Organizing Networks For Stroke Management

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In the Era of Thrombectomy, Let Us Also Protect the Majority of Patients With Stroke Who Only Require Medical Treatment!

Enrique C. Leira, MD, MS; Sean I. Savitz, MD

Stroke. 2018;49

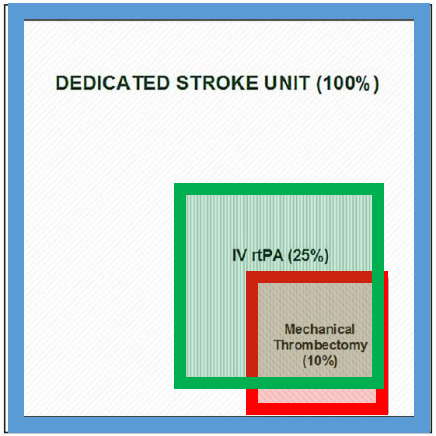
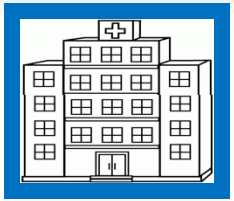
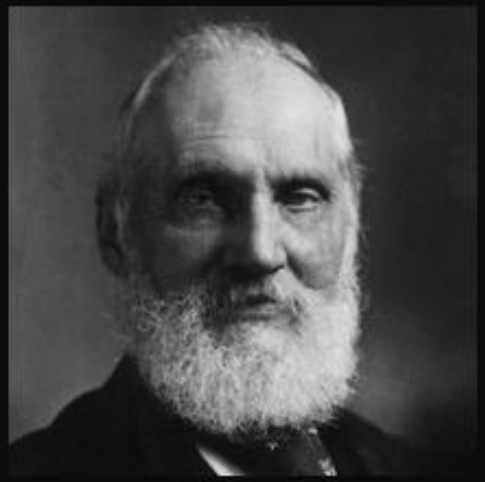


Figure. Eligibility for established stroke interventions. IV rtPA indicates intravenous recombinant tissue-type plasminogen activator.

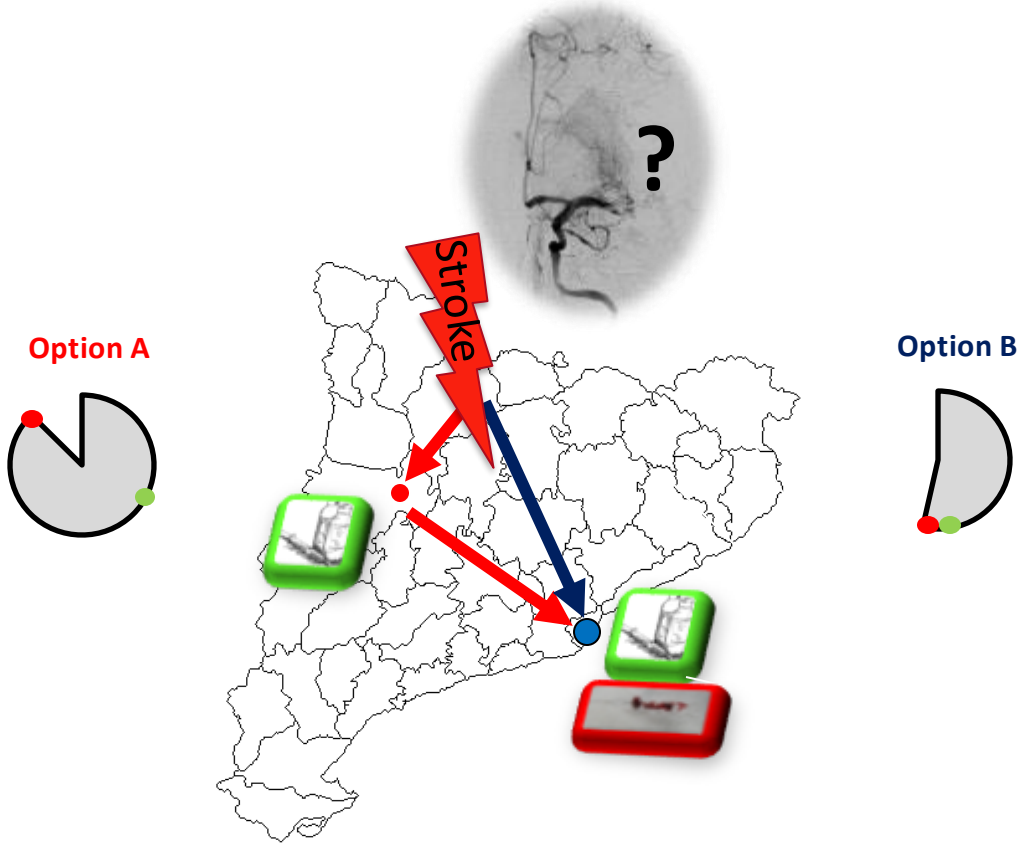




If you can not measure it, you can not improve it.

~ Lord Kelvin

Mothership Vs Drip&Ship



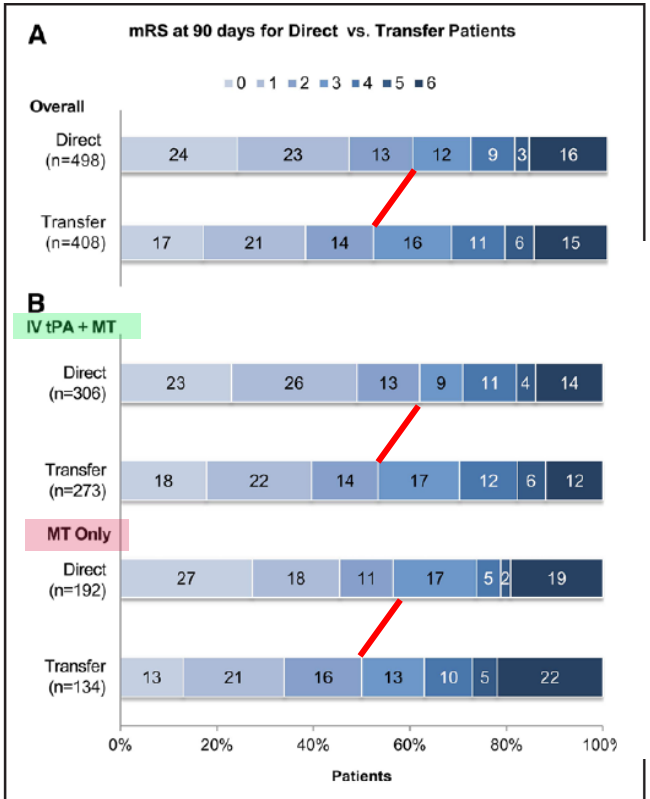
ORIGINAL RESEARCH ARTICLE

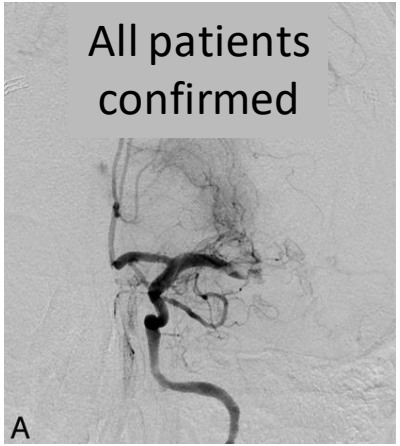
Interhospital Transfer Before Thrombectomy Is Associated With Delayed Treatment and Worse Outcome in the STRATIS Registry (Systematic Evaluation of Patients Treated With Neurothrombectomy Devices for Acute Ischemic Stroke)

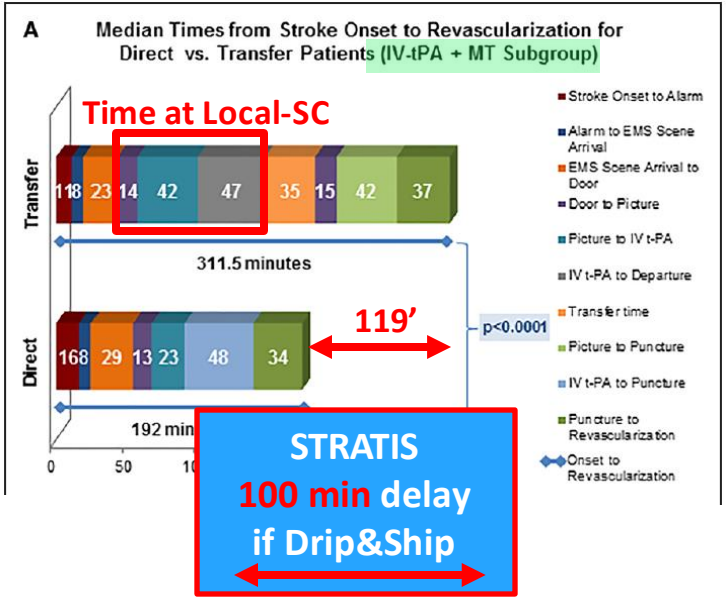
ORIGINAL RESEARCH ARTICLE

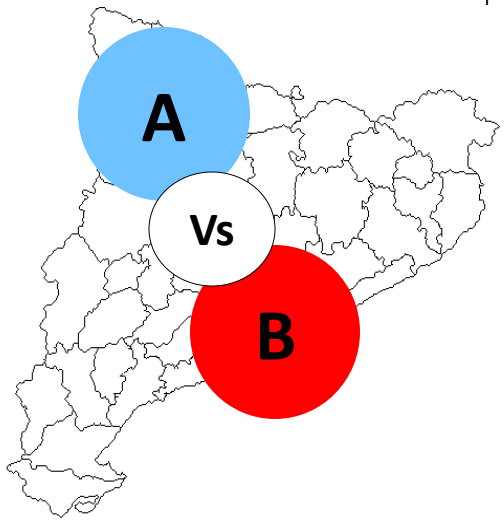
Editorial, see p 2322

Michael T. Froehler, MD, PhD







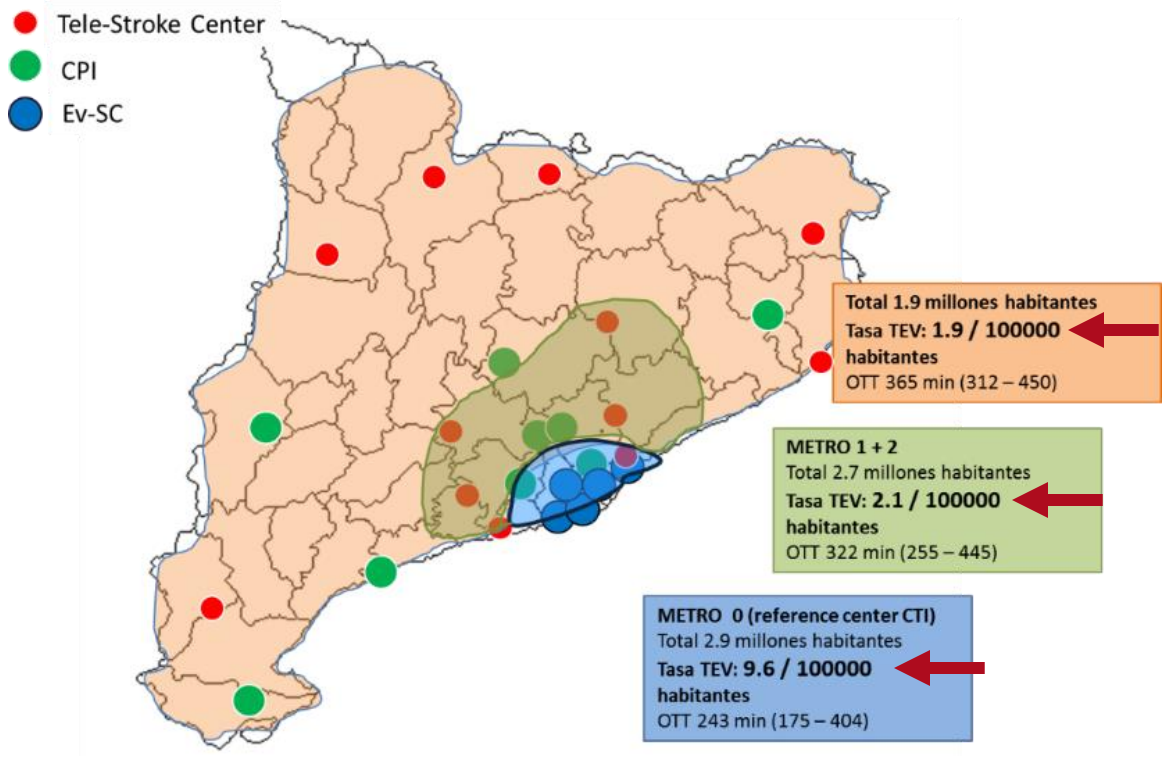


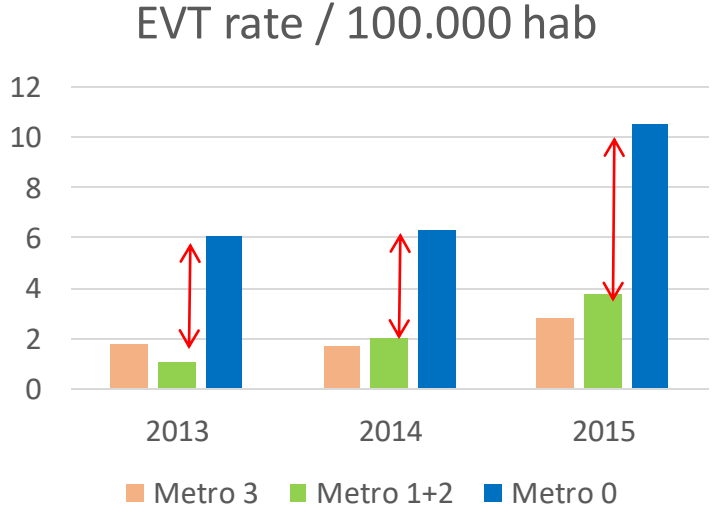
Access to Endovascular Treatment in Remote Areas

Analysis of the Reperfusion Treatment Registry of Catalonia

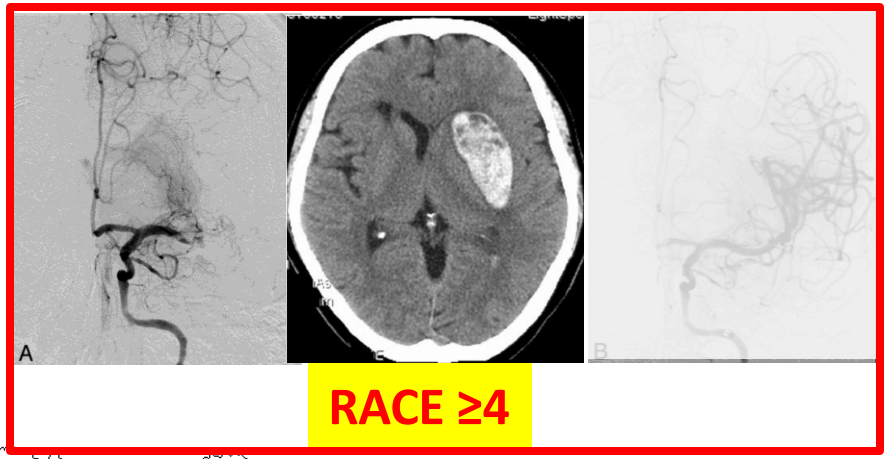
Natalia Pérez de la Ossa, PhD; Sònia Abilleira, PhD; Laura Dorado, PhD; Xabier Urra, PhD; Marc Ribó, PhD; Pere Cardona, PhD; Eva Giralt, MD; Joan Martí-Fàbregas, PhD; Francisco Purroy, PhD; Joaquín Serena, PhD; David Cánovas, MD; Moisés Garcés, MD; Jurek Krupinski, PhD; Anna Pellisé, MD; Júlia Saura, MD; Carlos Molina, PhD; Antoni Dávalos, PhD; Miquel Gallofré, PhD; on behalf of the Catalan Stroke Code

Stroke. 2016;47:1381-1384.

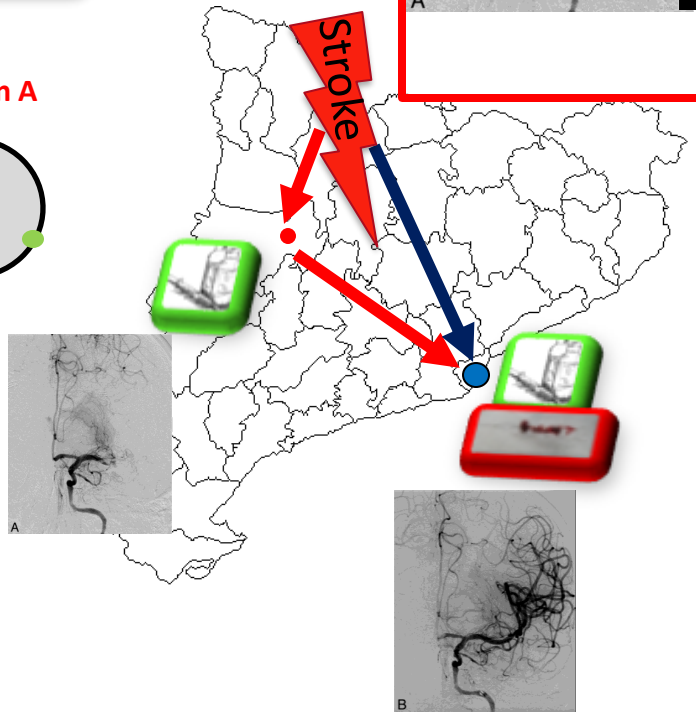




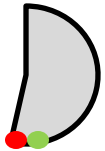
Equipoise



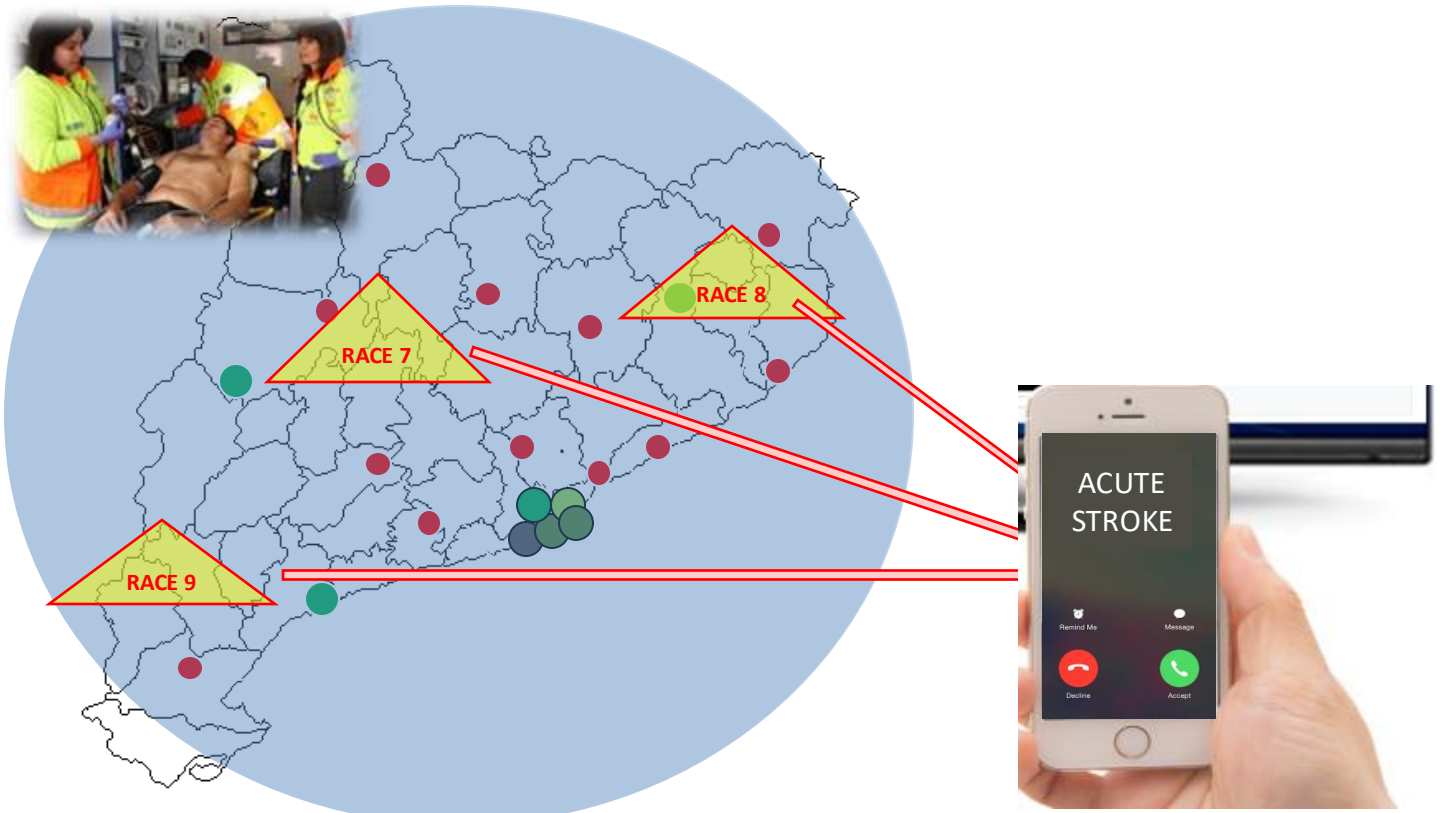
Option A

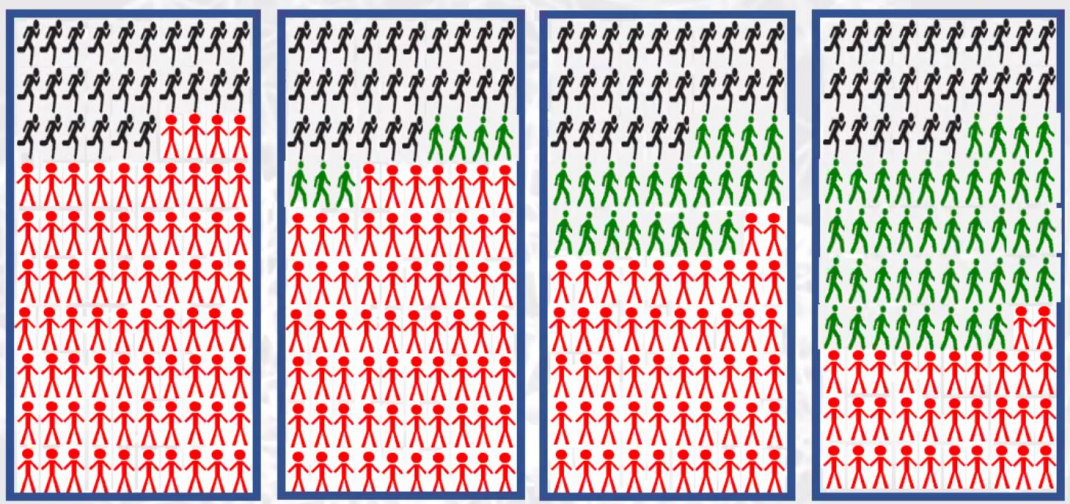


Option B



PREHOSPITAL STROKE SEVERITY SCALES


RACE 8
RACE 7
RACE 9
ACUTE
STROKE
Remind Me
Message
Decline
Accept



*Based on pooled analysis of tPA-RCTs (Lees K et al. Lancet 2010)

#Based on results of pre-and in-hospital tPA in stroke registry (Kunz et al. Circulation 2018)

Houston Mobile Stroke Unit— First in U.S. 2014

- Standard 12 foot ambulance
- Portable CT scanner
- Point-of-care laboratory
- Tele-radiology & neurology
- VN, RN, CT tech, Medic

J. Grotta

Promote preHosp Alert

Useful information to be provided by EMS

- Age / gender / baseline disability status
- Time from onset / onset unknown
- GCS (if altered)
- Prehospital severity scale
- Relevant past medical history
- Anticoagulation / recent surgery / contraindications for tPA
- Blood pressure
- Glycemia

- ESTIMATED TIME OF ARRIVAL

Evaluate / update

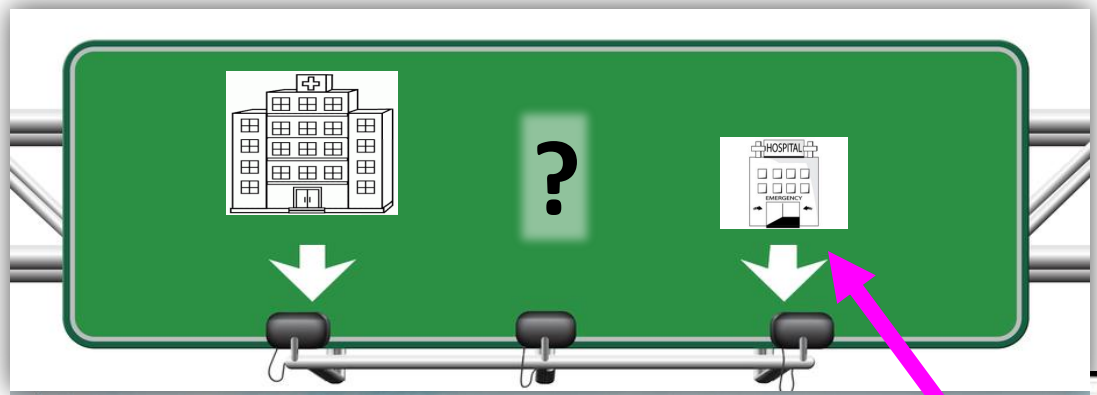
Structured information to receiving team

Transportation means

Specific in-route treatment protocols for stroke

GPS - Apps - chats

Mobile video conference

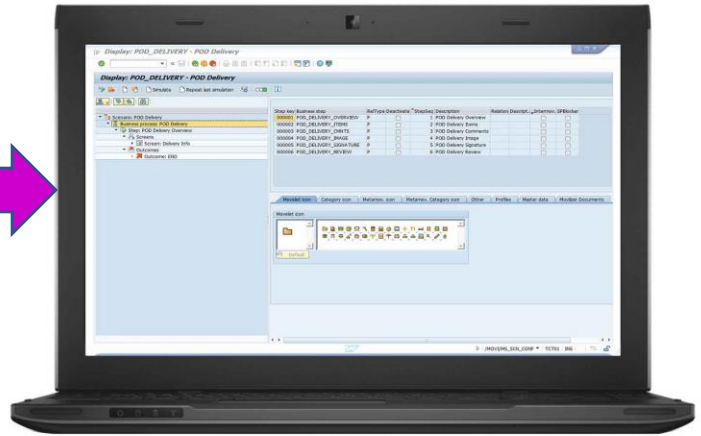

?
HOSPITAL
EMERGENCY


ACUTE
STROKE
Remind Me
Message
Decline
Accept

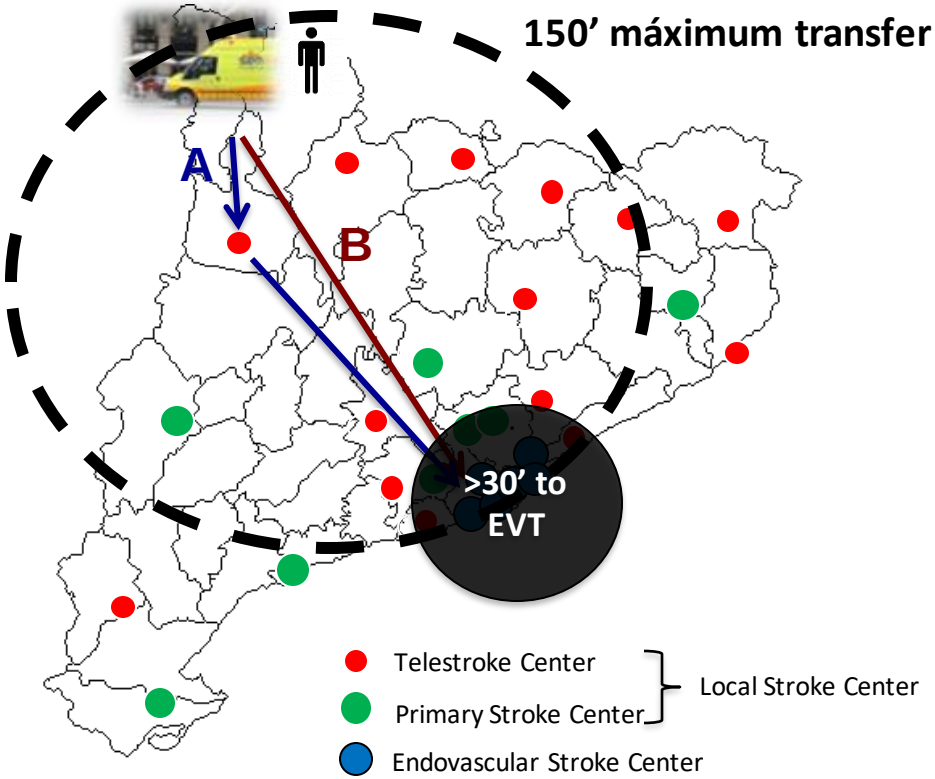

Chats Vall d'Hebron ICTUS
Study Time: 15:16
4 Dec 2020 15:38
Alvarito
87a, afasia aislada en mejoría, hace 1 año idem con estudio normal
4 Dec 2020 16:40
Marta
Bajamos a código angio
Type a message...
ACUTE
STROKE
Remind Me
Message
Decline
Accept
H
Teclado táctil

Pre-admit/register patient before arrival

- Patient registration
- Request necessary procedures in the system before arrival: CT / Blood test …



Network characteristics and aplicability elsewhere



RACECAT

Total sample: 1401 patients
(949 ischemic stroke – target population)
Recruited over 3 years

Results

A

Local-SC Arm (n=713)

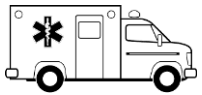
Complications: 31 (4.6%)
Intubation: 2 (0.3%)

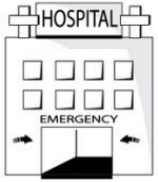
Onset to first center: median 88min (61-145)

<4 hours: 86.3% **(Admitted on time for iv-tPA)**

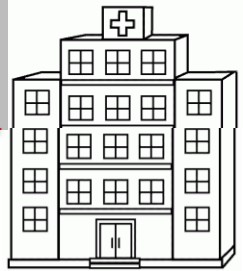
Onset to randomization: 59 min

Stroke





EVT candidates 302/467 ischemic Strokes (64.7%)



DIDO 78 (63-97) min

B

EVT-SC Arm (n=688)

Onset to randomization: 67 min

Onset to first center: median 142 (100-231) min

Complications: 70 (10.4%)
Intubation: 7 (1%)

<4 hours: 76.3% **(Admitted on time for iv-tPA)**

The power of prehospital scales

RACE>4

Diagnostic at first hospital

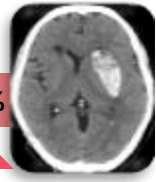
Median NIHSS: 17 (11-21)

All included patients

		Allocated intervention	
		Local-SC	EVT-SC
Initial diagnostic (ITT population)	n	690	679
Ischemic Stroke	n (%)	450 (65.2%)	470 (69.2%)
TIA	n (%)	17 (2.5%)	12 (1.8%)
ICH	n (%)	165 (23.9%)	137 (20.2%)
SAH	n (%)	8 (1.2%)	4 (0.6%)
Mimic	n (%)	50 (7.2%)	56 (8.2%)
Missing	n	0	0

Ischemic Stroke 67.7%

Hemorrhagic Stroke 25.%



All included patients: confirmed LVO+ 46%

All ischemic patients: confirmed LVO+ 67%

Large Vessel Occlusion		Local-SC	EVT-SC
Total	n	467	482
LVO +	**n (%)**	**303 (64.9%)**	**333 (69.1%)**
LVO -	n (%)	116 (24.8%)	137 (28.4%)
Not evaluated	n (%)	48 (10.3%)	12 (2.5%)
Missing	n	0	0

Results. Acces to reperfusión treatments

Proportion of patients receiving iv-tPA or EVT (modified ITT population)

	Allocated intervention		
	Local-SC (n=467)	**EVT-SC (n=482)**	**p value**
Patients receiving iv-tPA	282 (60.4%)	229 (47.5%)	<0.001
Patients receiving EVT	184 (40.9%)	235 (50.0%)	0.003
EVT (EVTp)	57 (12.7%)	113 (24.0%)	
Both (iv-tPA + EVT)	127 (28.2%)	122 (26.0%)	

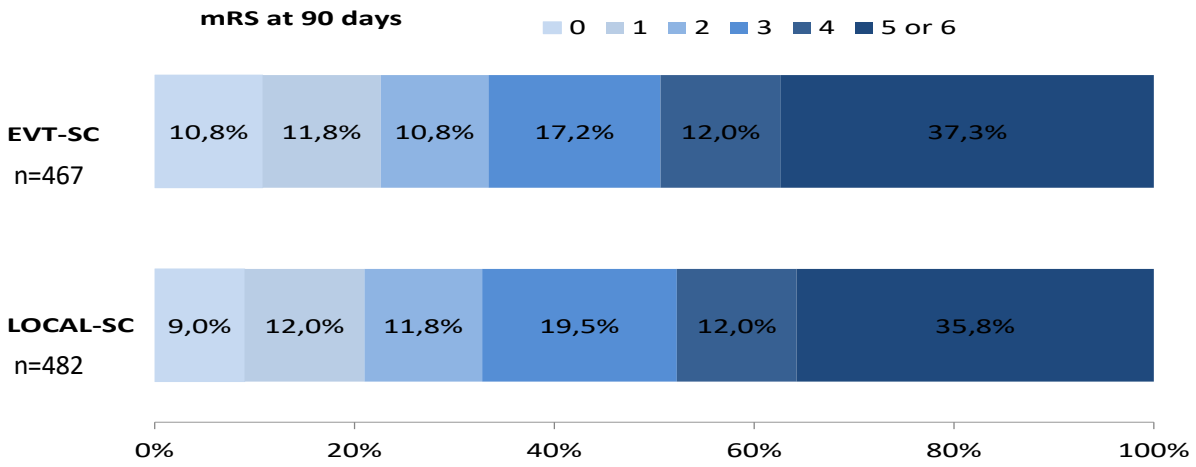
Time from symptom onset to iv-tPA administration and groin puncture (modified ITT population)

	Allocation intervention		
	Local-SC	**EVT-SC**	**p value**
iv-tPA (alone or followed by EVT)	n=282	n=229	
Time from symptom onset to iv-tPA (min)*	120 (89, 168)	155 (120, 195)	<0.001
Door to needle (min)*	33 (25, 48)	30 (22, 40)	NS
EVT (with or without previous iv-tPA)	n=184	n=235	
Time from symptom onset to groin puncture (min)*	270 (215, 347.5)	214 (172, 230)	<0.001
Door to groin (min)*	43.0 (32.0, 59.0)	71.5 (49.5, 97.5)	<0.001

*median (Q1,Q3)

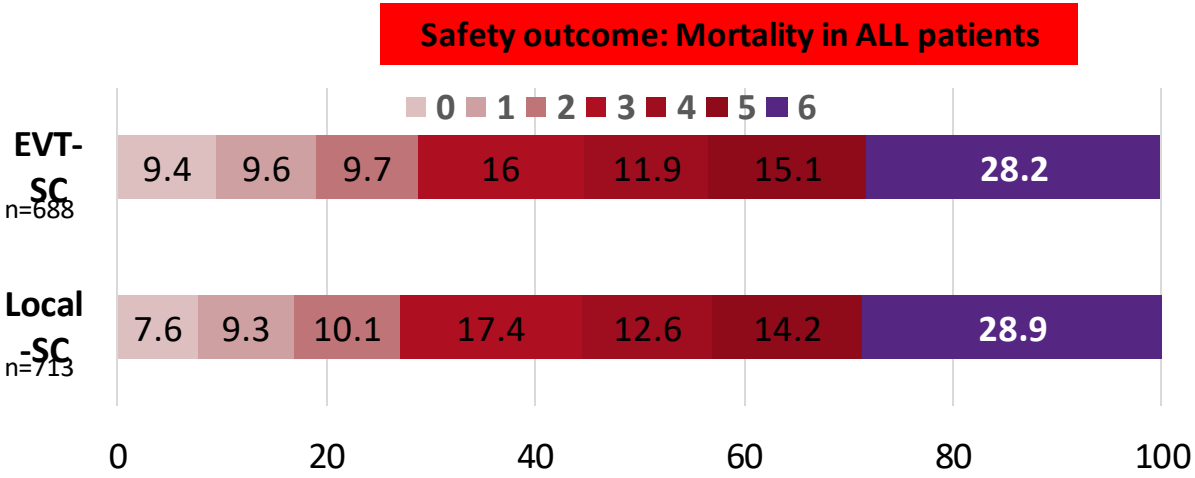
Results: Outcome. Effect on disability.

Primary efficacy outcome: mRS at 90 days in the mITT (ischemic stroke patients)



	OR (EVT vs. Local)	IC95%
Odds ratio[1] adjusted	**1.029**	0.818, 1.295
Odds ratio unadjusted	**0.990**	0.789, 1.243

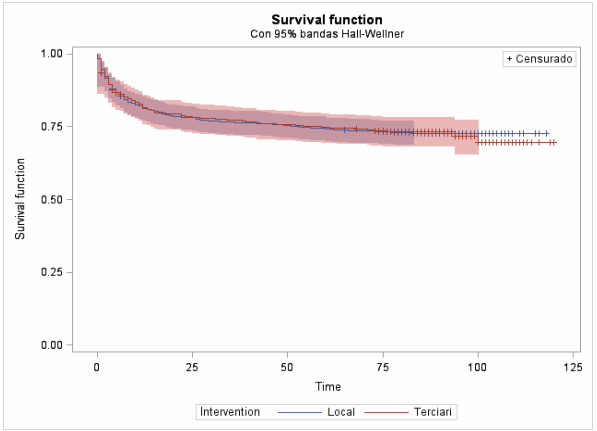
Results: Outcome. Safety



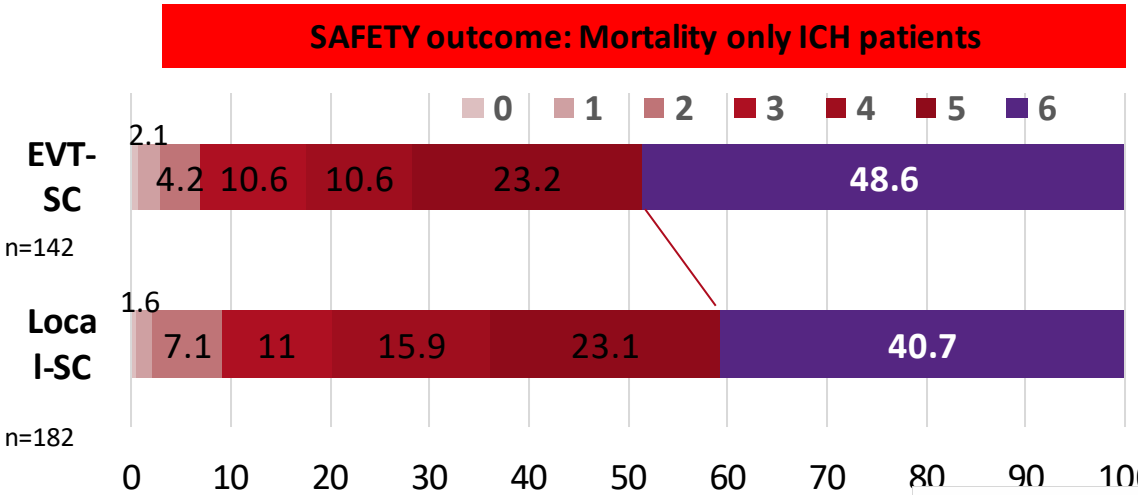
	Hazard Ratio (EVT vs. Local)	IC 95%
Adjusted[1] Hazard Ratio	**0.965**	0.787 - 1.183
Hazard Ratio	**0.995**	0.812 - 1.220

Death at 90 days (all patients)

[1] Adjusted for stratified factors, age and RACE



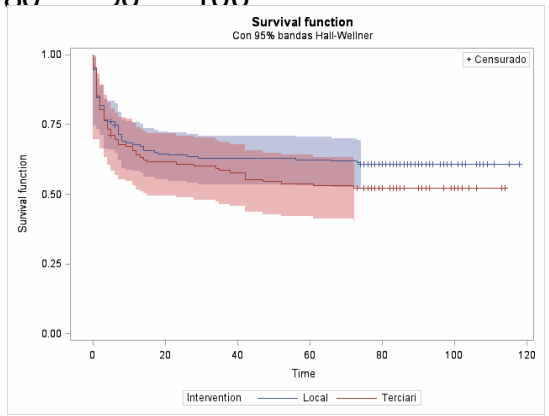
Results: Outcome. ICH Safety concerns



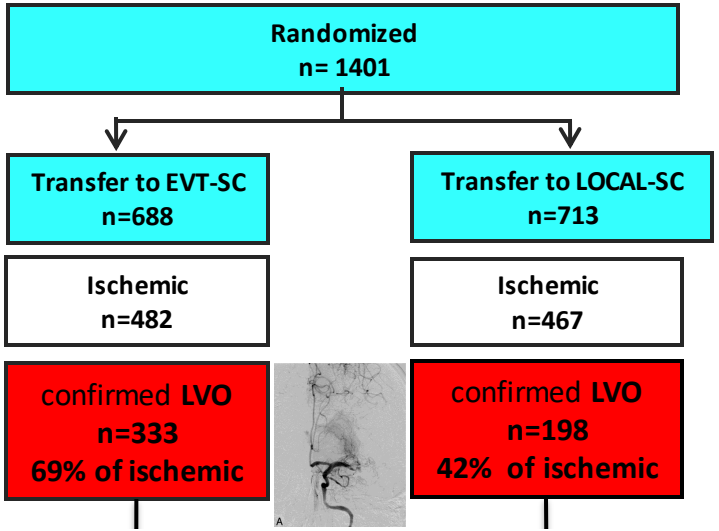
	Hazard Ratio (EVT vs. Local)	IC 95%
Adjusted[1] Hazard Ratio	**1.216**	0.864 - 1.709
Hazard Ratio	**1.301**	0.929 - 1.820

Death at 90 days (hemorrhagic stroke patients)

[1] Adjusted for stratified factors, age and RACE



The power of iv.tPA

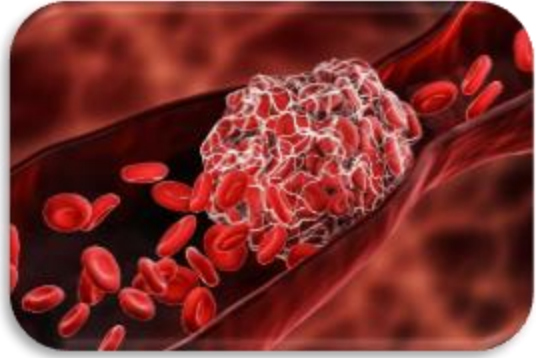


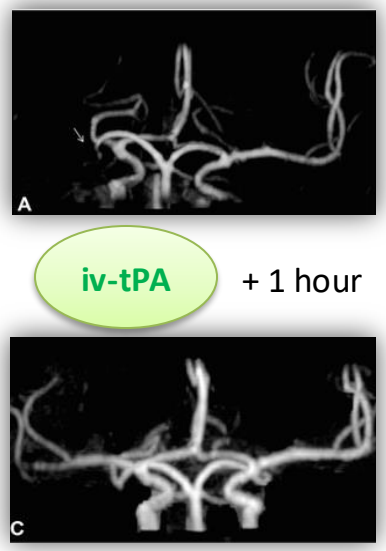
Perez de la Ossa
ISC 2021

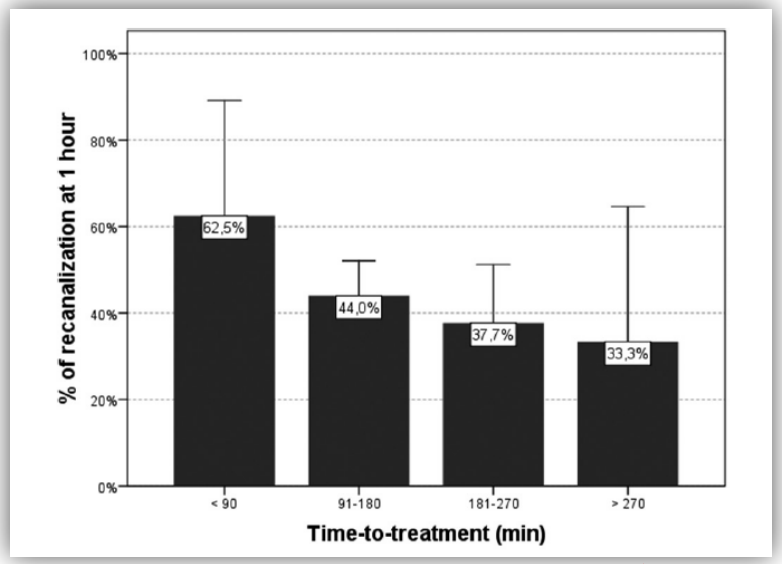
Impact of Time to Treatment on Tissue-Type Plasminogen Activator–Induced Recanalization in Acute Ischemic Stroke

Marian Muchada, MD; David Rodriguez-Luna, MD, PhD; Jorge Pagola, MD, PhD; Alan Flores, MD; Estela Sanjuan, RN; Pilar Meler, RN; Sandra Boned, MD; Jose Alvarez-Sabin, MD, PhD; Marc Ribo, MD, PhD; Carlos A. Molina, MD, PhD; Marta Rubiera, MD, PhD

Stroke. 2014;45:2734-2738.



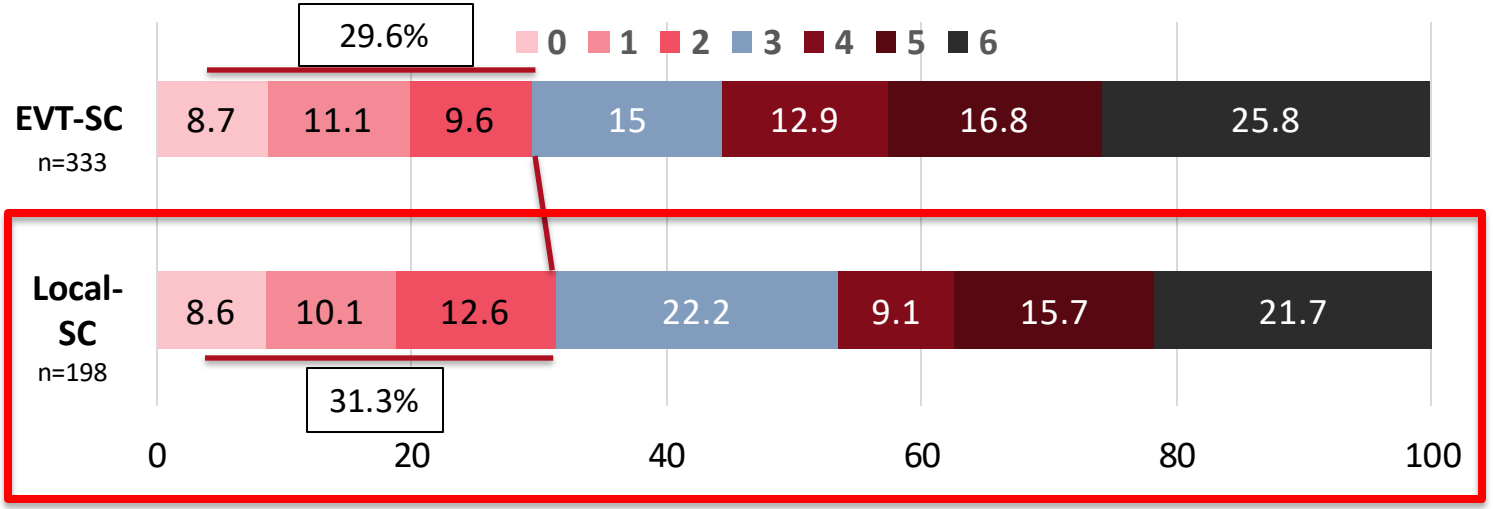




Confirmed LVO patients

RACECAT

Patients with confirmed LVO at the 1rst center



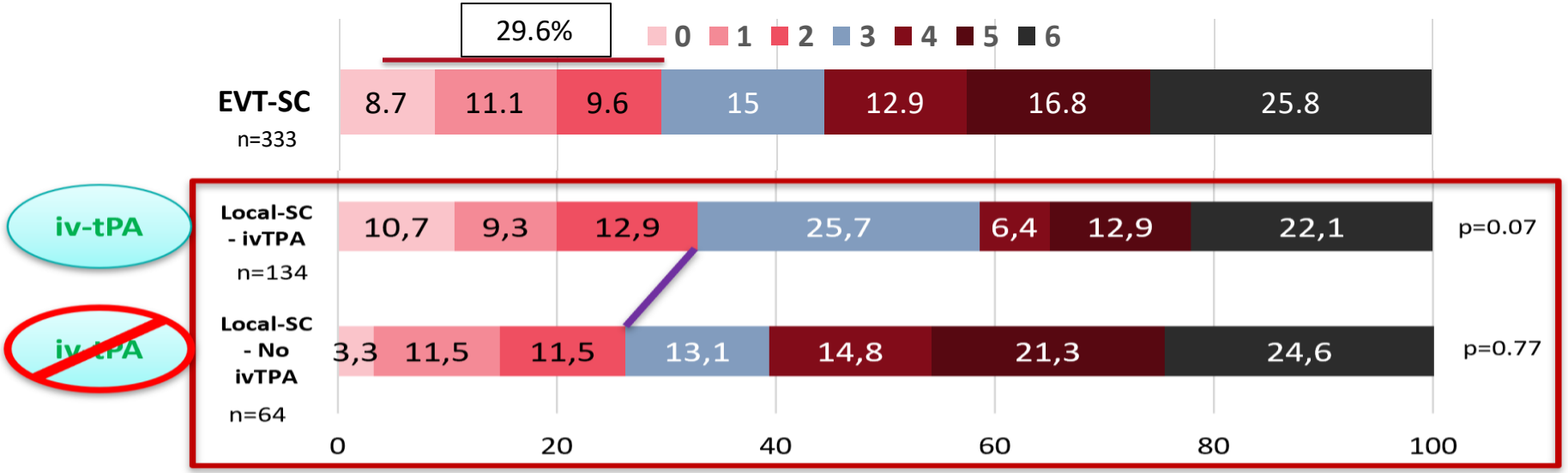
Adjusted OR 1.225 (IC 95% 0.887 - 1.690)

Adjusted for stratified factors, age and RACE

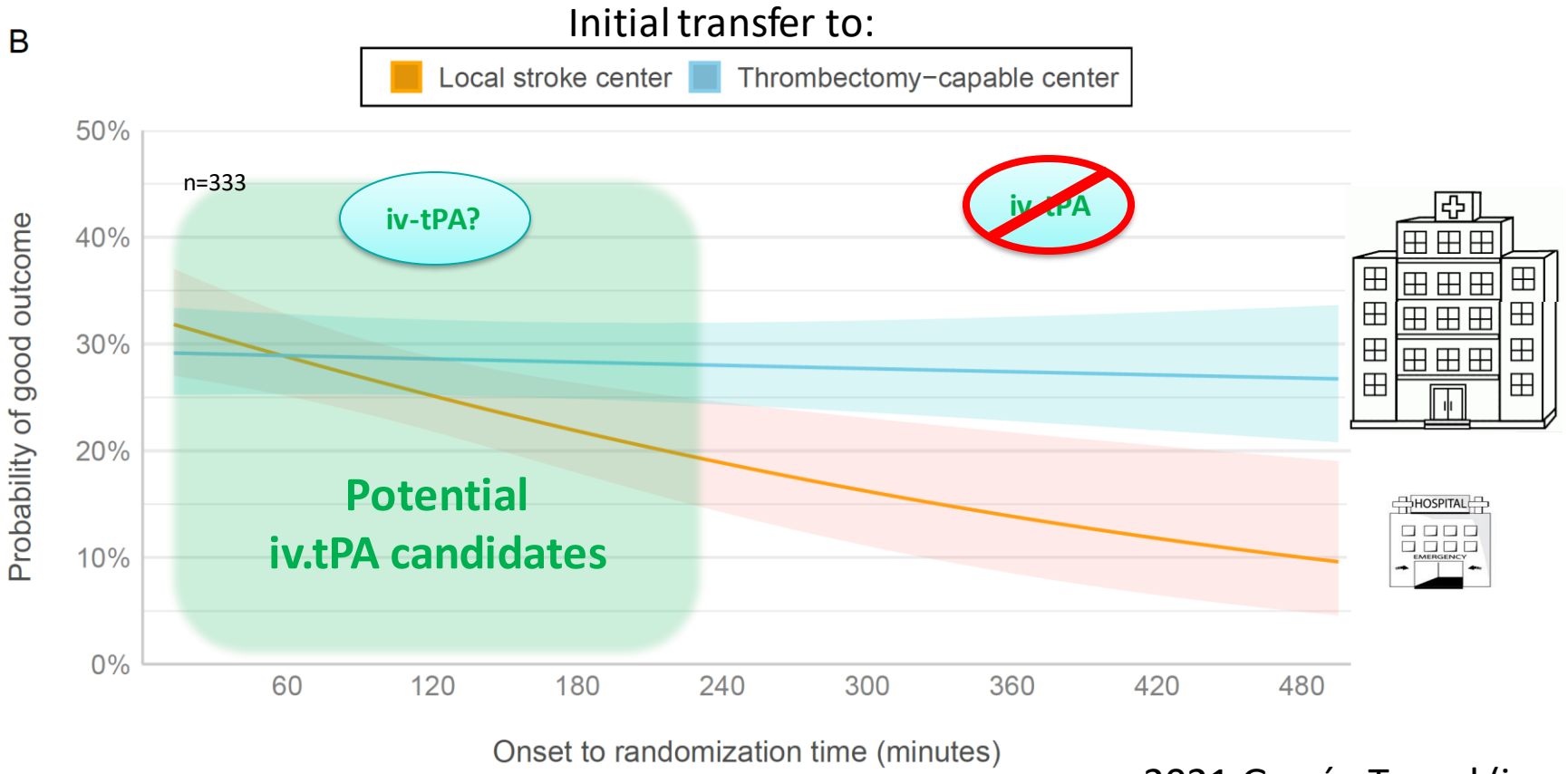
Confirmed LVO patients

RACECAT

Patients with confirmed LVO at the 1rst center



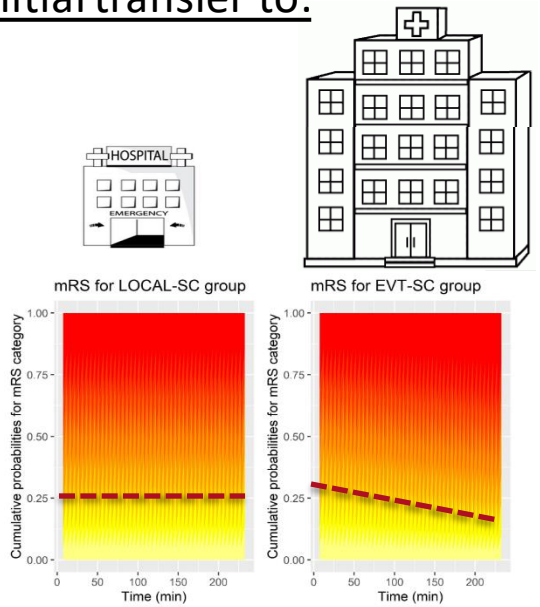
Influence of time on initial transfer decision

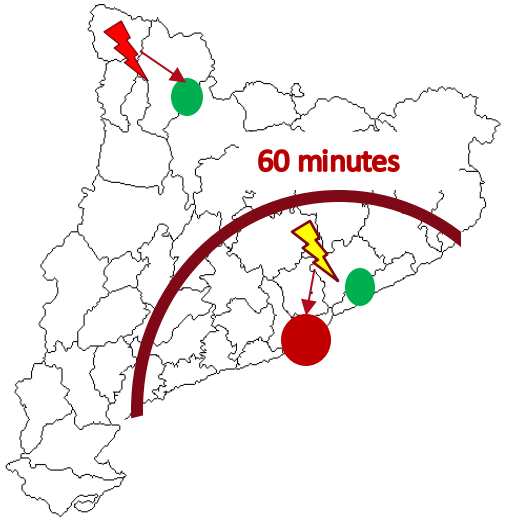


2021 García-Tornel (in-press)

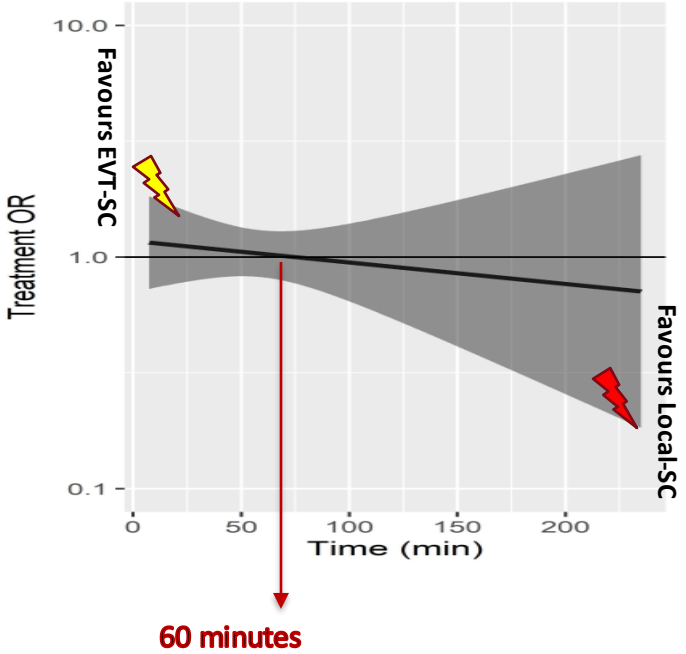
Impact of Initial relative Transfer time

Initial transfer to:





Odds ratio according to Transfer time to EVT from initial location

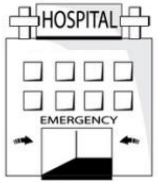


Estimated Transfer time to EVT from initial location

Adjusted by age and RACE scale

Influence of efficient multilevel coordination

STRATIS
100’



DIDO
78 (63-97) min

Patients treated with EVT

	Transfer to Local-SC n=184	Direct transfer to EVT-SC n=235
NIHSS baseline	19 (15, 21)	18 (14, 21)
TICI 2b-3	83.2%	85.9%
Transfer time to 1rst center	21 (13, 32)	61 (35, 86)
Door to needle (iv-tPA)	33 (25, 48)	30 (22, 40)
DIDO	78 (63, 97)	NA
Door to EVT access	43 (32, 59)	71 (49, 97)
Onset to EVT access	**270 (215, 347)**	**214 (172, 230)**

Time in minutes: median (IQR)

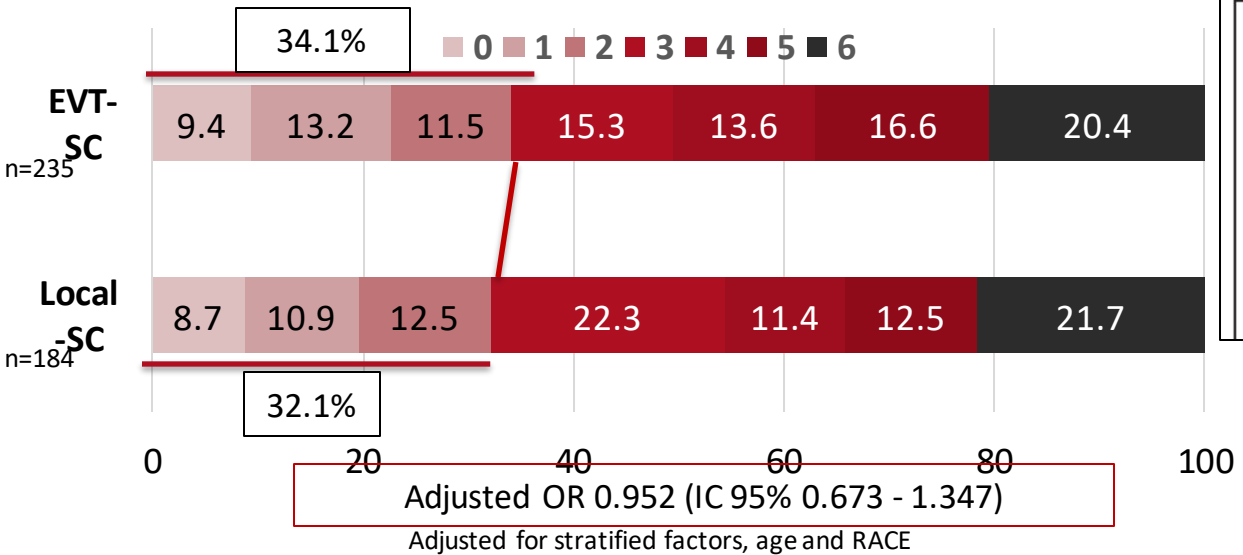
RACECAT
56’

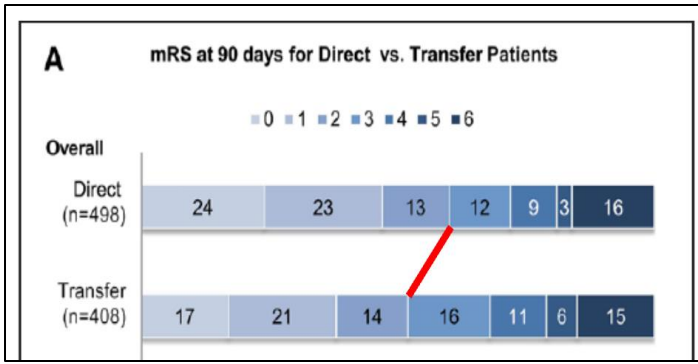
Influence of efficient multilevel coordination

Patients treated with EVT

RACECAT
56’

STRATIS
100’

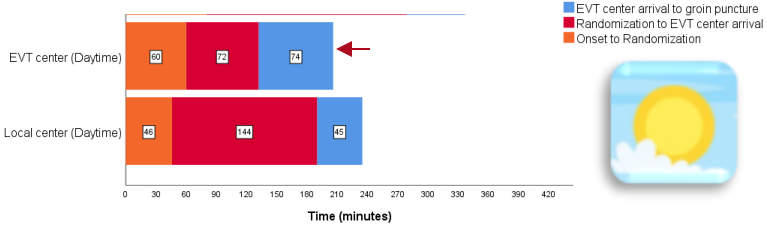




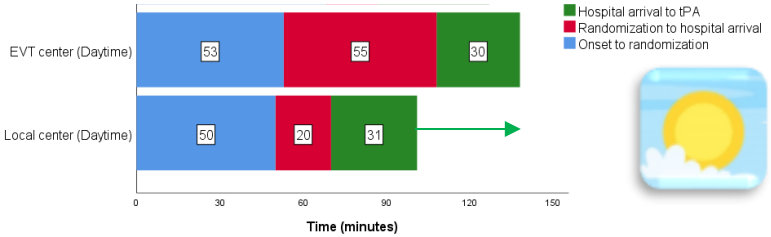
Efficient coordination: impact of Day / Night

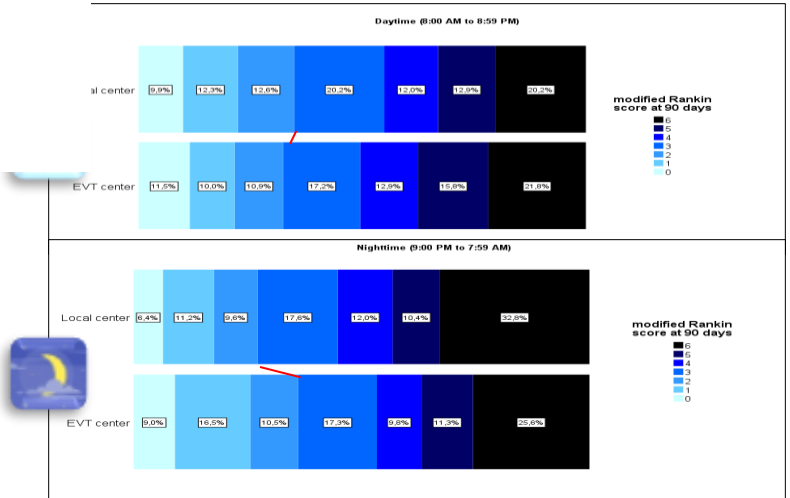
García-Tornel ESOC 2021

EVT



iv-tPA

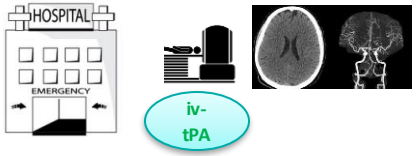




JAMA Neurology | Original Investigation

Association of a Primary Stroke Center Protocol for Suspected Stroke by Large-Vessel Occlusion With Efficiency of Care and Patient Outcomes

Ryan A. McTaggart, MD; Shadi Yaghi, MD; Shawna M. Cutting, MD, MS; Morgan Hemendinger; Grayson L. Baird, PhD; Richard A. Haas, MD; Karen L. Furie, MD, MPH; Mahesh V. Jayaraman, MD



JAMA Neurology | Original Investigation

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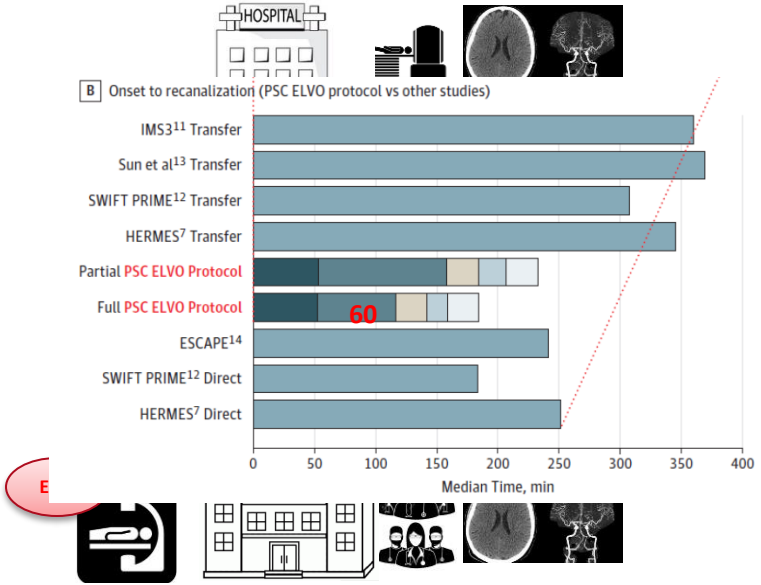


Original research

Gaynor E, *et al*. *J NeuroIntervent Surg* 2021;**0**:1–5.

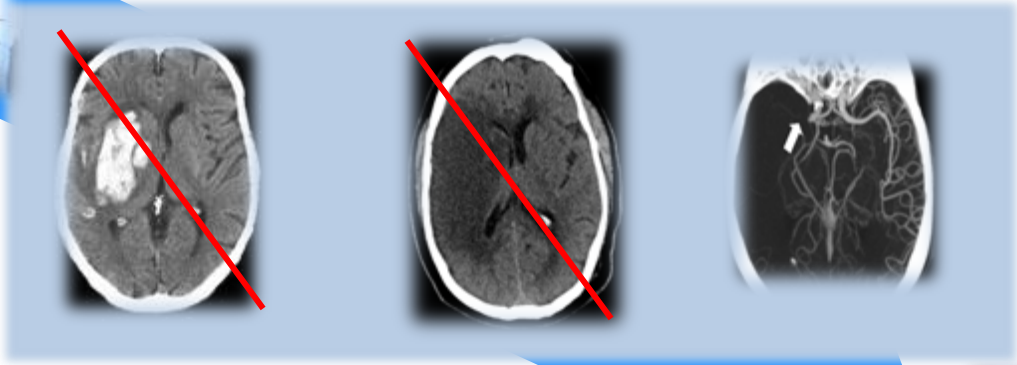
Ambulance waiting and associated work flow improvement strategies: a pilot study to improve door-in-door-out time for thrombectomy patients in a primary stroke center

Eva Gaynor,[1] Emma Griffin,[2,3] John Thornton,[2] Jack Alderson,[2] Mary Martin,[4] Anne O'Driscoll,[4] Patricia Daly,[4] Cathal O'Donnell,[5] Ronan Conroy,[6] Paul O'Brien[4]

Table 2 Comparison of pre-trial and trial periods for thrombectomy patients

	DIDO (min)			
	N	25%	50% (median)	75%
Pre-trial	19	77	96	133
Trial	27	39	45	57
			p<0·0001	

DOOR TO PUNCTURE TIME



Research

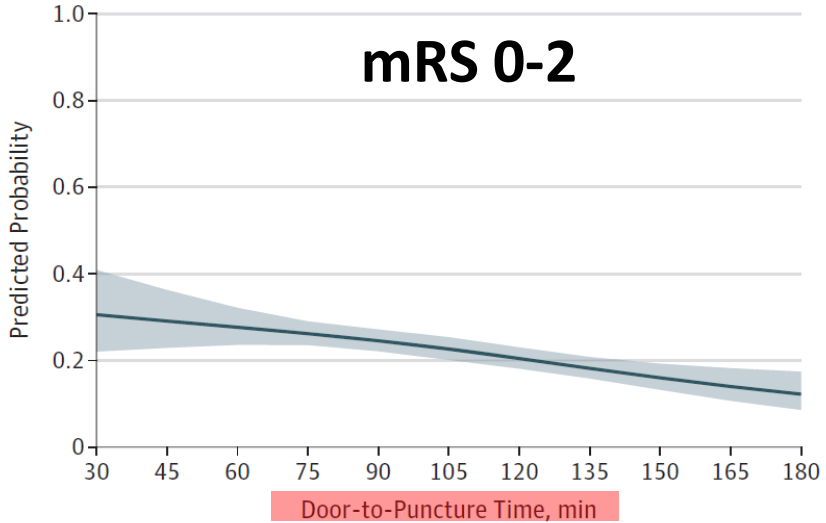
JAMA. 2019;322(3):252-263. doi:10.1001/jama.2019.8286

JAMA | Original Investigation

Association Between Time to Treatment With Endovascular Reperfusion Therapy and Outcomes in Patients With Acute Ischemic Stroke Treated in Clinical Practice

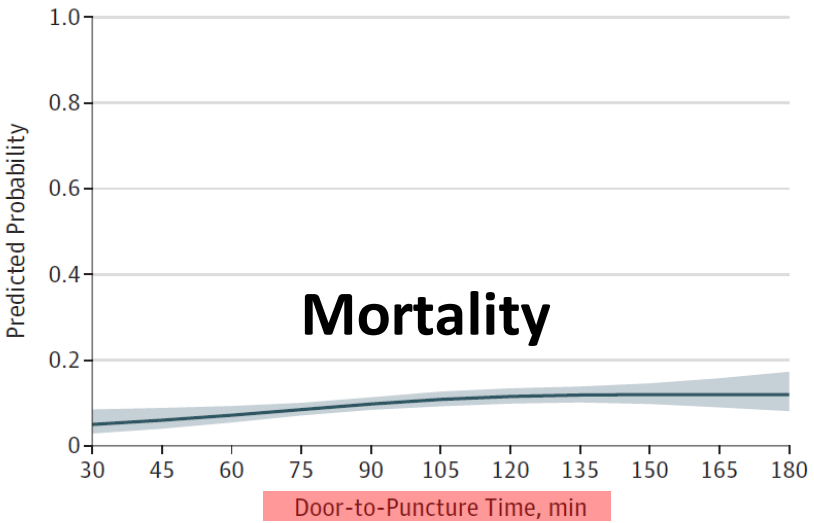
Reza Jahan, MD; Jeffrey L. Saver, MD; Lee H. Schwamm, MD; Gregg C. Fonarow, MD; Li Liang, PhD; Roland A. Matsouaka, PhD; Ying Xian, MD; DaJuanicia N. Holmes, MS; Eric D. Peterson, MD; Dileep Yavagal, MD; Eric E. Smith, MD, MPH

C Discharge (modified Rankin Scale [mRS], 0-2) by time from emergency department arrival to arterial puncture



No. of events	1	19	64	117	125	80	68	48	35	21	7
No. of patients	11	85	229	400	401	379	323	253	171	107	42

E Mortality by time from emergency department arrival to arterial puncture



No. of events	1	11	23	45	64	59	63	44	29	18	10
No. of patients	17	123	283	498	505	467	413	316	227	143	59

Research

JAMA. 2019;322(3):252-263. doi:10.1001/jama.2019

JAMA | Original Investigation

Association Between Time to Treatment With Endovascular Reperfusion Therapy and Outcomes in Patients With Acute Ischemic Stroke Treated in Clinical Practice

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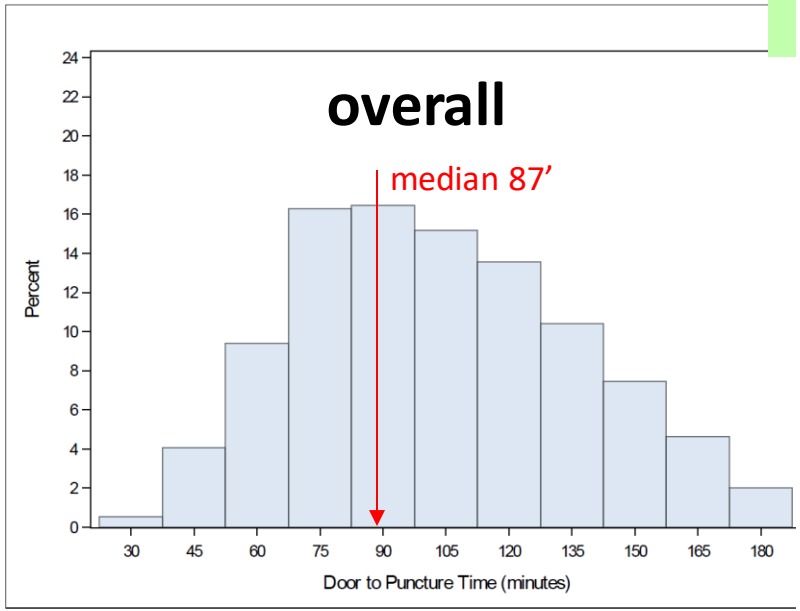
6756 patients

Median **ons**
Median **do**

B



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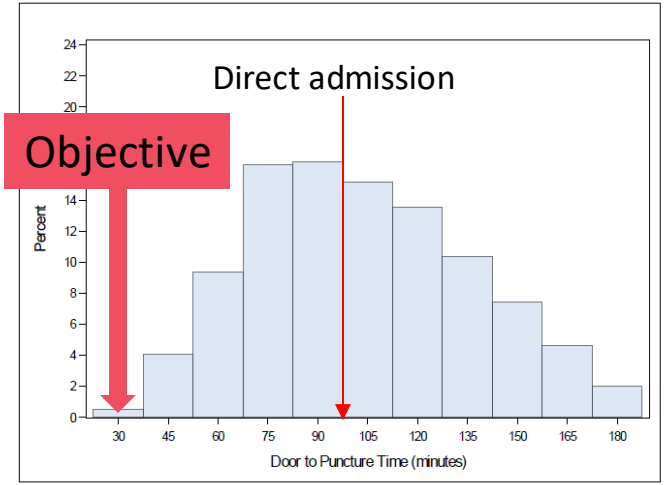

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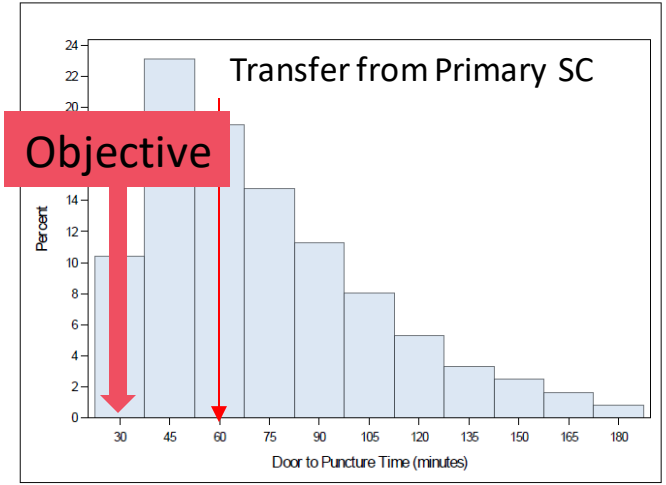
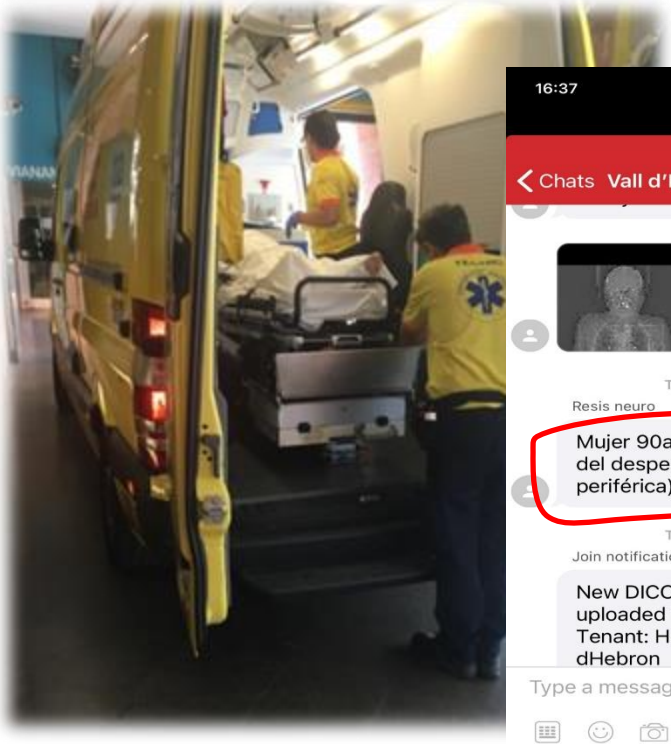
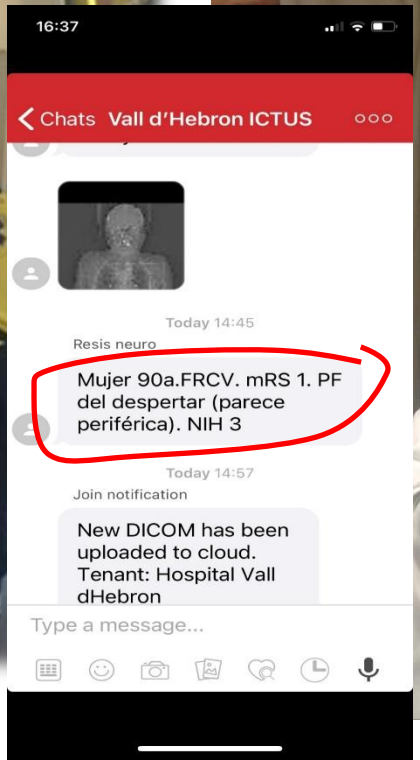
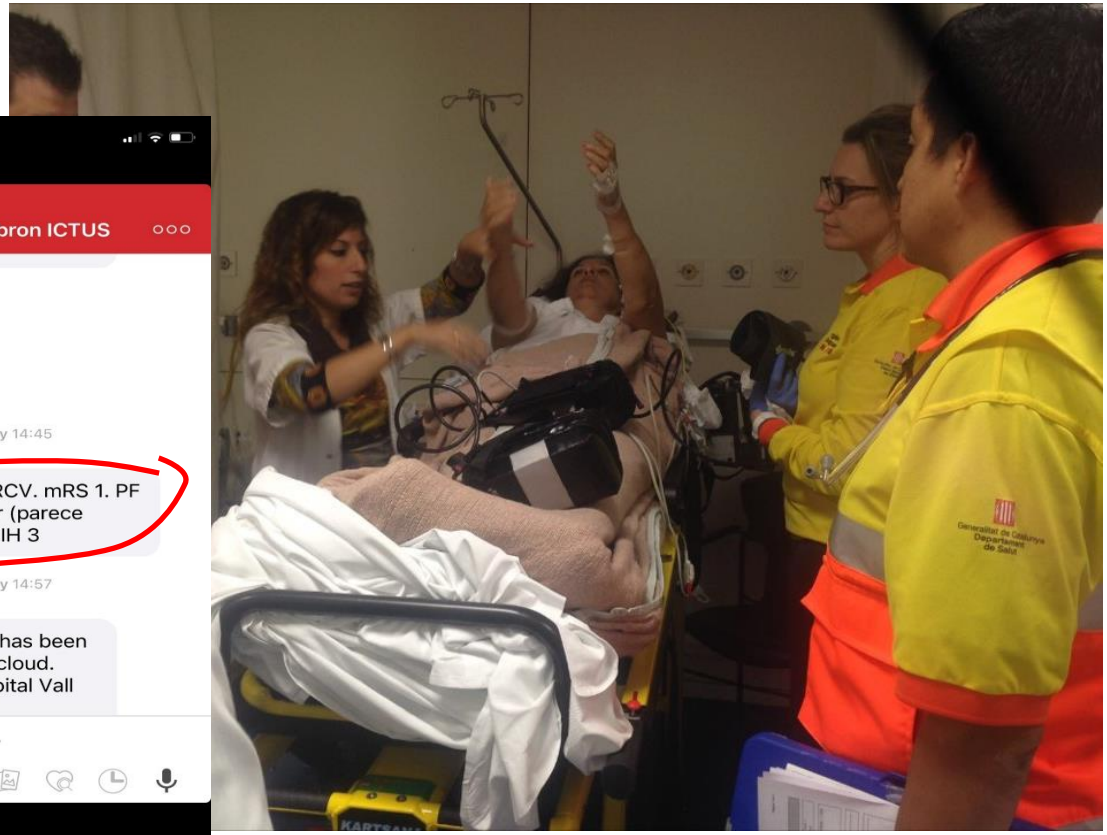


SCREENING on Arrival: NIHSS + neuro assessment







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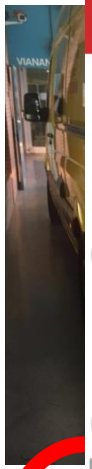

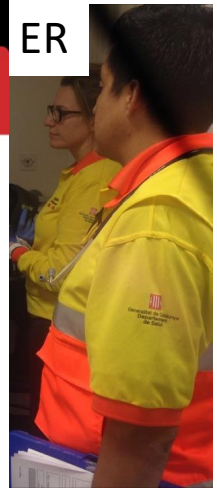

Chats Vall d'Hebron ICTU

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Patient Id: ****1850
Type: CT
Region: HEAD
Study Date: 2020/12/3
Study Time: 14:23

31 Dec 2020 14:43

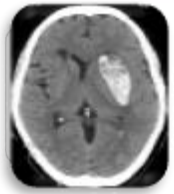
Bolus 14:42

31 Dec 2020 18:53

Type a message...

Chats Vall d'Hebron ICTUS

New DICOM has been uploaded to cloud.
Tenant: Hospital Vall dHebron
Patient Id: ****5584
Type: CT
Region: HEAD
Study Date: 2020/12/08
Study Time: 11:36



8 Dec 2020 11:47

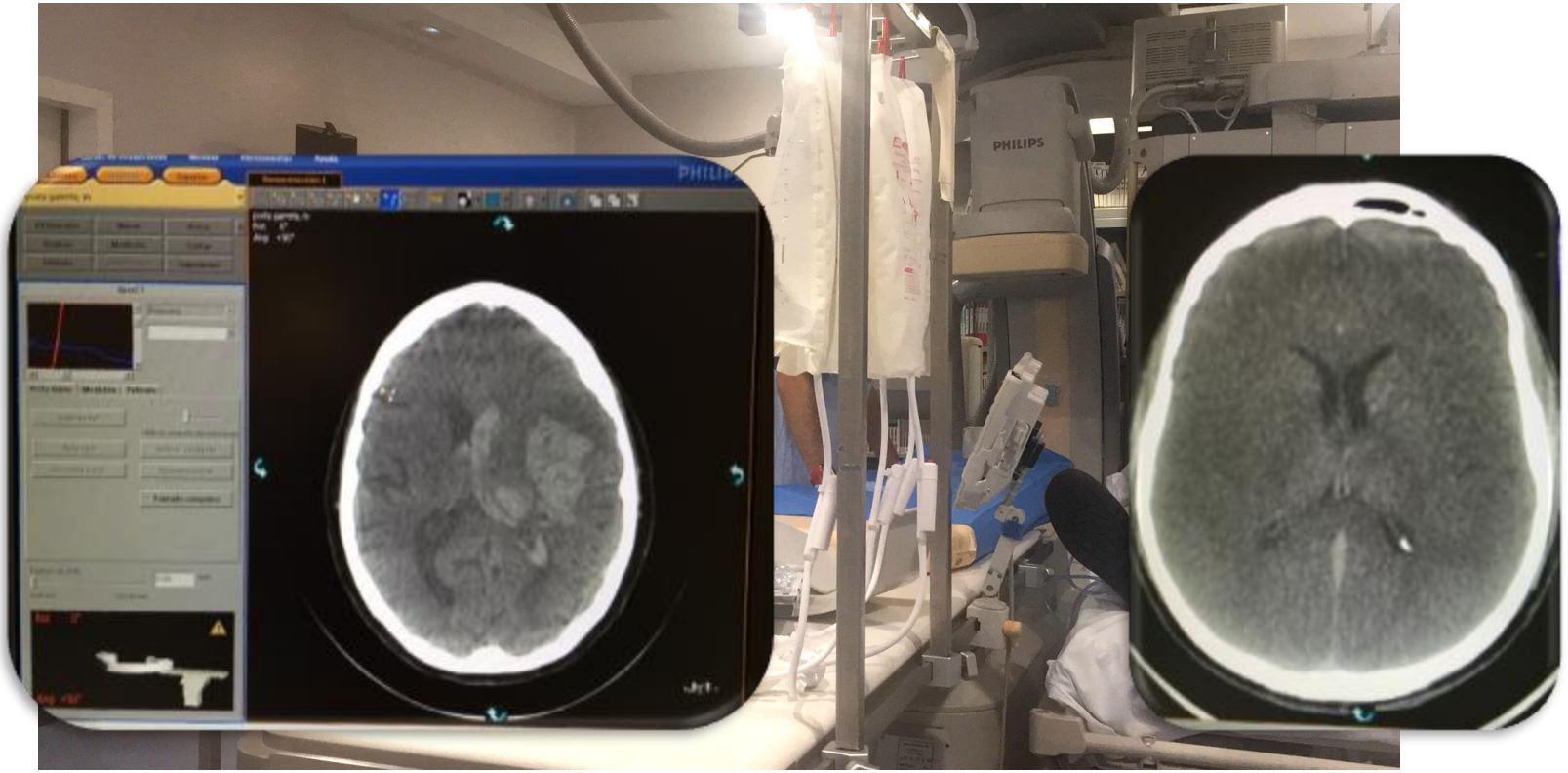
Suso

Urapidil 11:45 inicio

Type a message...

iv-tPA bolus in CT

DIRECT TRANSFER TO ANGIO-SUITE



0 1 2 3 4 5 min

JAMA Neurology | Original Investigation

JAMA Neurology Published online June 14, 2021

Direct to Angiography vs Repeated Imaging Approaches in Transferred Patients Undergoing Endovascular Thrombectomy

Amrou Sarraj, MD; Nitin Goyal, MD; Michael Chen, MD; James C. Grotta, MD; Spiros Blackburn, MD; Manuel Requena, MD; Haris Kamal, MD; Michael G. Abraham, MD; Lucas Elijovich, MD; Mark Dannenbaum, MD; Osman Mir, MD; Wondwossen G. Tekle, MD; Deep Pujara, MBBS, MPH; Faris Shaker, MBChB; Chunyan Cai, PhD; Laith Maali, MD; Yazan Radaideh, MD; Sujan Teegala Reddy, MD; Kaushik Niranjan Parsha, MD; Bader Alenzi, MD; Mohammad Ammar Abdulrazzak, MD; Jonathan Greco, DO; Daniel Hoit, MD; Sheryl B. Martin-Schild, MD; Sarah Song, MD, MPH; Clark Sitton, MD; Georgios K. Tsivgoulis, MD; Andrei V. Alexandrov, MD; Adam S. Arthur, MD, MPH; Arthur L. Day, MD; Ameer E. Hassan, DO; Marc Ribo, MD

Figure 1. Distribution of the 90-Day Modified Rankin Scale Score (mRS) in the Different Treatment Approach Groups at the Endovascular Thrombectomy (EVT) Center

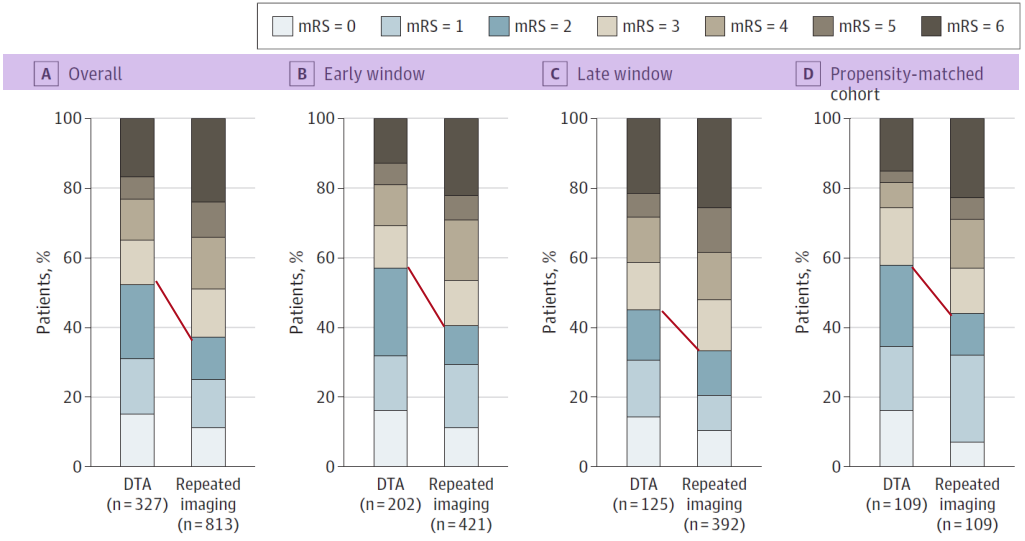
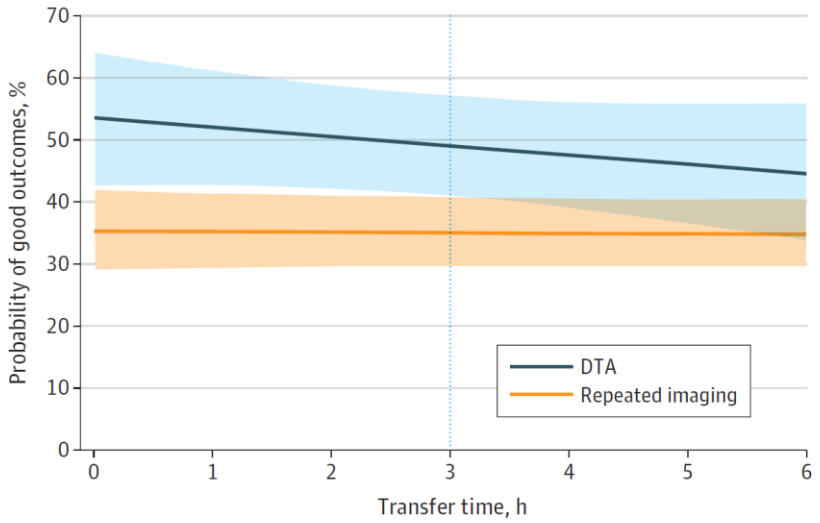


Figure 2. Probability of 3-Month Functional Independence After Endovascular Thrombectomy



JAMA Neurology | Original Investigation

Direct to Angiography Suite Without Stopping for Computed Tomography Imaging for Patients With Acute Stroke

A Randomized Clinical Trial

Manuel Requena, PhD; Marta Olivé-Gadea, MD; Marian Muchada, PhD; David Hernández, MD; Marta Rubiera, PhD; Sandra Boned, PhD; Carlos Piñana, MD; Matías Deck, MD; Álvaro García-Tornel, MD; Humberto Díaz-Silva, MD; Noelia Rodriguez-Villatoro, PhD; Jesús Juega, MD; David Rodriguez-Luna, PhD; Jorge Pagola, PhD; Carlos Molina, PhD; Alejandro Tomasello, MD; Marc Ribo, MD, PhD

Table 3. Workflow and Procedural Characteristics of the Modified Intention-to-Treat Population[a]

Characteristic	Patients, No. (%) DTAS (n = 74)	DTCT (n = 73)	*P* value
Patients receiving EVT			
Door-to-puncture time, median (IQR), min	18 (15-24)	42 (35-51)	<.001
No. of passes, median (IQR)	2 (1-3)	2 (1-3)	.22
Onset-to-reperfusion time, mean (SD), min	290.5 (141.7)	326.9 (122.2)	.32
Door-to-reperfusion time, median (IQR), min	57 (43-77)	84 (63-117)	<.001

JAMA Neurology

RCT: Direct to Angiography Suite Without Stopping for Computed Tomography Imaging in Acute Stroke

POPULATION

96 Men, 78 Women

Adults with suspected large vessel occlusion (LVO) stroke within 6 h of symptom onset

Mean age, 73.4 y (range, 19-95 y)

INTERVENTION

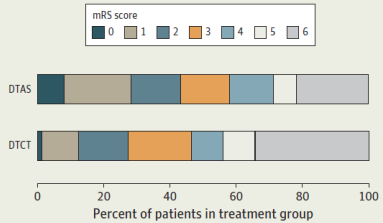
147 Patients randomized and analyzed

74 Direct transfer to angiography suite (DTAS)
Direct transfer to angiography suite for diagnosis of LVO using flat-panel computed tomography (CT) and angiogram

73 Direct transfer to CT scan (DTCT)
Direct transfer to CT scan for usual imaging protocols, including CT and CT angiography

FINDINGS

DTAS significantly improved functional independence for adults with acute ischemic stroke compared with DTCT for usual imaging protocols



Adjusted odds ratio for 1-point improvement of mRS score:
2.2 (95% CI, 1.22-4.08)

SETTINGS / LOCATIONS

1 Stroke center in Barcelona, Spain

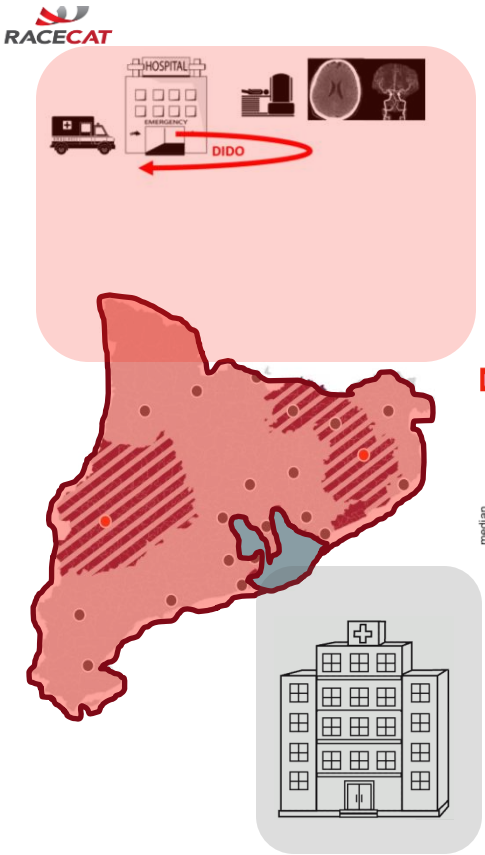
PRIMARY OUTCOME

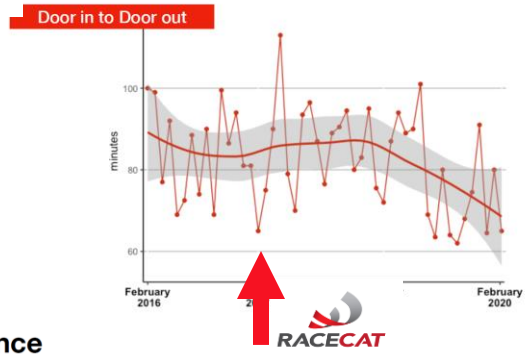
Functional independence, as measured by distribution of the 7-category modified Rankin Scale (mRS) score (range, 0 [no symptoms] to 6 [death]) at 90 d after stroke in patients with confirmed LVO

Requena M, Olivé-Gadea M, Muchada M, et al. Direct to angiography suite without stopping for computed tomography imaging for patients with acute stroke: a randomized clinical trial. *JAMA Neurol*. Published online August 2, 2021. doi:10.1001/jamaneurol.2021.2385

Impact of collective motivation on a populational level

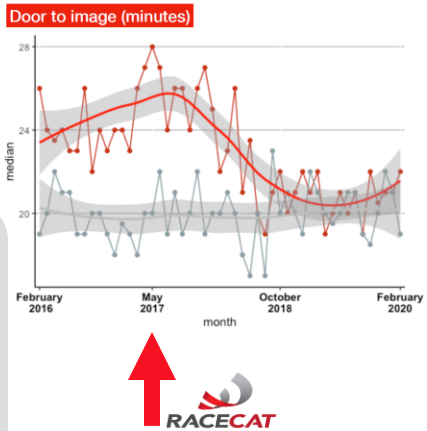
Key Performance Indicators in Catalan Centers 2016-2020

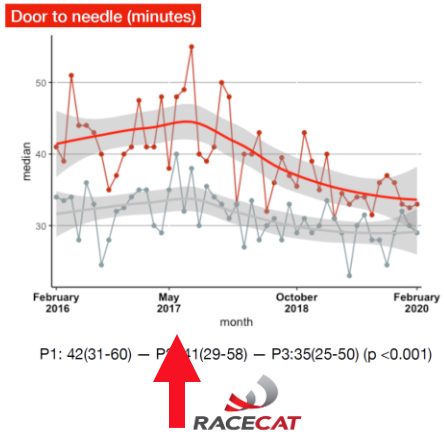




RESULTS

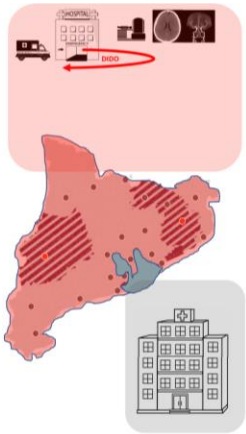
LSC performance





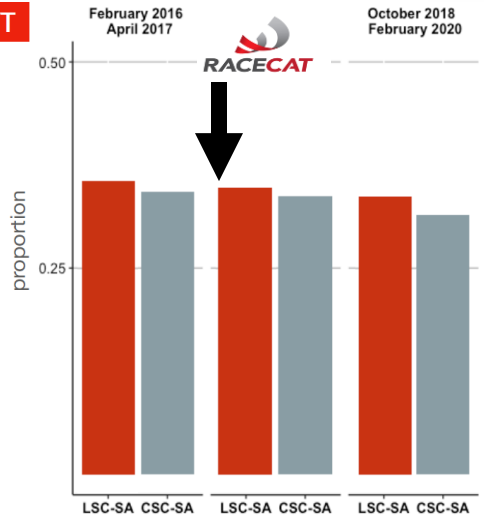
Olivé-Gadea, 2021. in press

Impact of collective motivation on a populational level



iv-tPA

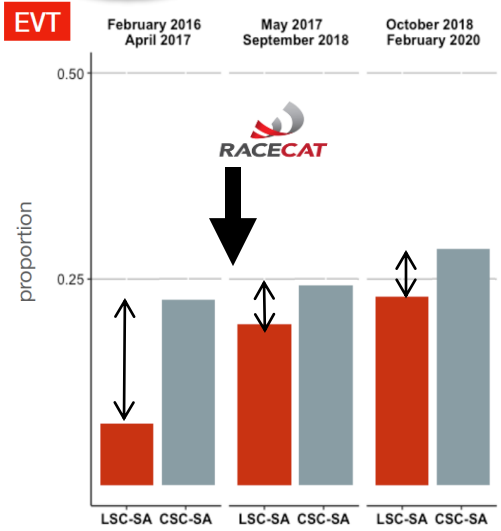
IVT



P1: 33.9% – P2: 34.5% – P3: 33.7% (p =0.84)

EVT

EVT



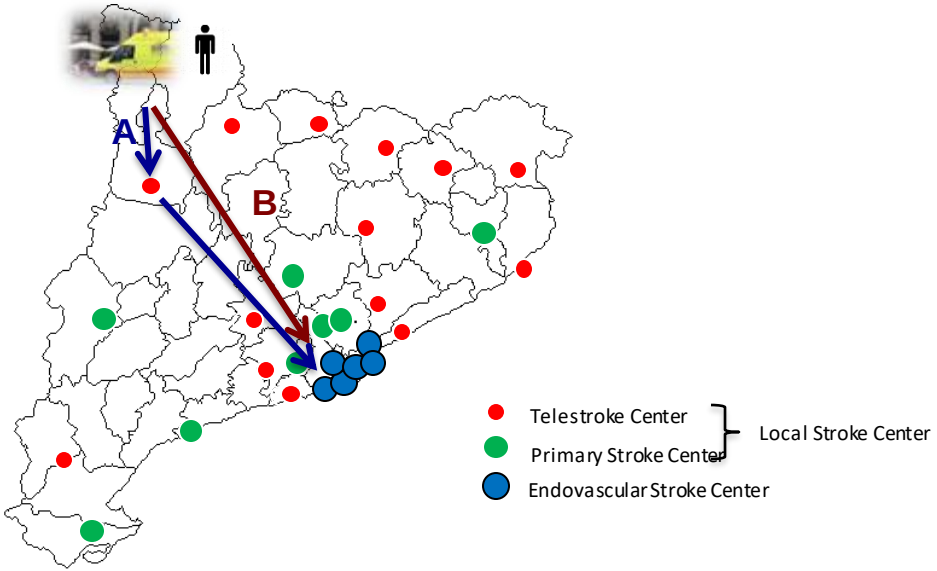
P1: 7.5% – P2: 19.2% – P3: 22.5% (p <0.001)

Conclusion

- The RACECAT trial paralleled a significant improvement in key indicators:
  - EVT rate increased by 57% for AIS activated in LSC service areas

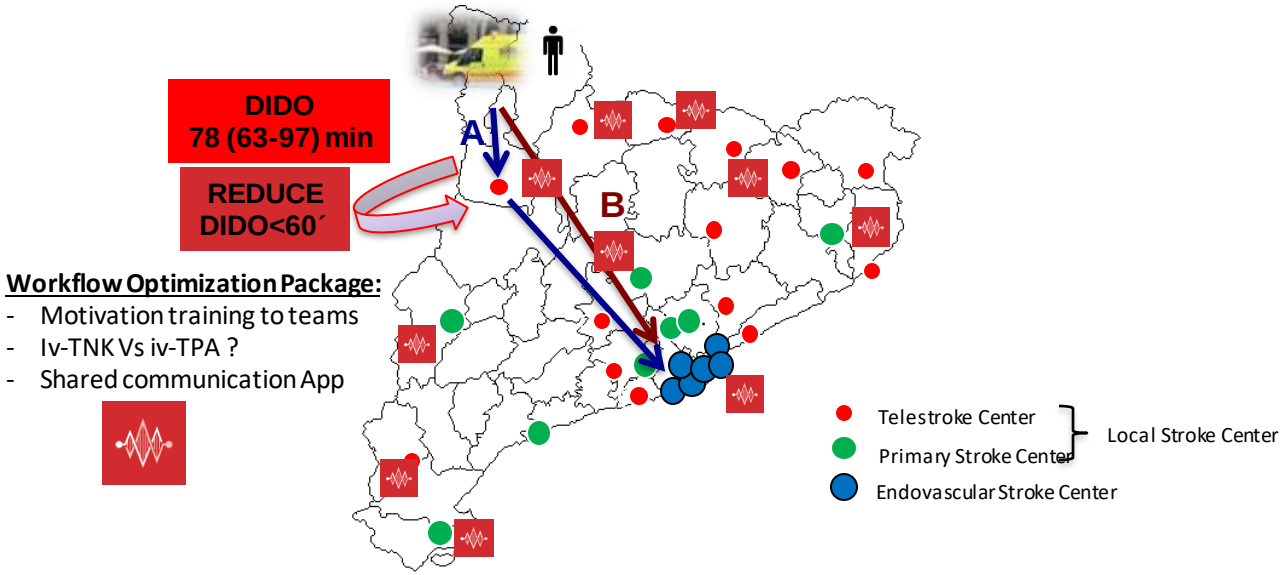
Olivé-Gadea, 2021. in press

Future regional organizational options



Predominant adoption of a Mothership model might lead to loose expertise and motivation at local-SC with no overall proven clinical benefit.

TEAM work, shared objectives
Predominant Drip&Ship



The key to success is efficient 24/7 coordination