

# A one-to-one telestroke network

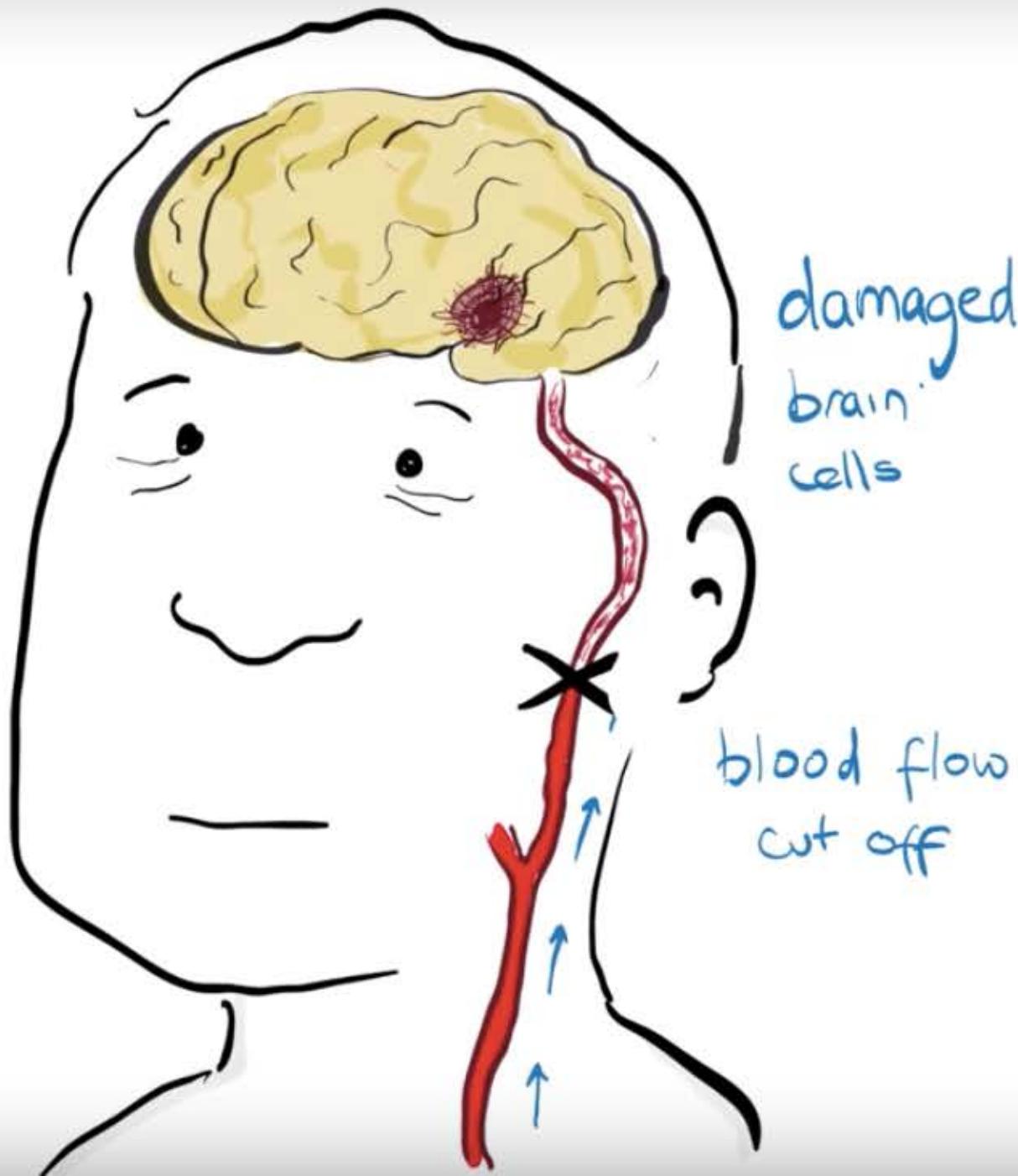
The first Italian study of a web-based telemedicine  
system for thrombolysis delivery and patient monitoring



“

# What is a stroke?

”



damaged  
brain  
cells

blood flow  
cut off

“

**What are the  
symptoms of a stroke?**

”

SPEECH DIFFICULTIES



FACIAL  
PARALYSIS



HEADACHE



CONFUSION



VISION LOSS



BALANCE



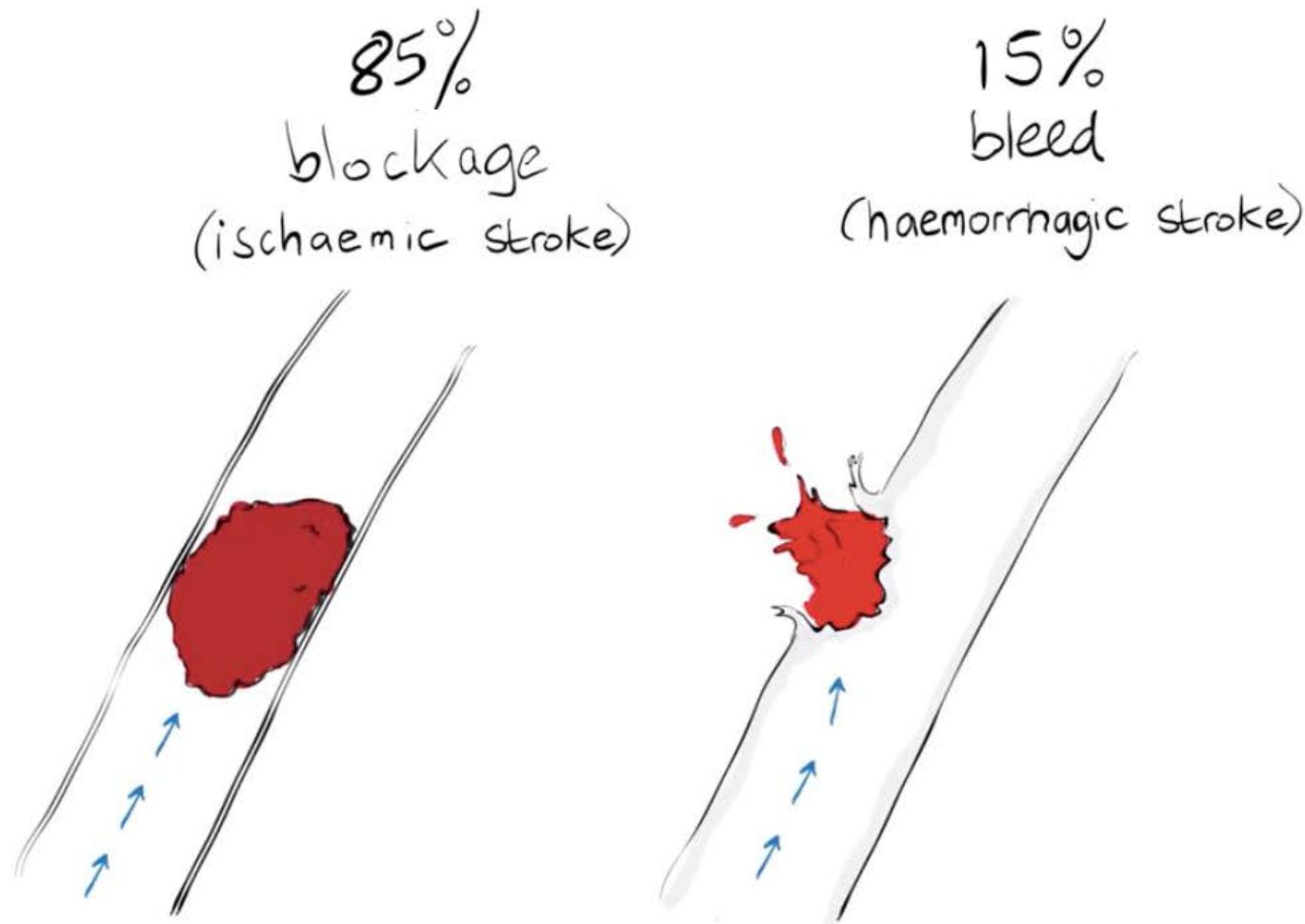
WEAKNESS



DIFFICULTY  
SWALLOWING

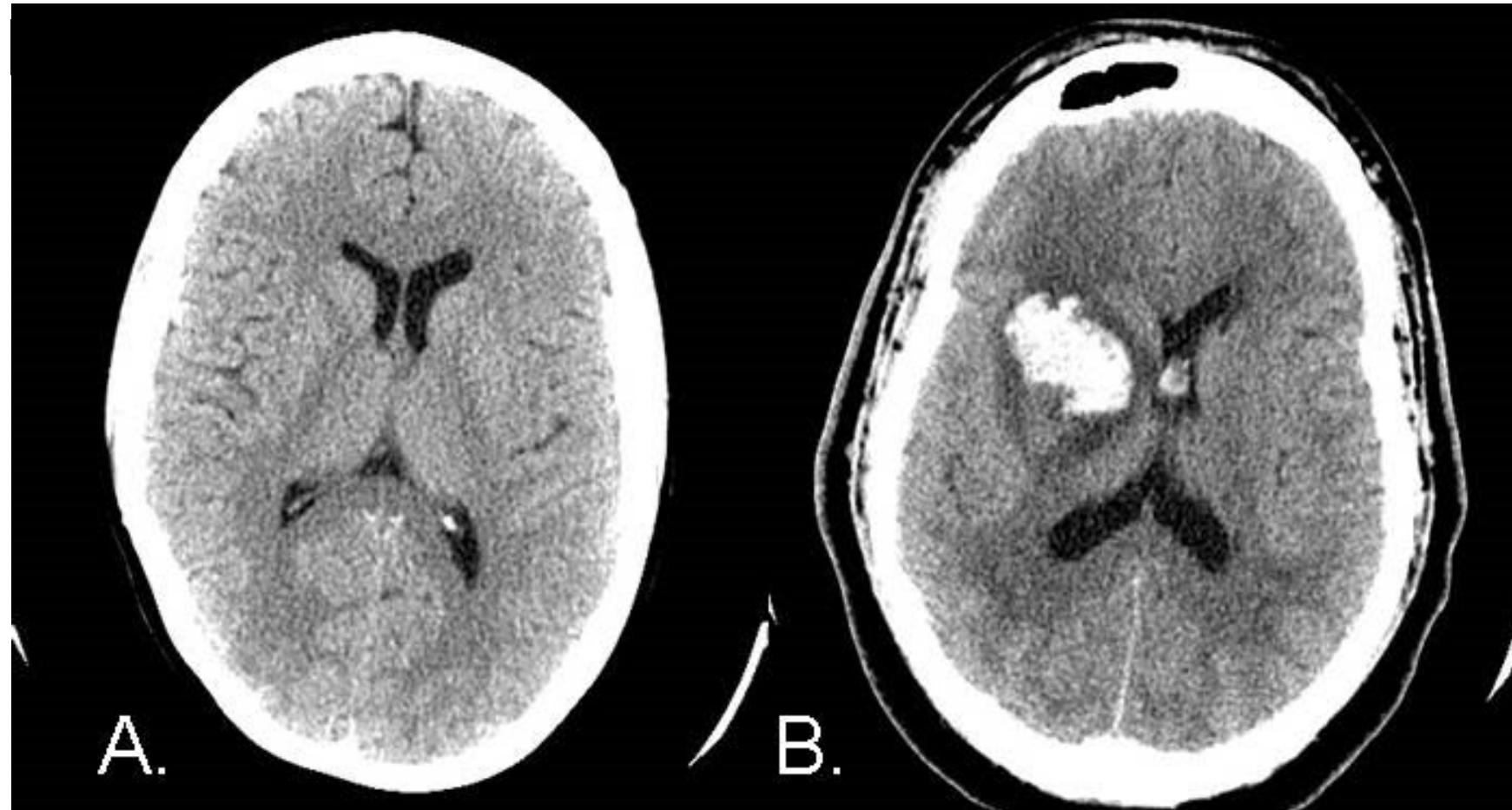


# Two types of strokes



# Treatment of stroke

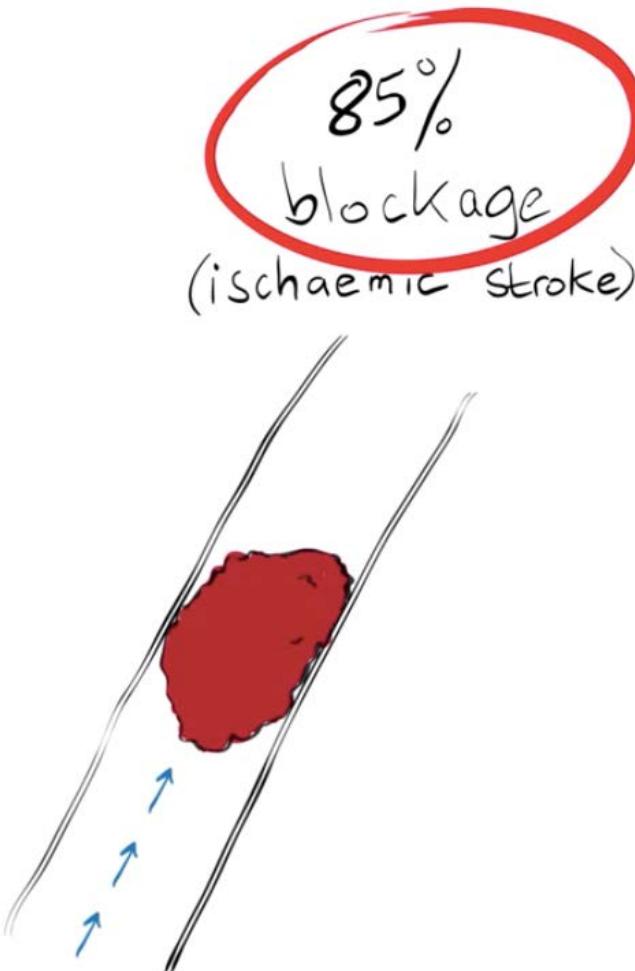
Really important to know which type of stroke a patient has:



Fellow student question:

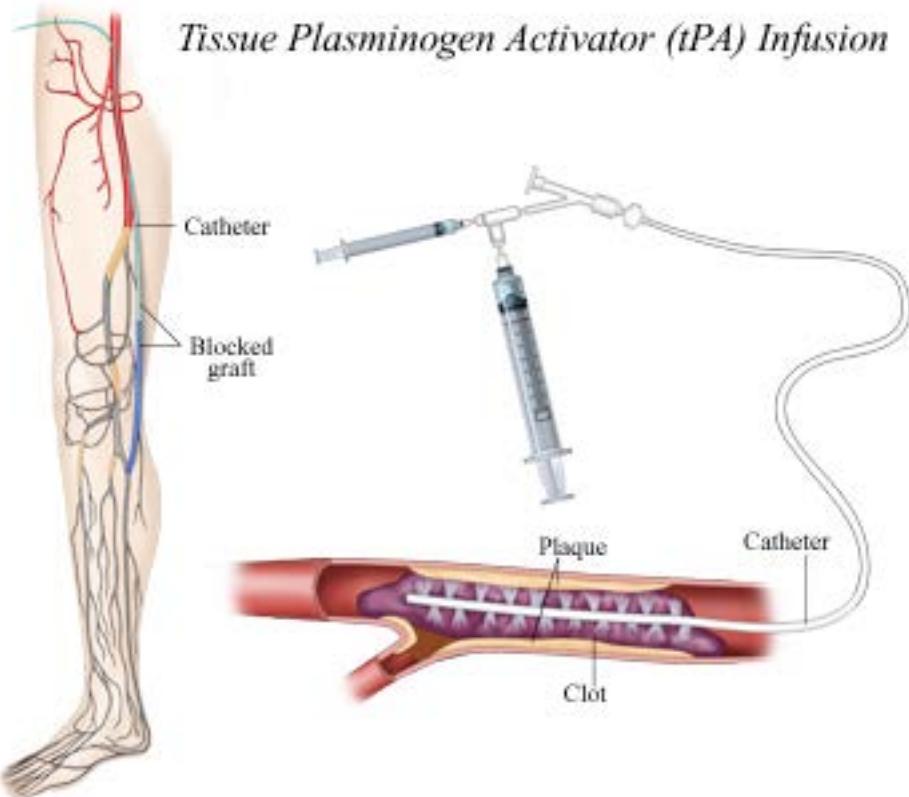
*What is thrombolytic therapy?*

# Treatment of stroke: tPA



- Thrombolytic therapy
- tPA = Tissue Plasminogen Activator
- Clot buster
- FAST: treatment within 3 hours

# Treatment of stroke: tPA



## Risks:

- haemorrhagic stroke
- stomach bleeding
- intestinal bleeding
- bleeding in the urine
- bleeding of healing wounds

# Time is of the essence



## Veneto Region Italy

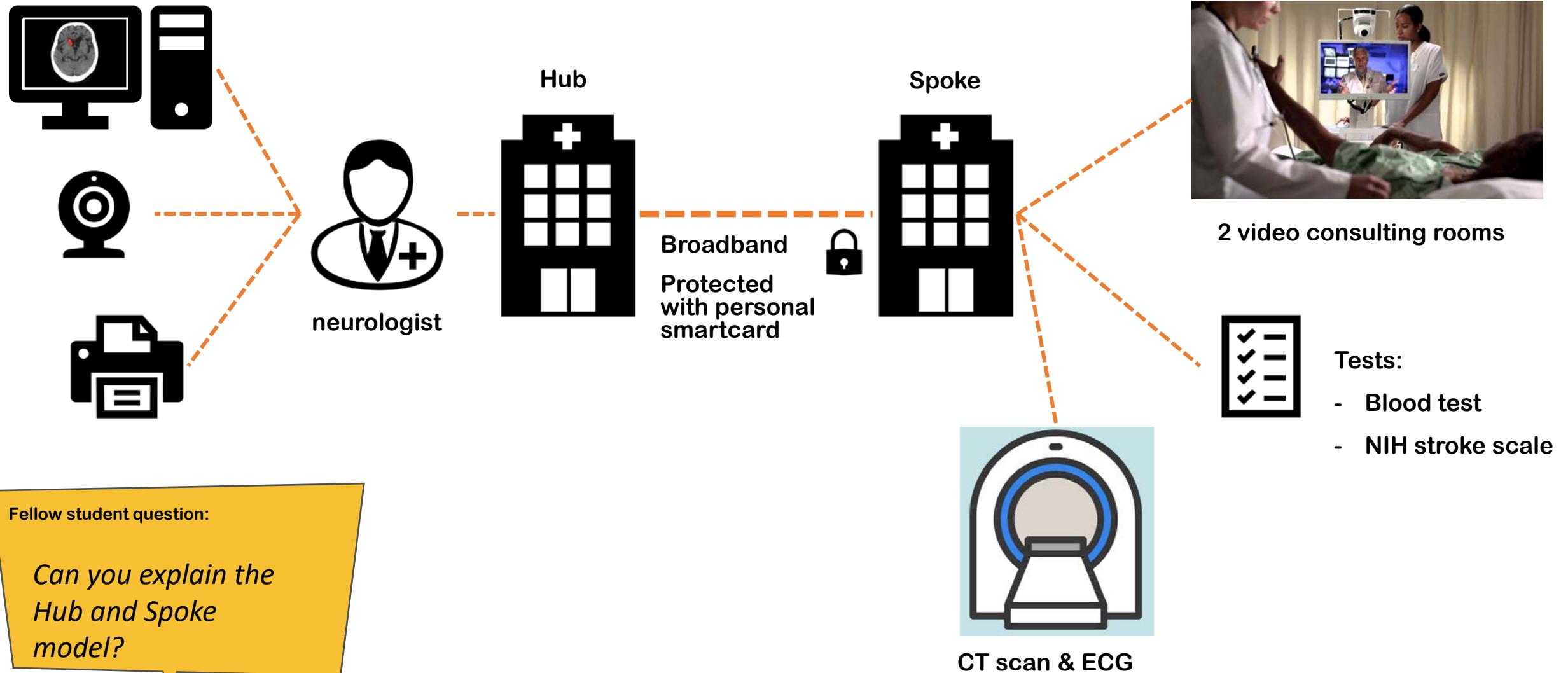
### Treviso Hospital (Hub)

- Stroke unit with stroke specialists
- Neurologic ward (24/7)

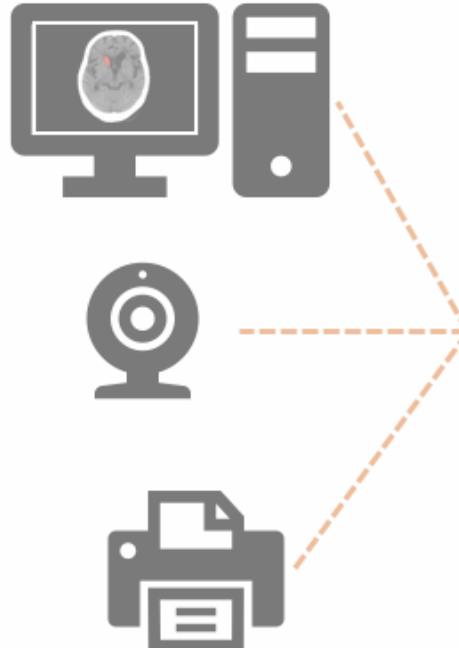
### Conegliano hospital (Spoke)

- No neurology department
- Neurology service from 8 am to 5 pm
- Unable to transfer acute stroke patients to Treviso

# Implementation of Telestroke system



# Implementation of Telestroke system



## Recommendations:

- Patient is eligible for thrombolytic treatment and tPA must be administered
- Patient is eligible for thrombolytic treatment but must be transferred to the Hub center (because of tPA protocol violation)
- Patient is not eligible for thrombolytic treatment
- Other



2 video consulting rooms



Tests:

- Blood test
- NIH stroke scale



CT scan & ECG

# Results

**Table 1** Number of thrombolysis per year in the Hub center and in the telestroke program

Year	Thrombolysis				Total N	Total %		
	Stroke unit		Telestroke					
	N	%	N	%				
2011	24	22.7	5	20	29	22.1		
2012	40	37.7	10	40	50	38.2		
2013	42	39.6	10	40	52	39.7		
Total	106	100	25	100	131	100		

Percentage of patients	Change in NIHSS (after 24h)	Percentage of patients	Change in mRS (after 3 months)
48%	-4	42.8%	<2
28%	0	28.5%	3-4
8%	+4	10.7%	6
8%	Symptomatic haemorrhage	7.1%	No data

**Table 2** Characteristics of patients and times of treatment

	Age		Baseline NIHSS	Onset to door (min), median	Door to scan (min), median	Door to needle (min), median
	Mean (±SD)	Median				
Stroke unit	67.8 (±14.4)	71.5	11.6 (±6.1)	11	55 (I quartile 39, III quartile 74)	23 (I quartile 16, III quartile 38)
Telestroke	68.5 (±10.7)	72	10.4 (±5.0)	9	57 (I quartile 32, III quartile 72)	24 (I quartile 14, III quartile 38)

# Results

**Table 1** Number of thrombolysis per year in the Hub center and in the telestroke program

Year	Thrombolysis				Total	Total		
	Stroke unit		Telestroke					
	N	%	N	%				
2011	24	22.7	5	20	29	22.1		
2012	40	37.7	10	40	50	38.2		
2013	42	39.6	10	40	52	39.7		
Total	106	100	25	100	131	100		

Fellow student question:

*What is the NIH stroke scale score and how is it computed?*

[NIH Stroke Scale](#)

Percentage of patients	Change in NIHSS (after 24h)	Percentage of patients	Change in mRS (after 3 months)
48%	-4	42.8%	<2
28%	0	28.5%	3-4
8%	+4	10.7%	6
8%	Symptomatic haemorrhage	7.1%	No data

**Table 2** Characteristics of patients and times of treatment

	Age		Baseline NIHSS	Onset to door (min), median	Door to scan (min), median	Door to needle (min), median
	Mean ( $\pm$ SD)	Median				
Stroke unit	67.8 ( $\pm$ 14.4)	71.5	11.6 ( $\pm$ 6.1)	11	55 (I quartile 39, III quartile 74)	23 (I quartile 16, III quartile 38)
Telestroke	68.5 ( $\pm$ 10.7)	72	10.4 ( $\pm$ 5.0)	9	57 (I quartile 32, III quartile 72)	24 (I quartile 14, III quartile 38)

# Results

**Table 1** Number of thrombolysis per year in the Hub center and in the telestroke program

Year	Thrombolysis		mRS (modified Rankin Scale)							
	Stroke unit	Telestroke	0 - No symptoms.		1 - No significant disability. Able to carry out all usual activities, despite some symptoms.		2 - Slight disability. Able to look after own affairs without assistance, but unable to carry out all previous activities.		3 - Moderate disability. Requires some help, but able to walk unassisted.	
	N	%	N	%	patients	(after 24h)	patients	(after 3 months)	patients	(after 3 months)
2011	24	22.7	5	22.1	48%	-4	42.8%	<2		
2012	40	37.7	10	38.2	22	-4	42.8%	3-4		
2013	42	39.6	10	32	27	+4	10.7%	6		
Total	106	100	25	100	8%	Symptomatic haemorrhage	7.1%	No data		

**Table 2** Characteristics of pa

	Age		Door to needle (min), median	
	Mean ( $\pm$ SD)	Median	Median	Median
Stroke unit	67.8 ( $\pm$ 14.4)	71.5	11.6 ( $\pm$ 6.1)	11
Telestroke	68.5 ( $\pm$ 10.7)	72	10.4 ( $\pm$ 5.0)	9

# Results

**Table 1** Number of thrombolysis per year in the Hub center and in the telestroke program

Year	Thrombolysis				Total N	Total %		
	Stroke unit		Telestroke					
	N	%	N	%				
2011	24	22.7	5	20	29	22.1		
2012	40	37.7	10	40	50	38.2		
2013	42	39.6	10	40	52	39.7		
Total	106	100	25	100	131	100		

Fellow student question:

Could you explain more precisely what are: onset to door, door to scan and door to needle times?

Percentage of patients	Change in NIHSS (after 24h)	Percentage of patients	Change in mRS (after 3 months)
48%	-4	42.8%	<2
28%	0	28.5%	3-4
8%	+4	10.7%	6
8%	Symptomatic haemorrhage	7.1%	No data

**Table 2** Characteristics of patients and times of treatment

	Age		Baseline NIHSS Mean (±SD)	NIHSS Median	Onset to door (min), median	Door to scan (min), median	Door to needle (min), median
	Mean (±SD)	Median					
Stroke unit	67.8 (±14.4)	71.5	11.6 (±6.1)	11	55 (I quartile 39, III quartile 74)	23 (I quartile 16, III quartile 38)	95 (I quartile 82, III quartile 125)
Telestroke	68.5 (±10.7)	72	10.4 (±5.0)	9	57 (I quartile 32, III quartile 72)	24 (I quartile 14, III quartile 38)	73 (I quartile 98, III quartile 121)

# Results

**Table 1** Number of thrombolysis per year in the Hub center and in the telestroke program

Year	Thrombolysis				Total	Total		
	Stroke unit		Telestroke					
	N	%	N	%				
2011	24	22.7	5	20	29	22.1		
2012	40	37.7	10	40	50	38.2		
2013	42	39.6	10	40	52	39.7		
Total	106	100	25	100	131	100		

Fellow student question:

*Why do the numbers of patients treated thanks to the Telestroke system in Table 1 seem very artificial (5,10,10 for years 2011-2013)?*

Fellow student question:

*Since T test was used, do you think the significant effect was due to the sample size? Dont you think effect size should have been measured to validate the results?*

**Table 2** Characteristics of patients and times of treatment

	Age		Baseline NIHSS	Onset to door (min), median	Door to scan (min), median	Door to needle (min), median
	Mean ( $\pm$ SD)	Median				
Stroke unit	67.8 ( $\pm$ 14.4)	71.5	11.6 ( $\pm$ 6.1)	11	55 (I quartile 39, III quartile 74)	23 (I quartile 16, III quartile 38)
Telestroke	68.5 ( $\pm$ 10.7)	72	10.4 ( $\pm$ 5.0)	9	57 (I quartile 32, III quartile 72)	24 (I quartile 14, III quartile 38)

Fellow student question:

Why the OTT and DTN pathway times were longer than the TEMPiS and REACH studies?

# Results

Table 4 Comparison of published representative European telestroke programs: telestroke models and telethrombolysis data

	TEMPiS [1]	TEMPiS [2]	EoE telestroke	Meuse (east france)	Finnish telestroke	Barcelona Spain	Madrid Spain	Italy
Number of thrombolysis	106	115	74	21	61	46	18	25
Mean age	68	69.7	69	72	70	nk	68	68.5
Median NIHSS	12	12	10	Mean 16	10	nk	6.5	9
Onset-to-treatment time (min)	141	134	170.1	169	130	nk	155	151.4
Door-to-needle time (min)	76	68	94.9	69	24	53.4	66	96.8
% hemorrhage	8.5	7.8 %	7.3	14	6.7 %	8.69 %	0	8
mRankin 3 months <2 (%)	nk	nk	nk	29 %	29.4 %	53.65 %	55.6 %	42.8 %
Period	February 2003–April 2004	2004	2010–2011	October 2010–February 2012	2007–2009	2007–2010	2010–2013	2011–2013

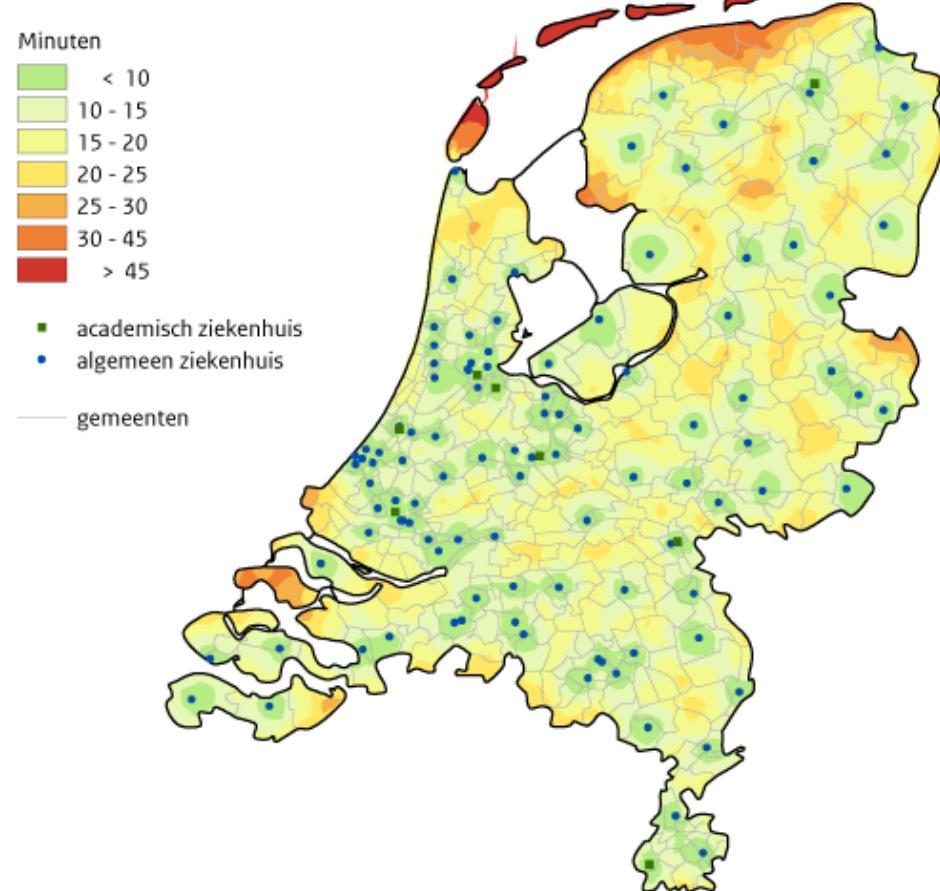
# Other telestroke projects

- REACH project: 8 rural community hospitals in Georgia (US)
- TEMPiS project in Bavaria (Germany): 2 hubs (stroke centers in Munich-Harlaching and in Regensburg) and 12 spokes (local hospitals in eastern Bavaria)
- Telemedicine project in the district of Meuse (a depopulated rural area in the east of France) with 1 hub (stroke unit hospital Nancy) and 1 spoke (Bar le Duc community hospital)
- Telemedicine project in North Carolina (US) with 1 hub (Medical University of South Carolina) and 12 spokes (community hospitals in South Carolina)
- UPMC telestroke network in western Pennsylvania with 1 hub (University of Pittsburgh Medical Center) and 12 spokes (community hospitals in western Pennsylvania)
- Telemedicine project in Spain with 1 hub and 1 spoke
- STRokE DOC trial in California (US) with 1 hub and 4 spokes
- The East of England telestroke project without hub/spoke but with 7 collaborating rural hospitals (Ipswich Hospital, James Paget University Hospital, Lister Hospital, Peterborough Hospital, Queen Elizabeth Hospital, Watford General Hospital, and West Suffolk Hospital)
- HUCH Telemedicine in Finland with 1 hub (Helsinki University Central Hospital) and 5 spokes (community hospitals)
- TESS project in south Germany with 1 hub (stroke unit of Günzburg) and 7 spokes (rural hospitals)
- STENO project in Germany: stroke network of 20 hospitals (one of the largest thus far)
- Madrid Telestroke project with 1 hub and 1 spoke
- NHS Scotland telestroke; 5 networks of multiple hospitals

# Telestroke in the Netherlands

**Reistijd naar dichtstbijzijnde ziekenhuis 2018**

exclusief buitenpoliklinieken en kinderziekenhuizen, met de auto

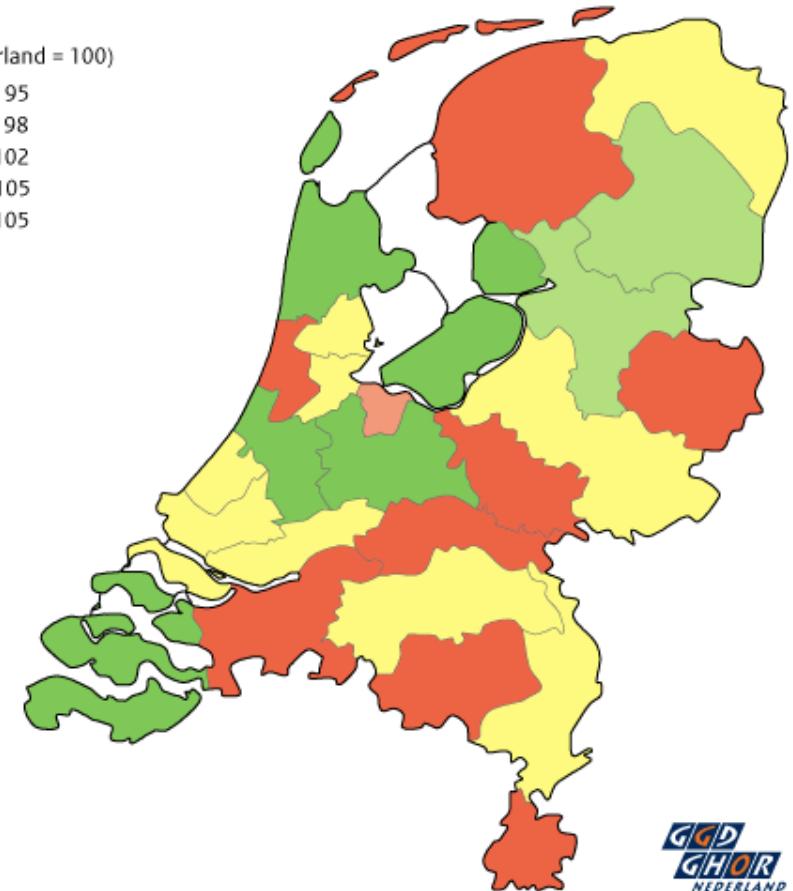


**Sterfte aan beroerte 2013-2016**

Per GGD-regio, gecorrigeerd voor leeftijd en geslacht

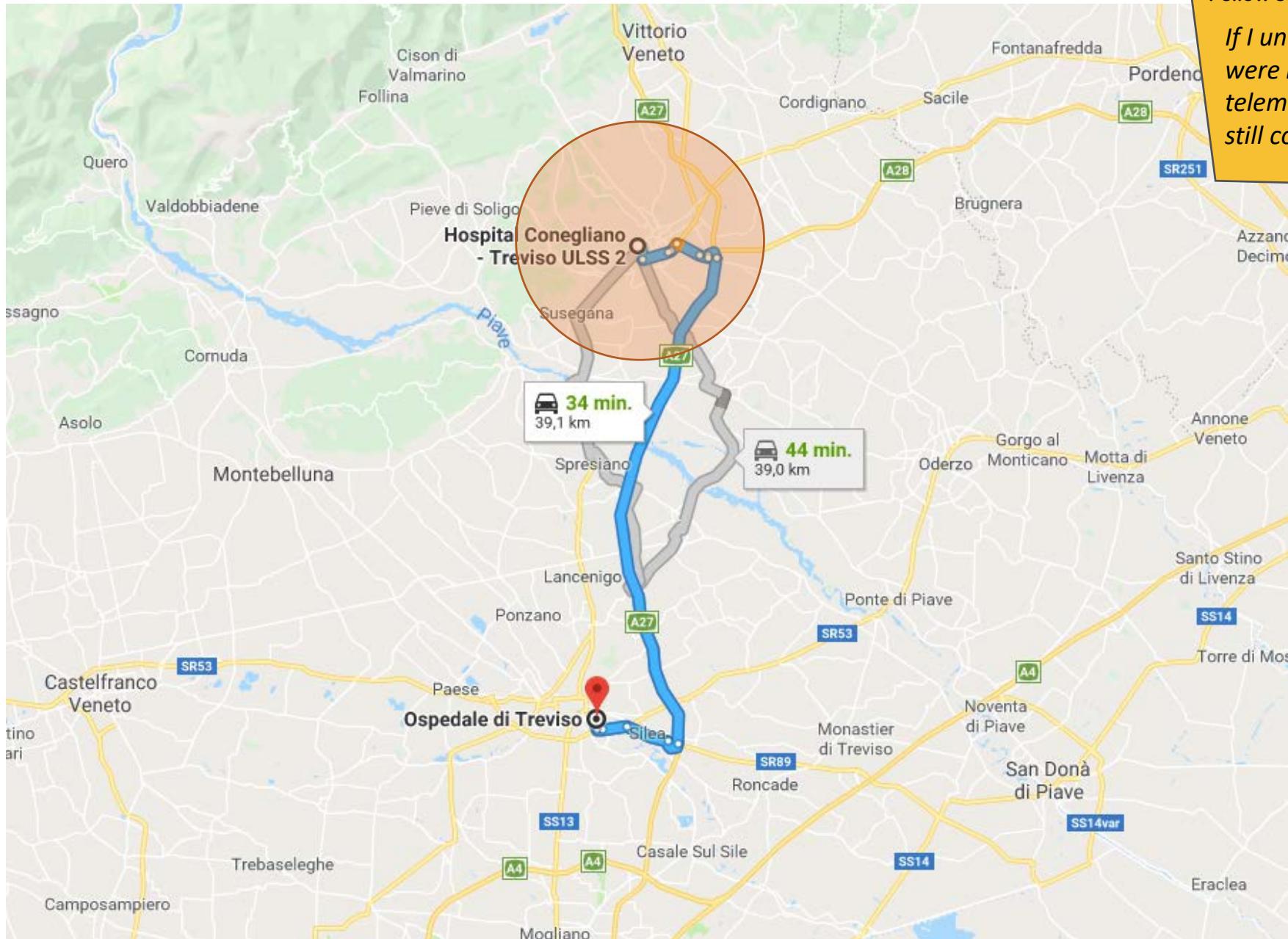
Index (Nederland = 100)

- [light green] < 95
- [light yellow-green] 95 - 98
- [yellow] 98 - 102
- [orange] 102 - 105
- [red] ≥ 105



Fellow student question:

If I understand correctly, patients were not helped quicker thanks to telemedicine. Why do the authors still conclude this was a success?



## **Question to you**

*Do you think that the usage of telethrombolysis poses a greater risk to the patient versus the patients that receive thrombolysis at the hub center?*

## **Question to you**

*Could other therapies and/or illnesses be implemented into this system?*

# **Questions?**

# Implementation of Telestroke system



- **HEALTH OPTIMUM (HEALTHcare delivery OPTIMisation throUgh teleMedicine)**
- EU programme eTEN (deployment of trans-European e-services in the public interest)
- EU funding of €67 million for Veneto region

