Emergency and Urgent Care Network: Analysis of the Stroke Care Line According to Care Times and Outcomes

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Authors' contributions

This work was carried out in collaboration among all authors. Authors KFdSL, RLdPA, OMPN and AAM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author JLR managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

Background: Given the importance of acute stroke care for public health in terms of its burden and consequences like disability and death, evidence-based practice has directed the development of clinical protocols and operational guidelines to care of the populations affected by this pathology.

Aim: To evaluate the impact of implementing the stroke care line in the Urgency and Emergency Care Network of a large Brazilian municipality.

Methods: This is a retrospective study, conducted between 2014 and 2019 in public health services in Ribeirao Preto, SP, a large municipality of Brazil. Data was collected through secondary sources. A total of 403 patients were included in the study, of which: 172 were treated between 2014 and 2016 and 231 between 2017 and 2019; 118 were served by the mobile pre-hospital care services and 285 by the fixed pre-hospital care services. Data comprise clinical, epidemiological characteristics and severity of cases, as well as stroke care times and outcomes and were analyzed using descriptive techniques, Mann-Whitney and Chi-squared tests.

Results: First care provided by a mobile pre-hospital care unit increased from 16.9% to 38.5%. The service times for people undergoing thrombolysis were shorter in the period from 2017 to 2019 compared to 2014 to 2016 in the door-to-needle, stroke onset-to-call, stroke onset-to-ambulance dispatch and regulation-to-door times. Stroke victims treated first by a mobile (ambulance) unit had shorter care times when compared to those who received care in a fixed unit, except in ambulance dispatch-to-door time. No difference was identified in the percentage of outcomes studied in the period from 2017 to 2019 compared to the period from 2014 to 2016. There was a higher craniectomy occurrence in people treated at home than in those attended in health services. The percentage of unfavorable stroke outcomes increased depending on the case severity.

Conclusion: The care flow organization with defined responsibilities for each care point through the creation of a care line and the use of pre-established protocols reduced pre- and in-hospital care times; however, they did not have a significative influence on the case outcomes.

1. INTRODUCTION

Stroke was in the second place in the number of deaths and the third in deaths and disabilities combined in 2019 and around 62% of all new strokes were ischemic in the same year [1]. Strokes killed 103,045 Brazilians in 2021, while heart diseases were responsible for the deaths of 115,689 people in the same period [2]. Therefore, the disease is the second cause of death in Brazil.

Given the importance of pathology for public health, evidence-based practice has directed the development of clinical protocols and operational guidelines for acute stroke care [3], which aim to reduce the time it takes to handle cases, perform imaging tests and provide therapeutic resources [4]. Therefore, after the onset of stroke signs and symptoms, patients must arrive at the hospital in less than 4.5 hours to receive therapies such as thrombolysis [5,6].

The Ministry of Health in Brazil approved the Clinical Protocol and Therapeutic Guidelines - Thrombolysis in Acute Ischemic Stroke, with the objective of achieving timely application of therapeutic measures and consequently a reduction in disabilities and deaths associated with stroke [7]. Furthermore, the use of Stroke Units and thrombolysis in the Brazilian Health System were recommended from 2012 onwards, and its effectiveness and feasibility were proven in 2020 by the RESILIENT study [8].

Such measures were recommended in conjunction with a reorganization of the Brazilian Health System, which must act according to a management model called Healthcare Networks (HCN), with the principle of integrating the different care points according to the technological density of each one [9]. As an element of the HCN, the Urgency and Emergency Care Network (UECN) aims to articulate and integrate health equipment with the aim of qualifying care to users in urgent and emergency situations [10].

From this perspective, the need for arrangements and qualification of pre-hospital care for stroke cases provided in Primary Healthcare Units, Emergency Care Units and Mobile Emergency Care Services (called SAMU

in Brazil) is recognized, as this care serves as the basis for defining the treatment to be offered in a hospital environment. These arrangements favor structuring care lines with a defined therapeutic plan, care flows and specific assignments for each care point with the aim of increasing patient survival and reducing damage and deaths [11].

A literature review identified the importance and relevance of implementing protocols in stroke care and their effectiveness in reducing the time elapsed between the onset of symptoms and the start of treatment [12], as well as increasing the performance of reperfusion therapies and improving prognosis after discharge [13].

In view of the above, this study aimed to evaluate the stroke care line in the UECN of a large Brazilian municipality based on care times, as well as case outcomes.

2. MATERIALS AND METHODS

This is a retrospective study conducted in the UECN of the municipality of Ribeirão Preto, São Paulo, Brazil, which had an estimated population of 720,116 inhabitants in 2021 [14]. The municipality is organized into five Health Districts, each of which has a health unit with an emergency service that operates 24 hours a day and primary care units. Entry to the reference hospital for stroke treatment must occur through a request to the SAMU which responds and takes the case at the location of the incident or at the health units.

The Emergency Unit of the Hospital das Clínicas of the Medicine Faculty of Ribeirão Preto (*Unidade de Emergência do Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto* - UE-HCFMRP) became the reference hospital for stroke patients in 2014. Since then, there have been significant changes in the care provided by the *UE-HCFMRP* due to the evolution of therapies; creation of stroke beds; opening of the Stroke Unit in 2016; provision of a full-time vascular neurologist; and constant training of the multidisciplinary team [15]. Therefore, The Care Line for stroke patients was structured in the city of Ribeirão Preto between 2014 and 2016.

The study population consisted of all adult individuals diagnosed with ischemic stroke in the period from 2014 to 2019 attended by public services of the UECN of Ribeirão Preto and who underwent thrombolysis. The study included individuals aged 18 years or over, with a diagnosis of acute ischemic stroke confirmed by imaging examination, residing in Ribeirão Preto and treated at the *UE-HCFMRP*. People who Pre-Hospital Care (PHC) times were incomplete were excluded.

Data was collected through secondary sources (TRUE Systems - medical record from SAMU, Hygiaweb - municipality's medical record and database from the "Ribeirão Preto Prospective Stroke Registry" study – REAVER study). The following variables were considered for the study: year of ischemic stroke, recanalization procedure, place of first care, service vehicle, sex, age, risk factors (previous stroke, systemic arterial hypertension - SAH, diabetes mellitus - DM, dyslipidemia, smoking, chronic arterial fibrillation, congestive heart failure, chronic arterial disease, Chagas disease), use of antiplatelet agents (ASA and warfarin) and statins, NIHSS scale, stroke onset time, call time to SAMU, ambulance dispatch time, hospital vacancy regulation time, hospital admission time, thrombolysis time, length of hospital stay, hemorrhagic transformation, symptomatic hemorrhagic transformation, decompressive craniectomy, in-hospital death, and Modified Rankin Scale after three months.

The data were analyzed using descriptive techniques through frequency distribution, position measurements (mean and median) and variability (standard deviation, interquartile range). The times of the care stages for stroke patients were evaluated as follows:

- Stroke onset-to-needle - between symptoms onset and thrombolytic therapy initiation;
- Stroke onset-to-door - between symptoms onset and hospital admission;
- Door-to-needle - between hospital admission and thrombolytic therapy initiation;
- Stroke onset-to-call - between the symptoms onset and the call to SAMU;
- Call-to-ambulance dispatch - between the SAMU call and the ambulance dispatch;
- Stroke onset-to-ambulance dispatch - between symptoms onset and ambulance dispatch;
- Stroke onset-to-regulation - between symptoms onset and hospital bed provision;
- Regulation-to-door - between the hospital bed provision and hospital admission;

- Ambulance dispatch-to-door - between ambulance dispatch and hospital admission;
- Hospitalization - days the patient was hospitalized.

Such times were analyzed using median and interquartile range. These times were compared in relation to the study period (2014 to 2016 x 2017 to 2019) and the type of pre-hospital care unit (mobile PHC x fixed PHC) using the Mann-Whitney test, since the data did not meet the assumptions of normality and homoscedasticity. Finally, the Chi-squared test was used to analyze the association between the study periods and the type of PHC unit with case outcomes. A significance level of 5% was adopted for all tests carried out in the study.

3. RESULTS AND DISCUSSION

A total of 3,757 patients admitted to the *UE-HCFMRP* with suspected stroke from 2014 to 2019 were identified. Of this total, 403 patients were included in the study, of which: 172 were treated between 2014 and 2016 and 231 between 2017 and 2019; 118 were served by the mobile PHC and 285 by the fixed PHC (Fig. 1).

Among the patients included in the study, approximately half were male (53.3%) and the majority were aged between 50 and 79 years (70.0%). Hypertension was predominant (77.4%) regarding risk factors for stroke, followed by DM (32.5%) and dyslipidemia (31.5%), while in the second period studied there was an increase in dyslipidemia cases (p<0.001). Among the stroke cases studied, 31.1% used Acetylsalicylic Acid (ASA) and 27.1% used statins. For the NIHSS scale, 196 (48.6%) cases were considered moderate stroke and 77 (19.1%) moderate to severe stroke. The service provided by a Basic Support Unit (BSU) increased from 62.8% in the period from 2014 to 2016 to 77.9% in the period from 2017 to 2019 (p<0.001). Among the cases handled by the mobile PHC, 105 (89.0%) were carried out by a BSU, and 183 (64.2%) among those handled by the fixed PHC also involved this same type of vehicle (BSU), p<0.001 (Table 1).
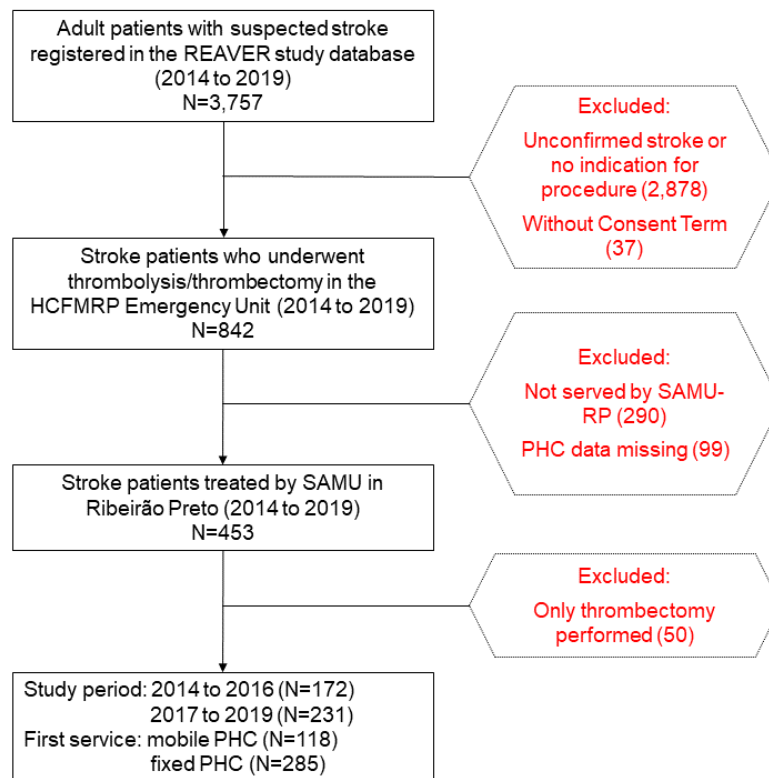
Fig. 1. Study participant inclusion flowchart on the impact of implementing the stroke care line in the Urgency and Emergency Care Network of Ribeirão Preto, Brazil, 2023
Legend: HCFMRP – Hospital das Clínicas of the Medicine Faculty of Ribeirão Preto; SAMU – Mobile Emergency Care Service; PHC - Pre-Hospital Care.

Table 1. Characteristics of people affected by a stroke undergoing thrombolysis*, residing and treated in Ribeirão Preto from 2014 to 2019

Variables		Study period			First care			Total
		2014 to 2016 N=172 %(n)	2017 to 2019 N=231 %(n)	p	Mobile PHC N=118 % (n)	Fixed PHC N=285 % (n)	p	N=403 %(n)
Male sex		50.6%(87)	55.4%(128)	0.336	49.2%(58)	55.1%(157)	0.277	53.3%(215)
Age range	Under 40 years	4.1%(7)	2.2%(5)	0.713	2.5%(3)	3.1%(9)	0.433	3.0%(12)
	40-49 years	7.6%(13)	6.5%(15)		6.8%(8)	7.0%(20)		6.9%(28)
	50-59 years	21.5%(37)	19.9%(46)		19.5%(23)	21.1%(60)		20.6%(83)
	60-69 years	23.8%(41)	26.0%(60)		20.3%(24)	27.0%(77)		25.1%(101)
	70-79 years	25.6%(44)	23.4%(54)		24.6%(29)	24.2%(69)		24.3%(98)
	80 years or more	17.4%(30)	22.1%(51)		26.3%(31)	17.5%(50)		20.1%(81)
Systemic Arterial Hypertension		80.2%(138)	75.3%(174)	0.244	76.3%(90)	77.9%(222)	0.773	77.4%(312)
Diabetes Mellitus		27.9%(48)	35.9%(83)	0.089	31.4%(37)	33.0%(94)	0.751	32.5%(131)
Dyslipidemia		20.9%(36)	39.4%(91)	**<0.001**	29.7%(35)	32.3%(92)	0.606	31.5%(127)
Previous stroke		23.3%(40)	31.2%(72)	0.079	33.1%(39)	25.6%(73)	0.129	27.8%(112)
Chronic arterial fibrillation		29.7%(51)	21.7%(50)	0.067	24.6%(29)	25.3%(72)	0.885	25.1%(101)
Congestive heart failure		21.5%(37)	27.3%(63)	0.185	25.4%(30)	24.6%(70)	0.855	24.8%(100)
Smoking		26.7%(46)	19.1%(44)	0.067	17.0%(20)	24.6%(70)	0.095	22.3%(90)
Chronic Artery Disease		12.8%(22)	12.6%(29)	0.944	12.7%(15)	12.6%(36)	0.982	12.7%(51)
Chagas disease		12.8%(22)	8.2%(19)	0.098	10.2%(12)	10.2%(29)	0.947	10.2%(41)
Use of ASA		26.7%(46)	35.1%(81)	0.195	31.4%(37)	31.6%(90)	0.770	31.5%(127)
Use of Warfarin		5.8%(10)	4.3%(10)	0.414	2.5%(3)	6.0%(17)	0.132	5.0%(20)
Statin Use		22.1%(38)	30.7%(71)	0.124	22.9%(27)	28.8%(82)	0.157	27.0%(109)
NIHSS Scale	0	0.6%(1)	-	0.220	-	0.3%(1)	0.090	0.2%(1)
	1 to 4	7.0%(12)	9.5%(22)		3.4%(4)	10.5%(30)		8.4%(34)
	5 to 15	44.8%(77)	51.5%(119)		46.6%(55)	49.5%(141)		48.6%(196)
	16 to 20	23.3%(40)	16.0%(37)		22.0%(26)	17.9%(51)		19.1%(77)
	More than 20	23.3%(40)	22.9%(53)		28.0%(33)	21.1%(60)		23.1%(93)
	No information	1.2%(2)	-		-	0.7%(2)		0.5%(2)
Ambulance	Basic Support Unit	62.8%(108)	77.9%(180)	**<0.001**	89.0%(105)	64.2%(183)	**<0.001**	71.5%(288)
	Advanced Support Unit	37.2%(64)	22.1%(51)		11.0%(13)	35.8%(102)		28.5%(115)

Legend: ASA – Acetyl Salicylic Acid; PHC - Pre-Hospital Care.
* Also included 112 cases that underwent thrombolysis + thrombectomy

In the present study, it was identified that approximately half of the affected patients were male, which is considered in the literature to be a non-modifiable risk factor for stroke [16]. This risk also increases with age, with only 10% of cases found to occur in people under 50 years of age [17], a result also found in the present study.

The two most prevalent comorbidities among stroke cases were hypertension and DM. SAH constitutes the main modifiable risk factor for stroke, and adequate blood pressure control should be a priority for Primary Healthcare and outpatient services aiming to prevent complications [18,19], such as stroke. Hyperglycemia in DM induces a large number of changes in vascular tissues and consequently a form of accelerated atherosclerosis [20], which is directly related to stroke. Other risk factors were also found in the study population, and even in smaller proportions they should also be considered when planning care in order to reduce stroke incidence.

Regarding the use of medications, around a third (⅓) of the cases used antiplatelet drugs and/or statins, which are indicated to prevent or avoid complications of health conditions that can lead to stroke. In this sense, it is worth highlighting the possibility of irregular use of medications or inappropriate medication dosage and/or monitoring for the case in question.

Around three quarters (¾) of the patients were cared for by a BSU, which is composed of a driver rescuer and a nursing technician, while the others were cared for by an Advanced Support Unit (ASU), whose team is composed of a doctor, nurse and rescuer. According to the care protocol established in Ribeirão Preto, the first care does not need to be exclusively carried out by an ASU. Therefore, the number of services provided by BSU increased, which may also be a reflection of a greater number of BSU vehicles which are distributed in Decentralized Bases, enabling greater proximity and mobility to stroke victims. Such recommendations, together with educational campaigns in the municipality, restructuring of the service network and frequent training of the team may have resulted in an increase in the number of cases first treated at home and in directing the ASU towards more cases that require advanced medical management.

The service provided by mobile PHC at the location of the incident increased from 16.9% in the period from 2014 to 2016 to 38.5% in the period from 2017-2019 (p<0.001). There was a higher percentage of cases that arrived at the hospital within 2 hours in the second period of the study and among the cases treated by mobile PHC (49.4% p=0.024 and 75.4%, p<0.001, respectively).

The service times for patients undergoing thrombolysis were shorter in the period from 2017 to 2019 compared to 2014 to 2016 in the door-to-needle, stroke onset-to-call, stroke onset-to-ambulance dispatch and regulation-to-door times. Patients treated by mobile PHC all had shorter service times compared to those treated at fixed PHC, except ambulance dispatch-to-door time and hospital stay (Table 2).

With the proof of the effectiveness of administering thrombolytic recanalizing medication in stroke in 1995, care has become a medical emergency that requires immediate treatment, as the faster the reperfusion treatment, the less the probability of developing sequelae [21]. and other unfavorable outcomes. In this sense, Saver (2006) [22] reinforces the phrase "time is brain", since "the typical patient loses 1.9 million neurons every minute that the stroke is not treated". Thus, the importance of carrying out studies involving service times is highlighted in order to identify needs for organizational arrangements and adjustments in HCN, through appropriate mobilization of support, logistical and governance systems to offer timely care and reduce the population physical, social and health harm [23].

There was a significant reduction in door-to-needle time, but not in stroke onset-to-door time when comparing the studied periods. The reduction of this time should be a priority for the UECN, with actions aimed at organizing PHC and prioritizing the initial care of cases by mobile PHC components [24], since PHC time was shorter when this type unit was involved in the first care.

PHC time has two components. The first is the decision time [25], which depends on recognition of stroke signs and symptoms by the affected person themselves or by anyone in contact with them after the stroke onset. Therefore, improvement in the knowledge level regarding the disease on the part of lay people must be among the priorities of health services, providing educational campaigns about the disease [26] and also training Primary Healthcare

professionals to guide the signs, symptoms and risk factors of stroke with the aim to reduce time spent looking for care [25]. This recommendation is reinforced, since a recent study carried out in Brazil showed that only 43.8% of respondents would call SAMU in the event of signs and symptoms suggestive of a stroke and only 20% knew the correct telephone number (192) [27].

The second component of PHC time is transport time, which correspond to the ambulance dispatch-to-door time. This time was higher when the service was provided by a mobile PHC unit, since rescuers need to perform the Cincinnati scale in care provided at home to evaluate signs suggestive of stroke, perform blood glucose measurements to differentiate from a state of hypoglycemia, puncture venous access and pass the case on to the medical regulator to provide a hospital vacancy and notify the patient's arrival. Some of these activities can be advanced when the patient is first seen at the health unit, and therefore the ambulance dispatch-to-door time is shorter when this occurs.

Even so, the stroke onset-to-door time and the other times analyzed in the PHC were shorter when the patient was treated by the mobile PHC, reflecting the efforts made by the municipality to reorganize pre-hospital emergency services. This reorganization was based on principles such as readiness, agility and speed, in addition to the qualification of teams to recognize signs of severity, perform first care and act as a gateway to the health system, forwarding the case for specialized care [28]. Thus, the fact that patients are primarily referred to health services is cited as an element which restricts performing thrombolysis due to the lack of dissemination of the protocolized care flow, which can improve care and standardize it according to the functioning of the UECN [29]. Furthermore, it is essential to train professionals who work in the SAMU radio operation, since the call-to-ambulance dispatch time was longer when the patient was in the health service, raising the possibility that these professionals may believe that the patient is well taken care of within the health unit, when in fact the ambulance must be sent quickly.

Care in the in-hospital care phase must follow the time goals established by the NINDS (The National Institute of Neurological Disorders and Stroke) and indicated by the AHA/ASA (American Heart Association/American Stroke Association) as a form of quality care and good

management of neurology services [30]. The following stand out among the goals indicated for in-hospital care: door-to-medical assessment time ≤ 10 minutes; door-to-stroke team time ≤ 15 minutes; door-to-exam time ≤ 25 minutes; door-to-examination interpretation time ≤ 45 minutes; and door-to-needle time ≤ 60 minutes.

The present study only analyzed the door-to-needle time among these times, which had a median and upper quartile of less than 60 minutes even before opening the stroke unit. This time decreased even further after this period, indicating the effects of reorganizing flows within the institution, making the start of treatment faster and achieving the proposed goals. This shows that there is in fact a greater need for the municipality to invest in actions to reduce PHC time in order to increase the number of people undergoing thrombolytic treatment.

Regarding stroke cases undergoing thrombolysis, no difference was identified in the percentage of outcomes between the studied periods. There was a higher occurrence of craniectomy in cases initially treated by a mobile PHC unit in relation to those whose first care was provided by a fixed PHC unit (Table 3).

There was no significant reduction regarding the length of stay, corroborating results from a literature review [12], which show that the length of stay is linked to the patient's health status and/or their pre-existing conditions, as well as complications that may occur during treatment.

Regarding the outcomes of the ischemic stroke cases in the study undergoing thrombolysis, it was identified that the proportion of unfavorable occurrences increased in line with the increase in the severity of the cases, as shown in another study [31], in which the baseline NIHSS score was essential for prediction of acute ischemic stroke outcomes. NIHSS above 20 points had a higher percentage of hemorrhagic transformation, symptomatic hemorrhagic transformation and craniectomy in the present study. Therefore, the outcome of cases treated with thrombolysis suggests a potential interface with the case severity, but not with the period studied, nor with the unit that provided the first care, since the unfavorable outcomes of ischemic stroke in people undergoing thrombolysis increased as the severity of the cases increased, according to the NIHSS scale score (Table 4).

Table 2. Care times for people affected by stroke undergoing thrombolysis*, residing and treated in the city of Ribeirão Preto from 2014 to 2019, second period and location of first care

Variables**	Study period		p	First care		p	Total N=403 Median (IQR)
	2014 to 2016 N=172 Median (IQR)	2017 to 2019 N=231 Median (IQR)		Mobile PHC N=118 Median (IQR)	Fixed PHC N=285 Median (IQR)		
Stroke onset-to-needle time	190(135-240)	173(120-228)	0.124	118(91-160)	200(155-243)	<0.001	180(124-232)
Stroke onset-to-door time	140(98-180)	123(81-184)	0.071	78(62-119)	153(112-197)	<0.001	133(88-182)
Door-to-needle time	46(32-58)	35(26-48)	<0.001	34(25-43)	42(29-56)	<0.001	38(27-52)
Stroke onset-to-call time	78(42-113)	63(21-112)	0.046	18(3-50)	86(54-126)	<0.001	69(30-112)
Call-to-ambulance dispatch time	17(9-32)	16(5-29)	0.072	6(2-23)	19(11-33)	<0.001	17(7-30)
Stroke onset-to-ambulance dispatch time	102(63-138)	80(34-145)	0.013	33(13-65)	115(75-156)	<0.001	95(48-142)
Stroke onset-to-regulation time	97(58-135)	86(48-132)	0.200	48(35-83)	107(69-145)	<0.001	93(51-133)
Regulation-to-door time	40(29-51)	32(22-48)	<0.001	24(16-41)	40(30-51)	<0.001	36(25-50)
Ambulance dispatch-to-door time	34(25-47)	37(27-51)	0.085	47(28-56)	33(25-44)	<0.001	36(25-49)
Hospitalization time	6(4-14)	7(4-11)	0.783	7(4-12)	6(4-12)	0.501	7(4-12)

Legend: PHC - Pre-Hospital Care; IQI – interquartile range.
* Also included 112 cases that underwent thrombolysis + thrombectomy; **times in minutes, except length of stay (days)

Table 3. Distribution of people affected by stroke undergoing thrombolysis*, residing and treated in the city of Ribeirão Preto from 2014 to 2019, according to case outcome and care period

		Study period		p	First care		p	Total %(n/N)
		2014 to 2016 %(n/N)	2017 to 2019 %(n/N)		Mobile PHC %(n/N)	Fixed PHC %(n/N)		
Hemorrhagic transformation		16.9%(29/172)	18.9%(43/227)	0.592	20.5%(24/117)	17.0%(48/282)	0.409	18.0%(72/399)
Symptomatic hemorrhagic transformation		9.3%(16/172)	6.1%(14/228)	0.235	8.6%(10/117)	7.1%(20/283)	0.609	7.5%(30/400)
Craniectomy		5.8%(10/172)	3.5%(8/231)	0.258	8.5%(10/118)	2.8%(8/285)	0.012	4.5%(18/403)
Death		17.4%(30/172)	10.8%(25/231)	0.056	11.7%(14/118)	14.4%(41/285)	0.502	13.6%(55/403)
Modified Rankin Scale after 3 months	0 to 2	49.0%(73/149)	49.2%(87/177)	0.697	44.6%(41/92)	50.9%(119/234)	0.581	49.1%(160/326)
	3 to 4	18.8%(28/149)	22.0%(39/177)		21.7%(20/92)	20.1%(47/234)		20.5%(67/326)
	5 to 6	32.2%(48/149)	28.8%(51/177)		33.7%(31/92)	29.1%(68/234)		30.4%(99/326)

Legend: PHC - Pre-Hospital Care
* Also included 112 cases that underwent thrombolysis + thrombectomy
N differs as analyzes did not include blank/ignored data

Table 4. Distribution of people affected by stroke undergoing thrombolysis*, residing and treated in the city of Ribeirão Preto from 2014 to 2019, according to case outcome and NIHSS scale

Variables		NIHSS				
		0 %(n/N)	1 to 4 %(n/N)	5 to 15 %(n/N)	16 to 20 %(n/N)	More than 20 %(n/N)
Hemorrhagic transformation		-/1	8.8%(3/34)	10.4%(20/193)	31.2%(24/77)	26.1%(24/92)
Symptomatic hemorrhagic transformation		-/1	2.9%(1/34)	3.1%(6/194)	11.7%(9/77)	14.1%(13/92)
Craniectomy		-/1	-/34	1.0%(2/196)	9.1%(7/77)	9.7%(9/93)
Death		-/1	-/34	5.1%(10/196)	16.9%(13/77)	32.3%(30/93)
Ranking after 3 months	0 to 2	100%(1/1)	73.7%(14/19)	68.3%(112/164)	26.2%(16/61)	21.5%(17/79)
	3 to 4	-/1	26.3%(5/19)	15.9%(26/164)	34.4%(21/61)	19.0%(15/79)
	5 to 6	-/1	-/19)	15.9%(26/164)	39.3%(24/61)	59.5%(47/79)

* Also included 112 cases that underwent thrombolysis + thrombectomy
N differs as analyzes did not include blank/ignored data

Among the limitations of the present study, it is worth highlighting that it was conducted in a single reference center which works with experienced doctors and with neurology residents 24 hours a day. Furthermore, the study was only conducted with victims undergoing thrombolysis, making it impossible to identify whether the reduction in care times occurred in all cases with suspected stroke, nor whether the thrombolysis rate increased.

4. CONCLUSION

The care flow organization for people affected by stroke mobilized the various health services which composed the UECN of Ribeirão Preto with defined responsibilities for each care level through creating a care line and the use of protocols. The study showed that reducing PHC times should still be a priority, with actions aimed at raising awareness among the lay population to correctly seek help and to prioritize the initial care of cases at home/place where the stroke occurred, since PHC time was shorter when victims were treated by mobile units. The study also highlights the quality of care at the reference hospital for stroke, as door-to-needle time was further reduced after creating the stroke unit.

ACKNOWLEDGEMENTS

CONSENT

It is not applicable.

ETHICAL APPROVAL

The study was conducted after authorization from the Research Project Assessment Committee of the Municipal Secretariat of Ribeirão Preto and the Scientific Council of the *UE-HCFMRP*. The study was also authorized by the Research Ethics Committee of the Ribeirão Preto College of Nursing at the University of São Paulo, according to opinion number 4,194,955.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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