according to the French National Hospital Database for follow-up and rehabilitation centers, PMSI-SSR), which corresponds with 32% of the survivors. Women were more likely to be hospitalised in a FRC unit than men (29% and 25% respectively).

The other forms of real discharge and destinations (depending on the corresponding PMSI services, when appropriate) were the other MSO services for a reason other than a stroke (5%), hospitalisation at home (HAH: 0.5%), psychiatric services (0.2%), long-term care units (LTCUs: 0.7%), and the medico-social sector (1.5%).

M1

**Variability in the départements of the age- and gender-standardised initial hospitalisation rates in MSO for full stroke per 100,000 adult residents in 2012**

Rate per 100,000 habitants

- [ 211.5; 307.2 ]
- [ 198.5; 211.5 [
- [ 182.7; 198.5 [
- [ 173.0; 182.7 [
- [ 143.3; 173.0 [

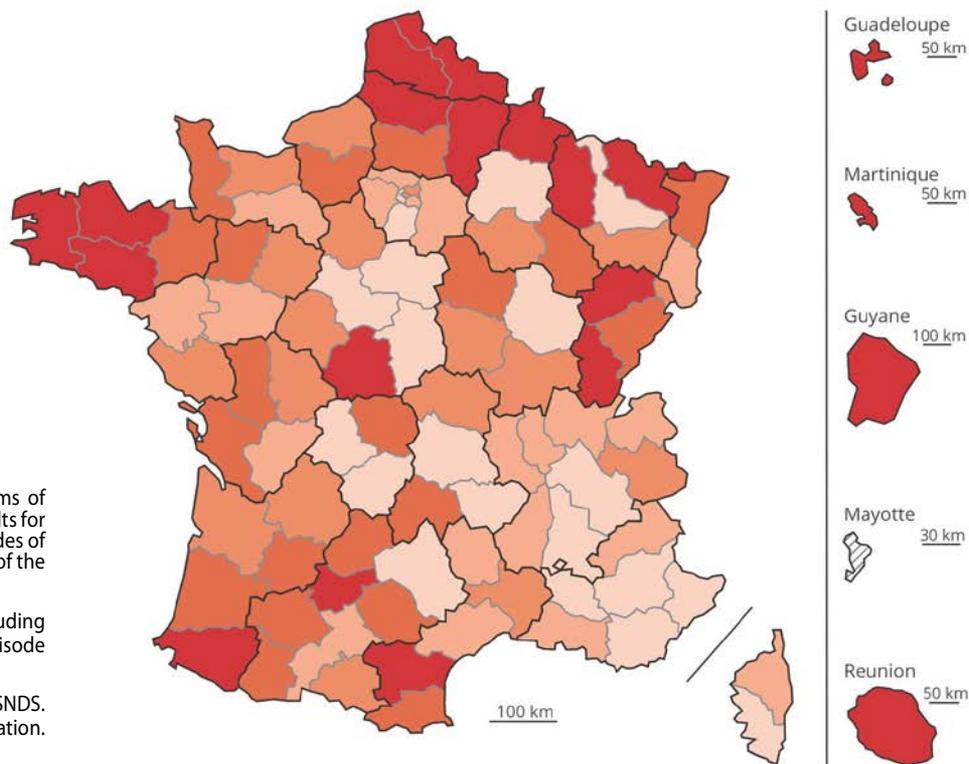
Absence of data  
Quantile discretisation

Minimum	143.3
Maximum	307.2
Average	193.9
Median	191.9
Standard deviation	24.0
Coefficient of variation	0.1
France (except Mayotte)	194.6

**Conclusion:** There is a rate of victims of full stroke (I60–I64) per 100,000 adults for each département. The distinct grades of colour correspond to a distribution of the rates in quintiles.

**Scope:** Adults living in France, including the DROM, hospitalised for a first episode of full stroke (I60–I64) in 2012.

**Sources:** PMSI-MCO and DCIR to SNDS. CNAM Extractions. INSEE Population. IRDES Exploitation.



M2

**Variability in the départements of the percentage of adult patients who were treated in a stroke unit (SU) during a first episode of full stroke in 2012**

Percentage of adults

- [ 48.8; 72.2 ]
- [ 39.8; 48.8 [
- [ 29.7; 39.8 [
- [ 13.9; 29.7 [
- [ 0.5; 13.9 [

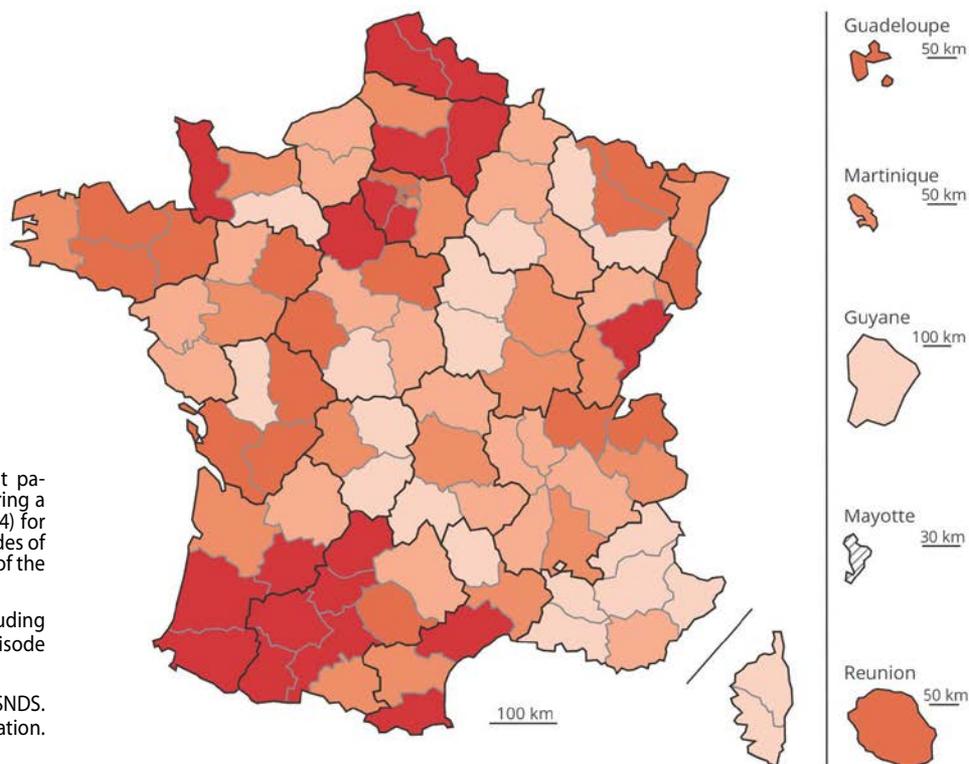
Absence of data  
Quantile discretisation

Minimum	0.5
Maximum	72.2
Average	33.4
Median	34.9
Standard deviation	17.1
Coefficient of variation	0.5
France (except Mayotte)	35.6

**Conclusion:** There is a rate of adult patients who were treated in a SU during a first episode of full stroke (I60 to I64) for each département. The distinct grades of colour correspond to a distribution of the rates in quintiles.

**Scope:** Adults living in France, including the DROM, hospitalised for a first episode of full stroke (I60–I64) in 2012.

**Sources:** PMSI-MCO and DCIR to SNDS. CNAM Extractions. INSEE Population. IRDES Exploitation.



M3

### There were significant regional variations in terms of stroke incidence and hospital treatments of stroke patients

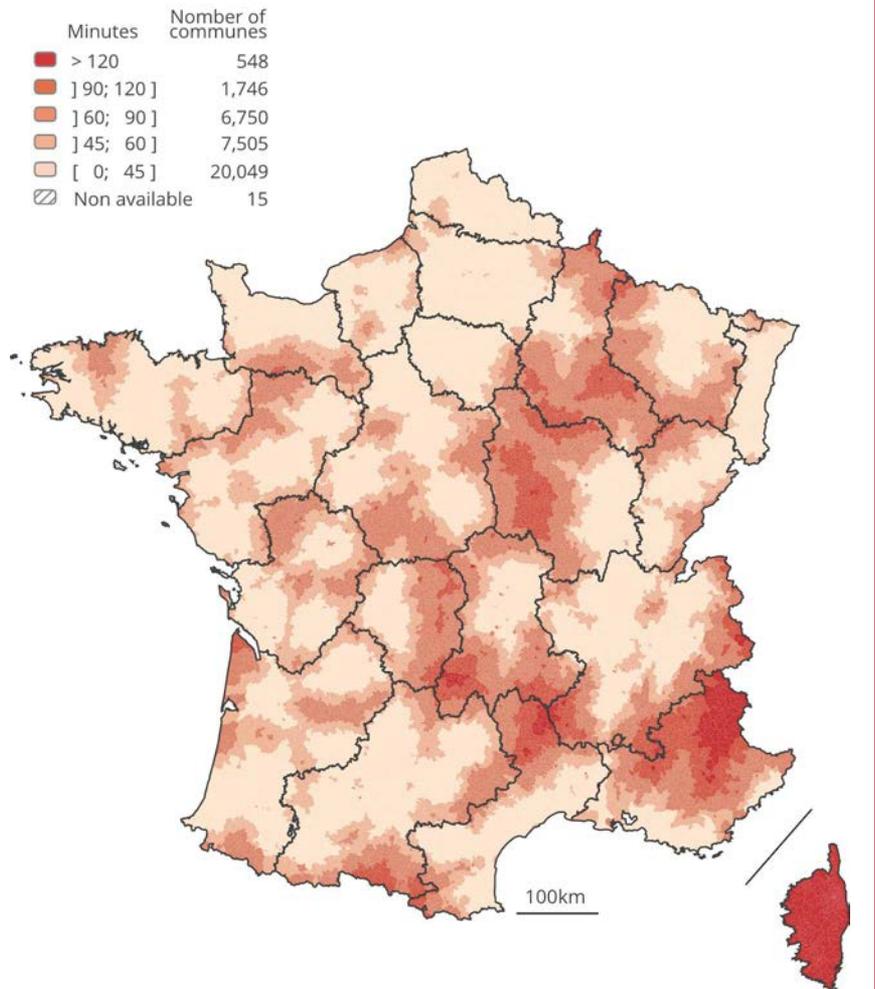
The age- and gender-standardised incidence rates of a full stroke varied significantly throughout France and the overseas regions and départements, varying by up to a factor of two, from the lowest rate in the Loiret region (143 full strokes/100,000 inhabitants) to the highest rate in Guiana (307) (see "Map 1"). In mainland France, stroke incidence rates remained low in the south-east compared with Brittany, the north, and the north-east.

The variability was even greater in the case of ischemic strokes, with a ratio of 1 to 4. The lowest rate was 51/100,000 inhabitants in the Puy-de-Dôme and the highest was 188 in Guiana. The hospitalisation rates for haemorrhagic strokes varied with a ratio of 1 to 2, from 29 per 100,000 inhabitants in the Haut-Rhin to 62 in Guiana.

The treatment of victims of a full stroke also varied throughout France. Ideally, patients should be treated in a stroke unit (SU) in the acute phase, but in 2012 (see "Map 2"), for example, patients living in the north and south-west were more likely to be treated in a SU in the Nord (62%), Pas-de-Calais (54%), the Gers (72%), and the Landes (69%). However, patients living in the south-east and certain départements in rural and mountainous areas were much less likely to be treated in a SU, such as in Corsica (<0.5% in the north and 3% in the south), in the Alpes-de-Haute-Provence (9%), the Hautes-Alpes (10%), Indre (6%), the Deux-Sèvres (6%), the Yonne (8%), and in Guiana (<1%).

The SU treatment rate was closely linked to the regional availability of SU beds in 2015 (de Peretti, 2017). Under the impetus of the 2010–2014 French Stroke National Action Plan (Plan d'Actions National AVC), there has been an acceleration in the development of the organised neurovascular chain and stroke units (SUs). Between 2009 and 2014, the number of SUs increased from 80 to 135, that is to say an increase of 60%, and SUs were established throughout France.

### Spatial accessibility to SUs in 2012



**Conclusion:** There is a rate of adult patients who were treated in a SU during a first episode of full stroke (I60–I64) for each département. The distinct grades of colour correspond to a distribution of the rates in quintiles.

**Scope:** Adults living in France, including the DROM, hospitalised for a first episode of full stroke (I60–I64) in 2012.

**Sources:** National Geographic Institute (IGN) communes. Calculation of road distances (road distance, the Agence de la Biomédecine-IRDES) and cartographic representation: IRDES.

However, what was the regional coverage of SUs in 2012? With regard to geographical accessibility, measured in terms of access time from the townhall of municipalities to the nearest SU, most of the towns and cities in the regions were at a suitable distance from a SU, with adequate travel times to ensure a high standard of care. The proportion of the French adult population with access to a SU in 45 minutes or less was 78%, ensuring adequate time, in addition to the emergency response time, for emergency responders to make a diagnosis and provide initial emergency treatment. Overall, six out of ten adults (59%) had access to a SU in 30 minutes or less and

three out of ten (30%) in 15 minutes or less. At the other extreme, the proportion of the French adult population at a travel distance of more than one hour and thirty minutes from a SU was 2%, but this applied to around one million people and represented more than 1,900 cases of full stroke and around 700 cases of potential transient ischemic attacks (TIA), who were likely to lose opportunities. These medically underserved populations were concentrated in certain regions, such as Corsica, where 100% of the inhabitants lived at a travel distance of more than two hours from a SU in 2012, and the mountainous areas that are clearly visible on Map

3, not only the Hautes-Alpes but also the Cantal, the Lozère, and the Haute-Marne where 99%, 62%, 51%, and 41% of the inhabitants respectively lived at a travel distance of more than 90 minutes from a SU. This highlights the value of telemedicine *via* the organised neurovascular chain in terms of making an accurate diagnosis and determining the indication for thrombolysis, as a first step. It should be noted that a SU was established in the hospital of Ajaccio (Corsica) in January 2014; the island now has a stroke service. In the overseas regions and départements (DROM), which are not represented on the map, only three of them had a SU in 2012, Martinique, Guadeloupe, and La Réunion.

However, not all the areas without a SU had access to an emergency department with an *ad hoc* medical imaging centre. There was better access to the nearest intensive care unit (respectively: < 15 minutes: 52%; < 30 minutes: 77%), but this was not as good as the access to a short-stay hospital (respectively: < 15 minutes: 76%; < 30 minutes: 98%).

The use of MRI varied from 4% to 59% depending on the département; these variations may be linked to encoding problems. Hence, in the overseas regions and départements (DROM), patients hospitalised in 2012 for a full stroke who had a MRI in Martinique represented 59% of the cases, compared with 4% in Guadeloupe. In mainland France, with rates of around 60%, the Doubs and the Nord were the départements where MRI was used the most, unlike the Puy-de-Dôme, the Savoie, the Deux-Sèvres, the Jura, and the Finistère, where the rate was less than 10%.

\* \* \*

The analysis of the exhaustive cohorts of patients hospitalised for a first episode of full stroke or a transient ischemic attack (TIA) in the National Health Data System (Système National des Données de Santé, SNDS) provided new information, particularly in relation to the consumption of ambulatory care. They provided a new and extended field of

research, as they included the 24 months before and after admission to MSO.

The spatial study revealed regional disparities in full stroke incidence that may be attributed, at least in part, to personal, medical, and environmental risk factors. However, the disparities in treatment in the acute phase are not only linked to the patients' clinical characteristics (the type and severity of the stroke, comorbidity, etc.), but also to the structural differences in healthcare provision and its organisation. Depending on the period and location of first-line admission, patients did not have the same access to diagnostic imaging, a SU, or a follow-up and rehabilitation care (FRC) center.

The gradual accumulation of the cohorts, covering the period 2010–2014, provides detailed data on the evolution of full stroke incidence and reported transient ischemic attacks. This data highlights certain advances made in treatment during the 2010–2014 Stroke National Action Plan (Plan d'Actions National AVC), notably the increase in treatment in SUs. ♦

## FOR FURTHER INFORMATION

- Amarenco P, Lavallee P-C, Monteiro L. *et al.* (2018). "Five-Year Risk of Stroke after TIA or Minor Ischemic Stroke". *N Engl J Med* 2018; oa1802712.
- Circulaire DGOS/R4/R3/PF3no 2012-106 du 6 mars 2012 relative à l'organisation des filières régionales de prise en charge des patients victimes d'accident vasculaire cérébral (AVC). [http://solidarites-sante.gouv.fr/fichiers/bo/2012/12-04/ste\\_20120004\\_0100\\_0081.pdf](http://solidarites-sante.gouv.fr/fichiers/bo/2012/12-04/ste_20120004_0100_0081.pdf)
- de Peretti C., Gabet A., Lecoffre C., Olié V., Woimant F. (2017). « Disparités régionales de prise en charge hospitalière des accidents vasculaires cérébraux en 2015 ». Drees, *Etudes Résultats*, n° 1010.
- de Pouvourville G. (2016). « Coût de la prise en charge des accidents vasculaires cérébraux en France ». *Archives of Cardiovascular Diseases Supplements* (2016) 8, 161-168. <http://www.em-consulte.com/en/article/1039064>
- Fery-Lemonnier E. (2009). « La prévention et la prise en charge des accidents vasculaires cérébraux en France : rapport à la Madame la ministre de la santé et des sports ». [http://solidarites-sante.gouv.fr/IMG/pdf/AVC\\_-\\_rapport\\_final\\_-\\_vf.pdf](http://solidarites-sante.gouv.fr/IMG/pdf/AVC_-_rapport_final_-_vf.pdf)
- Giroud M., Hommel M., Benzenine E., Fauconnier J., Béjot Y., Quentin C. (2015). FRESKO Study. "Positive Predictive Value of French Hospitalization Discharge Codes for Stroke and Transient Ischemic Attack". *Eur Neurol* 2015;74(1-2):92-9.
- Haute Autorité de santé (2009). « Accident vasculaire cérébral : prise en charge précoce (alerte, phase préhospitalière, phase hospitalière initiale, indications de la thrombolyse). Recommandations de bonne pratique ». [https://www.has-sante.fr/portail/jcms/c\\_830203/fr/accident-vasculaire-cerebral-prise-en-charge-precoce-alerte-phase-prehospitaliere-phase-hospitaliere-initiale-indications-de-la-thrombolyse](https://www.has-sante.fr/portail/jcms/c_830203/fr/accident-vasculaire-cerebral-prise-en-charge-precoce-alerte-phase-prehospitaliere-phase-hospitaliere-initiale-indications-de-la-thrombolyse)
- Lecoffre C., de Peretti C., Gabet A., Grimaud O., Woimant F., Giroud M., *et al.* (2017). « L'accident vasculaire cérébral en France : patients hospitalisés pour AVC en 2014 et évolutions 2008-2014 ». *BEH*. 7;(5):84-94. [http://invs.santepubliquefrance.fr/beh/2017/5/2017\\_5\\_1.html](http://invs.santepubliquefrance.fr/beh/2017/5/2017_5_1.html)
- Lecoffre C., de Peretti C., Gabet A., Grimaud O., Woimant F., Giroud M., *et al.* (2017). « Mortalité par accident vasculaire cérébral en France en 2013 et évolutions 2008-2013 ». *BEH*. 7;(5):95-100. [http://opac.invs.sante.fr/doc\\_num.php?explnum\\_id=10686](http://opac.invs.sante.fr/doc_num.php?explnum_id=10686)
- Ministère de la santé et des sports (2010). « Plan d'actions national Accidents vasculaires cérébraux 2010-2014 ». [https://www.cnsa.fr/documentation/plan\\_actions\\_avc\\_-\\_17avr2010.pdf](https://www.cnsa.fr/documentation/plan_actions_avc_-_17avr2010.pdf)
- Tuppin P., Rivière S., Rigault R., Tala T., Drouin D., Pestel L., Denis P. *et al.* (2016). "Prevalence and Economic Burden of Cardiovascular Diseases in France in 2013 According to the National Health Insurance Scheme Database". *Archives of Cardiovascular Diseases* 109, no 6 7: 399-411. [https://sfcario.fr/sites/default/files/pdf/Actualites/archiv\\_cardio.pdf](https://sfcario.fr/sites/default/files/pdf/Actualites/archiv_cardio.pdf)