

## Stroke networks and telemedicine: An Italian national survey

Laura Bernetti,<sup>1,2</sup>

Graziamaria Nuzzaco,<sup>3</sup>

Francesco Muscia,<sup>3</sup> Alessio Gamboni,<sup>4</sup>

Marialuisa Zedde,<sup>5</sup> Paolo Eusebi,<sup>1</sup>

Mauro Zampolini,<sup>2</sup> Francesco Corea<sup>2</sup>

<sup>1</sup>Neurologic Clinic, Department of Medicine, University of Perugia; <sup>2</sup>Stroke and Neurology Units, San Giovanni Battista Hospital, Foligno; <sup>3</sup>Stroke Unit, Ospedale di Legnano, Milano; <sup>4</sup>Emergency Department, San Giovanni Battista Hospital, Foligno; <sup>5</sup>Stroke Unit, Arcispedale di Reggio Emilia, Reggio Emilia, Italy

### Abstract

Stroke is the leading cause of disability and death. Nowadays, clinical benefits of stroke units and thrombolysis in ischemic stroke are evidence-based. Also the benefit of endovascular treatment for acute ischemic stroke has been established. Telemedicine has been used to improve access to care by allowing a neurologist at a remote location to interact with the patient and their family members. Prior studies have shown that the use of telemedicine for acute ischemic stroke is not only safe and effective, but it also increases the utilization of tPA, improving patient outcomes. This study aimed to investigate the diffusion of telemedicine in Italian stroke networks with an online questionnaire to assess: type of stroke care setting, Volume of thrombolysis-thrombectomy/year, access to stroke care between different hospitals, the presence of imaging sharing protocols within the network or patients dispatchment screening; type of network solutions. We have interviewed 24 Italian neurologists, working in large urban areas, from north southward, including Italian islands. In particular, these neurologists represented 14 different regions and 20 countries. A majority of neurologists replying to the survey (47.83%) worked in large general hospitals or smaller general hospitals (26%) and a smaller number of physicians (17.3%) were committed in University Hospital or (8.7%) independent foundation hospitals. The 60.87% of stroke networks involved in the survey had a low thrombolysis/year volume while the 30.43% had a thrombolysis/year volume above 100. According to the survey a local stroke network was established in 87.50% of cases. In the 45.83% of cases, the

hospitals care is not homogeneous within the network. A network for the consultation of neuroimaging between hospitals is available in 33.33% of cases. Within those describing an active network for Teleconsult the 57.14% used personal devices, while only the 25 % use professional teleconference system, and in 25% of cases used medical devices. Our findings demonstrated a relevant diffusion of Teleconsult in Italian stroke networks. The systems adopted are mostly individual solutions not integrated in protocolled pathways. These findings may encourage a systematization of Telemedicine medical curricula to increase larger access to neurological consults.

### Introduction

Stroke is the leading cause of disability and death.<sup>1</sup> Nowadays, clinical benefits of stroke units and thrombolysis in ischemic stroke are evidence-based. Infact, stroke can be acutely treated with tissue plasminogen activator (tPA), significantly improving functional outcome when given to appropriately selected acute ischemic stroke (AIS) patients within 4.5 hours. Also the benefit of endovascular treatment (ET) after acute ischemic stroke has long been debated. Recent studies have demonstrated the clinical benefit of ET up to approximately 8 hours after stroke onset, mainly in association with intravenous thrombolysis. The positive effect is higher if ET is initiated early and performed by an experienced team. Current ET techniques include thrombectomy with clot removal using stent retriever techniques or local thromboaspiration of the clot. ET seems to be so efficient that stroke care networks have to be organised to offer ET as quickly as possible in all patients who could benefit from this therapy. However, in Europe and in USA, national tPA treatment rates remain low despite the known benefits of treatment.<sup>2</sup>

Telemedicine (TM) is the use of telecommunication technologies to provide medical information and services.<sup>3</sup> Telemedicine has been used to improve access to care by allowing a neurologist at a remote location to interact with physicians, patients and their family members.

Prior research has shown that a way to increase access to acute neurological expertise is through TM diffusion. Telemedicine uses the direct audio-visual connections between a location that does not have expert specialistic care and provides a remote physician, TM delivers quality health care from large distances.

Correspondence: Francesco Corea, Stroke and Neurology Units, San Giovanni Battista Hospital, Via Arcamone, 06034, Foligno, Italy. Tel.: +39.07423307968 - Fax: +39.07423397962 E-mail: francesco.corea@uslumbria2.it

Key words: stroke; telemedicine; survey; Italy.

Acknowledgments: the authors would thank all colleagues for participating in the survey. Vincenzo Andreone, Antonio Baldi, Elisabetta Bollani, Sebastiano Bucello, Pietro Caliendo, Alberto Chiti, Anne Falcou, Giacomo Giacalone, Bruno Giometto, Michelangelo Mancuso, Maurizio Melis, Francesco Palmerini, Francesca Romana Pezzella, Emanuele Saggese, Michele Sebastianelli, Maria Sessa, Antonio Siniscalchi, Andrea Zini.

Contributions: LB, FC, AG handled manuscript draft; MZa, MZe, FM, GN, for data management; PE, statistical overview.

Conflict of interest: the authors declare no potential conflict of interest.

Funding: Francesco Corea received travel grants by ALMIRALL, DAIICHI SANKYO, BIOGEN.

Received for publication: 22 January 2018.

Revision received: 19 February 2018.

Accepted for publication: 24 February 2018.

This work is licensed under a Creative Commons Attribution NonCommercial 4.0 License (CC BY-NC 4.0).

©Copyright L. Bernetti et al., 2018

Licensee PAGEPress, Italy

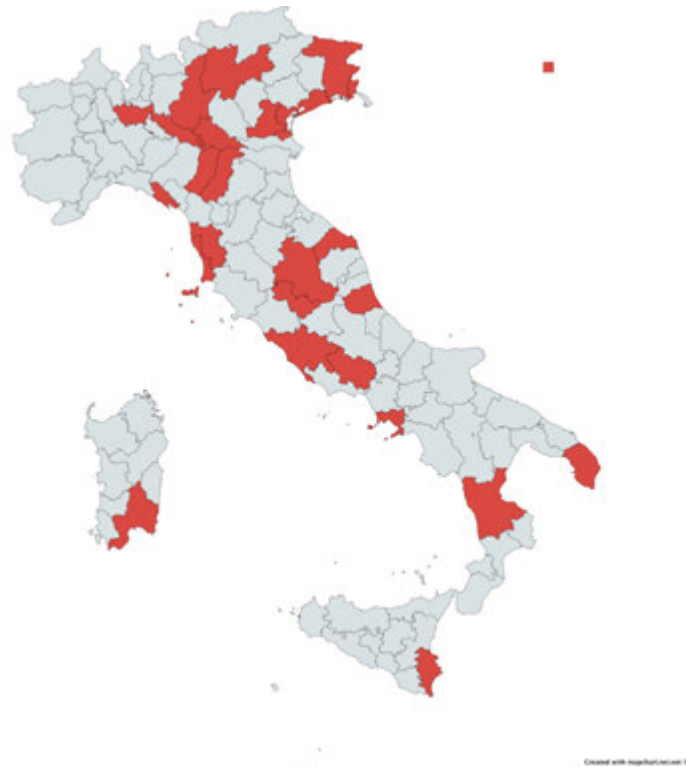
Neurology International 2018; 10:7599

doi:10.4081/ni.2018.7599

The American Academy of Neurology, due to shortage of neurologists in north America, addressed curricula for certifying physicians in teleneurology.<sup>5</sup> Prior studies have shown that the use of telemedicine for treatment of AIS is not only safe and effective, but it also increases the utilization of tPA, there by improving patient care and outcomes.<sup>6,7</sup> Previous research has shown that acute stroke care provided through audio/video TM is safe with acceptable clinical outcomes and, in many instances, can significantly improve utilization of IV tPA.<sup>6-9</sup> Since 2014, The American Stroke Association recommends that networks of telestroke should be developed to provide acute neurological expertise to locations that lack of on-site resources to improve access to acute stroke care.<sup>10,11</sup> In USA, fewer than 5% of patients who suffer from an AIS receive rt-PA.<sup>11</sup> Even fewer patients

living in regions with limited stroke-systems of care are administered rt-PA, which may be due to long distances these patients must travel to stroke centers.<sup>12</sup> Further, clinical expertise is essential to rapid diagnosis and treatment. Receiving care at a specialized stroke center, such as a Joint Commission (JC)-certified Primary Stroke Center (PSC), is associated with improved outcomes, as emergency physicians (EPs) often lack experience with rt-PA and are reluctant to use it.<sup>13</sup> Only 1% of individuals in rural areas, however, live within a 60-minute ground ambulance ride of a PSC.<sup>14</sup> Given the need for prompt evaluation and treatment, often including a neurological consult, there is concern that rt-PA is especially underused in rural or underserved urban areas. More generally, improving access to neurological services likely can improve the quality of care and outcomes for many patients with stroke, but it is unknown to what extent regional disparities in stroke care are related to disparities in access to neurological services.<sup>15</sup> In Italy, in 2010, the health care authorities<sup>16</sup> recommended guidelines about TM, to emphasize the use of this system and improve the accessibility of care in all the nation. However, inequities in coverage and in treatment provided still persist due to geographical barriers, trained personnel availability, technological capacity and organization among local health-care systems. However, in Italy the introduction of telemedicine into conventional health care systems still slow and inadequate.

This study aimed to investigate the diffusion of TM in Italian stroke networks. With an online questionnaire to assess: type



**Figure 1. A map of counties involved in the survey.**

**Table 1. Volume (%) of thrombolysis and thrombectomy in participating hospitals.**

	Year	N.	%
Thrombolysis	<10	2	8.70
	10-20	0	0.00
	>20	14	60.87
	>100	7	30.43
Thrombectomy	<10	10	43.48
	>10	13	56.52

**Table 2. Questionnaire answers overview.**

Question	Answers	N.	%
In your county is established a network of hospitals for the treatment of stroke?	No	3	12.50
	Yes	21	87.50
Access to therapies is homogeneous in all the different hospitals of your area?	No	11	45.83
	Yes above 70%	12	50.00
	Yes al 100%	1	4.17
Is there a network for the consultation of neu-roimaging between hospitals?	No	8	33.33
	Yes	1	4.17
	Yes inside the county	8	33.33
	Yes between more counties	7	29.17
Do you have hospitals consultations or tele-phone contacts to agree on hub procedures or transfers of patients?	No	0	0.00
	Yes in selected cases	9	37.50
	Yes always	15	62.50
Do you use video or audio teleconfereces to evaluate neuro-imaging data or clinical cases?	No	12	57.14
	Yes	9	42.86
If yes, what kind of technology do you use?	Certified medical devices	2	28.57
	Teleconference systems, non med-ical devices	1	14.29
	Other devices, including personal smartphones and/or social media	4	57.14

of stroke care setting, volume of thrombolysis-thrombectomy/year per site, access to stroke care between different hospitals, the presence of imaging sharing protocols within the network or patients dispatchment screening; type of network solutions.

## Materials and Methods

### Participants

With this retrospective study, we have interviewed 25 Italian board certified neurologists, that represented the larger urban areas (Milan, Naples, Rome), main stroke established centers from north southward of the peninsula, including also stroke specialists from the largest Italian islands (Elba, Sardinia and Sicily) (Figure 1). In particular, these neurologists comes from 14 different regions and 18 Italian municipalities. All of them had a specific interest in stroke or actively working in stroke units. The 47.83% of the sample neurologist worked in a general hospital, the 17.39% in the University Hospital, the 8.70% in research hospitals (IRCCS foundations) and the 26.09% work in regional hospitals.

During summer 2017, they are been subject to an online questionnaire to evaluate these items: type of structure working, number of thrombolysis-thrombectomy/year, type and quality of care between different hospitals, the presence of a network to evaluate neuroimaging or to organize transfers of patients to others Hospitals; type of technology of telemedicine solution to evaluate patients or clinical cases.

### Statistical analysis

Descriptive analysis with absolute and percentage frequencies of the qualitative variables was performed by using the Statistical Package for the Social Sciences SPSS software, version 12 (SPSS Inc, Chicago, IL).

## Results

The 60.87% of neurologists interviewed had a site with a volume of thrombolysis/year above 20, and the 30.43% above than 100 thrombolysis/year. While the 56.52% of neurologists that were interviewed reported a volume of thrombectomy/year above 10 cases (Table 1).

According to the expert opinion, there was an established network of hospitals for the treatment of stroke in 87.50% of cases. In the 45.83% of answers, the hospital care was not considered fully homogeneous inside the same network, and a network for

the consultation of neuroimaging between hospitals was missing in 33.33% of cases. Inside the same network consultations (via telephone or any other mean) were possible in 62.50% of settings and a video or audio teleconference to evaluate clinical cases was done in 42.86% of such stroke networks. In particular, around 50% of physicians adopting any kind of teleconference, used their own mobile phones with non professional system and or social media (e.g.: Skype®, WhatsApp® and FaceTime®). While only the 25 % of doctors used professional teleconference system, (e.g: Cisco®) and in 25 % of cases used of medical devices (Table 2).

## Discussion and Conclusions

Our findings demonstrated, at least a significant perceived gap, between hospitals standard care even in the same network.

The use of TM is large, but mostly with non professional devices or non medical equipment. These findings also suggest that adequate access to TM equipment may optimize the work of physicians and help access to stroke treatment as prescribed by evidence based statement.<sup>17</sup> So there is a need to enlarge the diffusion of TM in all European countries to uniform stroke care.<sup>18,19</sup>

The use of personal mobile phones is generally forbidden by good medical practice worldwide and may be allowed just in exceptional events for emergency reasons, and generally outside the hospitals.<sup>20,21</sup>

Moreover personal devices may have troubleshooting problems with mobile phone coverage and can't guarantee minimal quality standards. Equality to access of health care can't be based on the mobile phone the doctor on duty has with him, or the band speed of a mobile phone company.

Standard of care in TM are urgently needed, as well as an integration with the national guidelines stroke care pathway.<sup>22</sup> This in order to guarantee higher standard of quality, data safety and privacy for the population.

The main limit of our study is the small sample of stroke experts involved, but the coverage of large urban areas, the balance between university hospital and general hospitals may offer an interesting overview on the topic.

All doctors interviewed, are broad certified stroke experts with more than a decade of experience in the field. A systematic survey on all stroke centers may be recommended but we must take into account how large areas of the country have a low density of stroke ready hospitals. We may specu-

late how the use of personal devices shall be larger in less developed areas of the nation.

The European Stroke Organization telestroke committee recently published an intents letter,<sup>23</sup> in order to encourage national and international societies to facilitate the integration of telemedicine in standard stroke care. An expert opinion recommendation paper is on the way to be published.

## References

1. Towfighi A, Saver JL. Stroke declines from third to fourth leading cause of death in the United States: historical perspective and challenges ahead. *Stroke* 2011;42:2351-5.
2. Messé SR, Khatri P, Reeves MJ, et al. Why are acute ischemic stroke patients not receiving IV tPA? Results from a national registry. *Neurology* 2016;87:1565-74.
3. Perednia DA, Allen A. Telemedicine technology and clinical applications. *JAMA* 1995;273:483-8.
4. Wolff C, Boehme AK, Albright KC et al. Sex Disparities in Access to Acute Stroke Care: Can Telemedicine Mitigate this Effect? *J Health Dispar Res Pract* 2016;9.
5. Govindarajan R, Anderson ER, Hesselbrock RR, et al. Developing an outline for teleneurology curriculum: AAN Telemedicine Work Group recommendations. *Neurology* 2017;89:951-9.
6. Switzer JA, Hall C, Gross H, et al. A web-based telestroke system facilitates rapid treatment of acute ischemic stroke patients in rural emergency departments. *J Emerg Med* 2009;36:12-8.
7. Audebert HJ, Moulin T. Telestroke: the use of telemedicine in stroke care. Preface. *Cerebrovasc Dis* 2009;27:V-VI.
8. Adams RJ, Debenham E, Chalela J, et al. REACH MUSC: A Telemedicine Facilitated Network for Stroke: Initial Operational Experience. *Front Neurol* 2012;3:33.
9. Higashida R, Alberts MJ, Alexander DN, et al. Interactions within stroke systems of care: a policy statement from the American Heart Association/American Stroke Association. *Stroke* 2013;44:2961-84.
10. Schwamm LH, Audebert HJ, Amarenco P, et al Recommendations for the implementation of telemedicine within stroke systems of care: a policy statement from the American Heart Association. *Stroke* 2009;40:2635-60.
11. Demaerschalk BM, Miley ML, Kiernan TE, et al. Stroke telemedicine. *Mayo*

- Clin Proc 2009;84:53-64.
12. Eissa A, Krass I, Bajorek BV. Optimizing the management of acute ischaemic stroke: a review of the utilization of intravenous recombinant tissue plasminogen activator (tPA). *J Clin Pharm Ther* 2012;37:620-9.
  13. Eissa A, Krass I, Bajorek B. Barriers to the utilization of thrombolysis for acute ischaemic stroke. *J Clin Pharm Ther* 2012;37:399-409.
  14. Mullen MT, Wiebe DJ, Bowman A, et al. Disparities in accessibility of certified primary stroke centers. *Stroke* 2014;45:3381-8.
  15. Kulcsar M, Gilchrist S, George MG. Improving stroke outcomes in rural areas through telestroke programs: an examination of barriers, facilitators, and state policies. *Telemedicine J E-health* 2014;20:3-10.
  16. Italian Ministry of Health. TELEMEDICINA - Linee di indirizzo nazionali. Available from: [http://www.salute.gov.it/portale/documentazione/p6\\_2\\_2\\_1.jsp?lingua=italiano&id=2129](http://www.salute.gov.it/portale/documentazione/p6_2_2_1.jsp?lingua=italiano&id=2129)
  17. Wardlaw JM, Murray V, Berge E, del Zoppo GJ. Thrombolysis for acute ischaemic stroke. *Cochrane Database Syst Rev* 2014;7:CD000213.
  18. Arnao V, Popovic N, Caso V. How is stroke care organised in Europe? *Presse Med* 2016;45:e399-e408.
  19. Brainin M, Bornstein N, Boysen G, Demarin V. Acute neurological stroke care in Europe: results of the European Stroke Care Inventory. *Eur J Neurol* 2000;7:5-10.
  20. Derbyshire SW, Burgess A. Use of mobile phones in hospitals. *BMJ* 2006;333:767-8.
  21. Kidd AG, Sharratt C, Coleman J. Mobile communication regulations updated: how safely are doctors' telephones used? *Qual Saf Health Care* 2004;13:478.
  22. Agostoni E, Carolei A, Micieli G, et al. The organisation of the acute ischemic stroke management: key notes of the Italian Neurological Society and of the Italian Stroke Organization. *Neurol Sci* 2017.
  23. Corea F, Hubert G, Abilleira S. Letter by Corea et al. Regarding Article. Telemedicine Quality and Outcomes in Stroke: A Scientific Statement for Healthcare Professionals From the American Heart Association/American Stroke Association. *Stroke* 2017;48:e139.