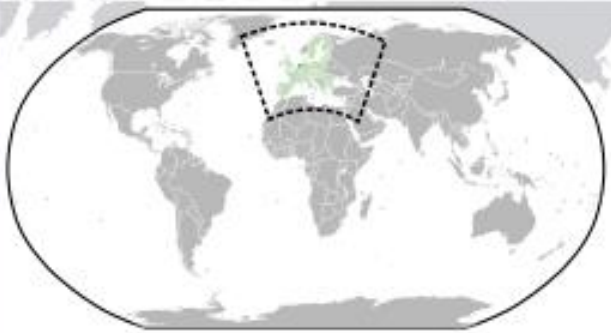
# Stroke in Europe, the Netherlands and Maastricht

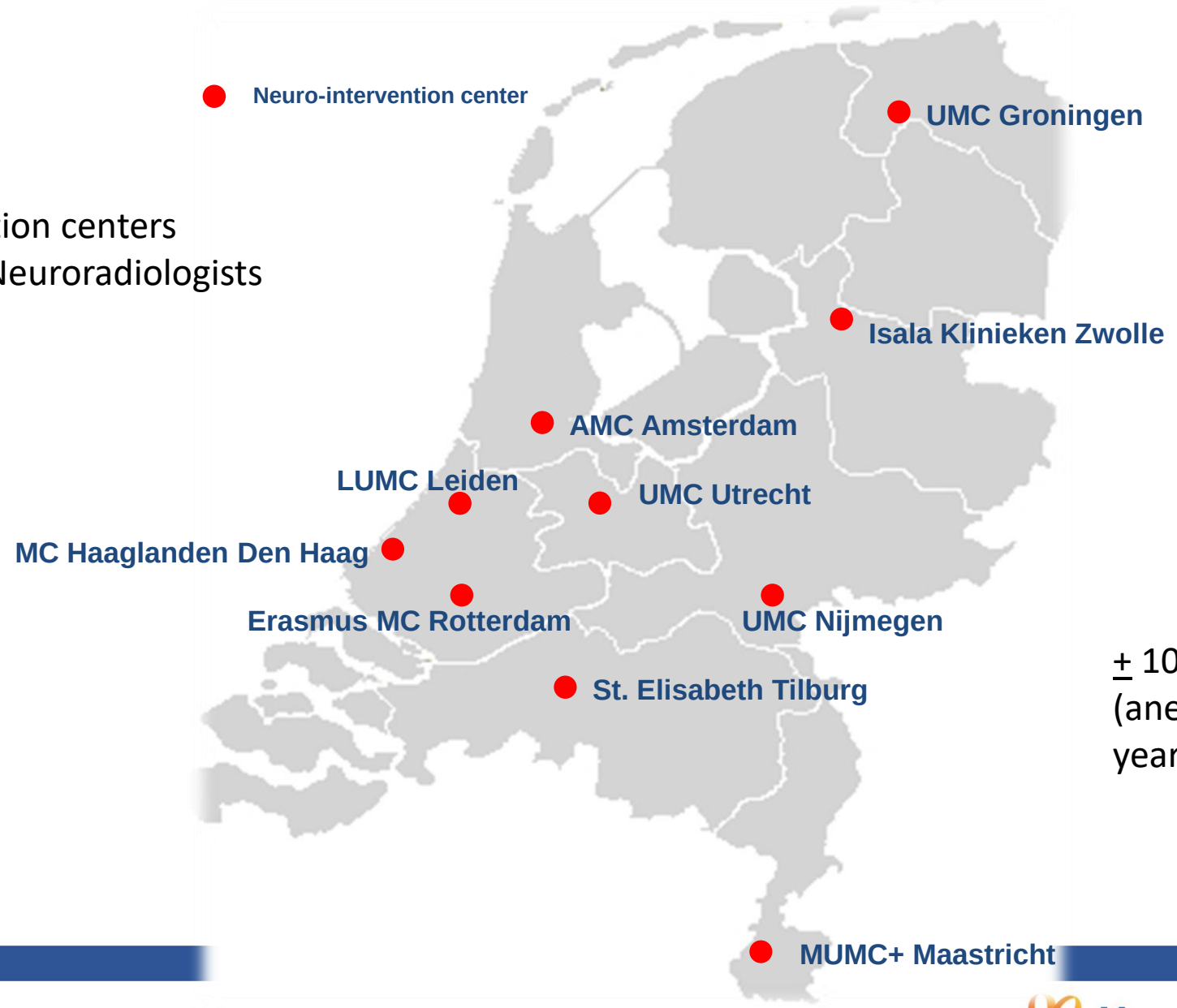
Wim van Zwam

- Current status in the Netherlands
- Maastricht experience
- Current Trials in the Netherlands



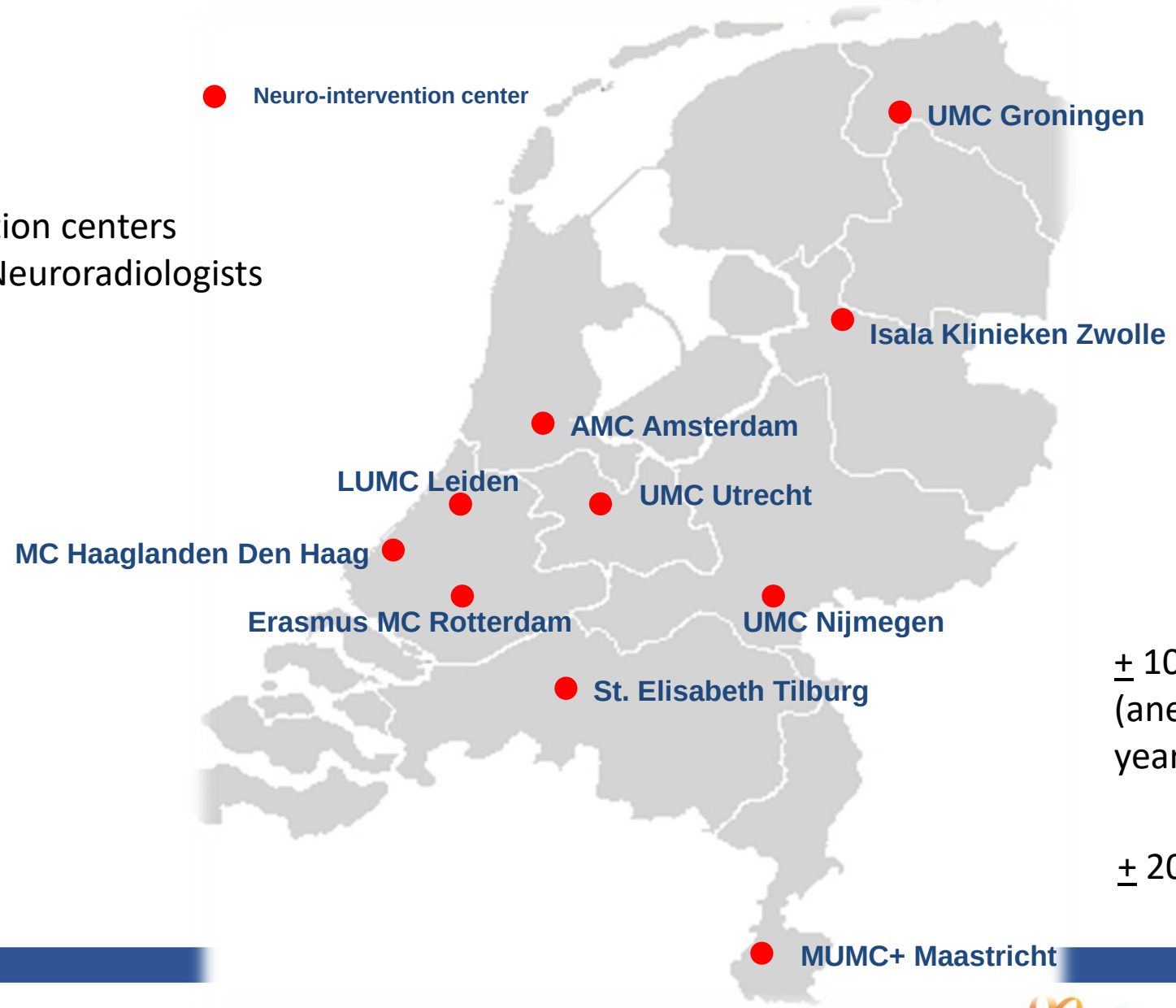

| Total N | 17,000,000 |
|---|---|
| Area | 37.354 km$^2$ |
| Population density | 455 / km$^2$ |
| Road length | 141,828 km |
| Road density | 3.8 km / km$^2$ |
| Hospitals | 90 |
| Intervention centers | 18 |
| Acute ischemic stroke | 20,000 / year |

10 neuro-intervention centers
28 Interventional Neuroradiologists




± 1000 neuro-interventions (aneurysm, AVM, Dural Fistula) per year

10 neuro-intervention centers
28 Interventional Neuroradiologists

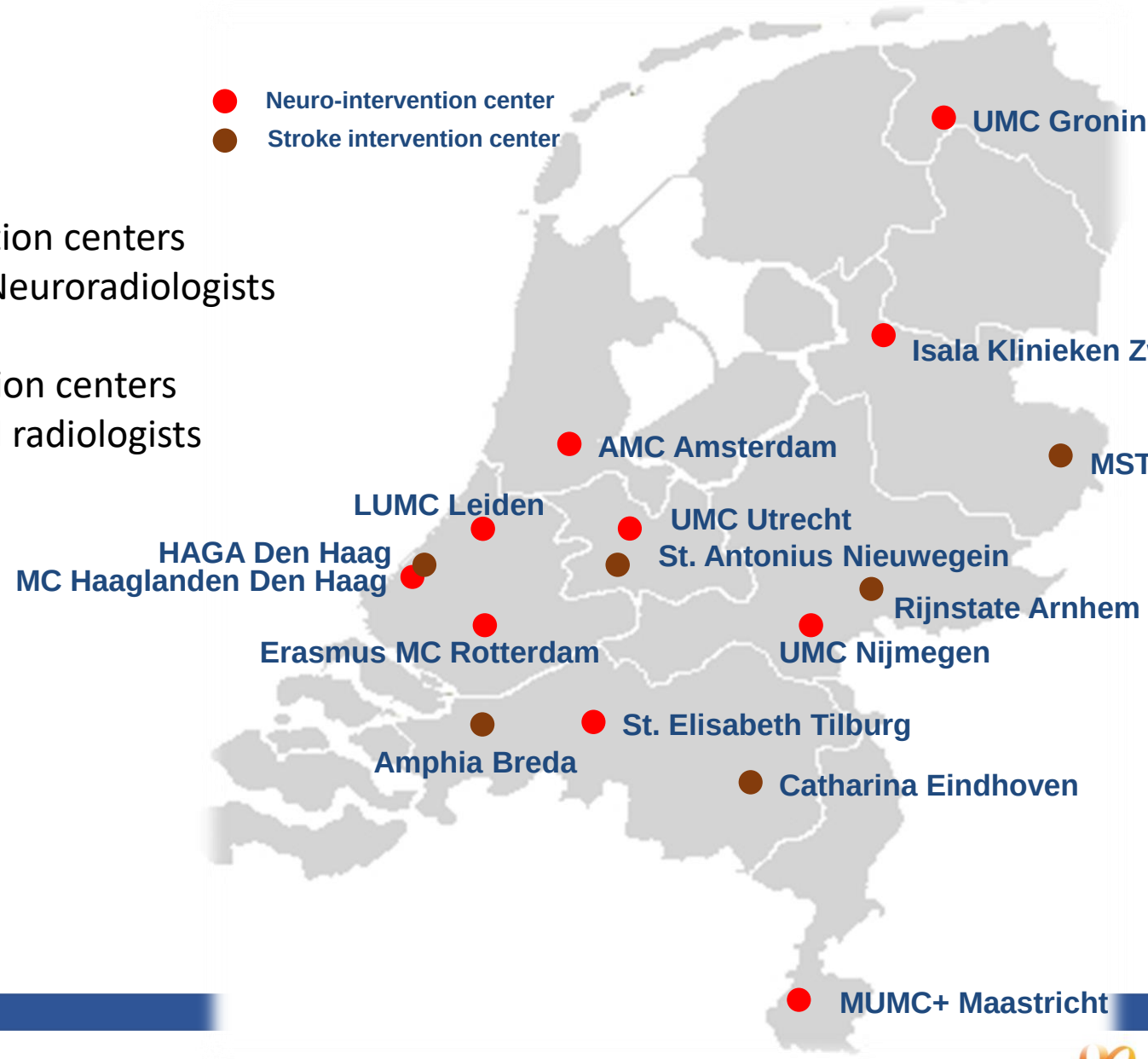



± 1000 neuro-interventions (aneurysm, AVM, Dural Fistula) per year

± 2000 EVTs per year

10 neuro-intervention centers
28 Interventional Neuroradiologists

6 ‘stroke-intervention centers
± 40 Interventional radiologists




± 1000 neuro-interventies (aneurysma, AVM, Durale Fistel) per jaar

± 2000 IATs per jaar

# Dutch criteria for Stroke Intervention Center

- 24/7 ”Stroke team” (Stroke interventionist, vascular neurologist, anesthesist)
- Minimum of 3 Stroke interventionists
- Minimum of 50 thrombectomies / center / yr
- Minimum of 20 procedures / interventionist / yr
- Median door-to-groin time < 60 minutes
- Participate in Dutch Stroke Registry

STANDARDS OF PRACTICE

# Multisociety Consensus Quality Improvement Revised Consensus Statement for Endovascular Therapy of Acute Ischemic Stroke

From the American Association of Neurological Surgeons (AANS), American Society of Neuroradiology (ASNR), Cardiovascular and Interventional Radiology Society of Europe (CIRSE), Canadian Interventional Radiology Association (CIRA), Congress of Neurological Surgeons (CNS), European Society of Minimally Invasive Neurological Therapy (ESMINT), European Society of Neuroradiology (ESNR), European Stroke Organization (ESO), Society for Cardiovascular Angiography and Interventions (SCAI), Society of Interventional Radiology (SIR), Society of NeuroInterventional Surgery (SNIS), and World Stroke Organization (WSO)

J Vasc Interv Radiol 2018; 29:441–453

**Table 3.** Endovascular Therapy Quality Improvement Case Review Triggers and Process Metrics

**Indications for Endovascular Treatment**

- Metric 1: At least 90% of patients who meet the institution selection criteria (indications/contraindications) should be treated with endovascular therapy.

**Data Collection**

- Metric 2: 100% of patients have the required minimum process and outcomes data entered into an institutional or national database, trial, or registry.

**Key Time Intervals**

*Door to imaging*

- Metric 3: 75% of patients being evaluated for revascularization should have imaging initiated within 30 minutes from time of arrival. At the best of centers with high volumes and an established resource infrastructure, this is expected to be achieved in 12 minutes.

*Imaging to puncture*

- Metric 4: 75% of patients treated with endovascular therapy should have an imaging-to-puncture time of 110 minutes or less. At the best of centers with high volumes and an established resource infrastructure, this is expected to be achieved in 50 minutes or less.
- Metric 5: For patients transferred from another site and in whom imaging is not repeated, 75% of patients being treated should have a door-to-puncture time of 80 minutes or less.

*Puncture to revascularization*

- Metric 6: In 70% of patients, mTICI score $\geq$ 2b should be reached ideally within 60 minutes of arterial puncture.

**Outcome Metrics**

*Recanalization/reperfusion*

- Metric 7: The mTICI scale should be the primary scale used to assess angiographic reperfusion.
- Metric 8: At least 70% of patients should have an mTICI score $\geq$ 2b/3 ($>$ 50% reperfusion) for all clot locations.

**Postprocedure CT/MR Imaging**

- Metric 9: At least 90% of patients should have a brain CT or MR imaging within 36 hours of the end of the procedure.

*SICH*

- Metric 10: 100% of cases with SICH are reviewed.
- Metric 11: No more than 10% of treated patients should develop SICH.

*Embolization of new territory*

- Metric 12: No more than 10% of patients should have embolization of new territory.

*Death within 72 hours of treatment*

- Metric 13: 100% of cases of death within 72 hours of the end of the procedure are reviewed.

**Clinical Outcomes**

- Metric 14: All treated patients have a documented NIHSS score at discharge. Attempts are made to contact and document a follow-up mRS score at 90 days (evaluated in person or via telephone) on all treated patients. At least 90% of treated patients have a documented 90-day mRS score.
- Metric 15: Of all treated patients, at least 30% are independent (ie, mRS score 0–2) at 90 days after treatment.

- Door to Imaging: 75% < 30 min
- Imaging to Groin: 75% < 110 min (< 50 min)

- Reperfusion: 70 % mTICI 2b/3 within 60 min

- Outcome: 100% have documented NIHSS at discharge
  >90% have documented mRS at 90 days
  >30% independent (mRS ≤ 2) at 90 days

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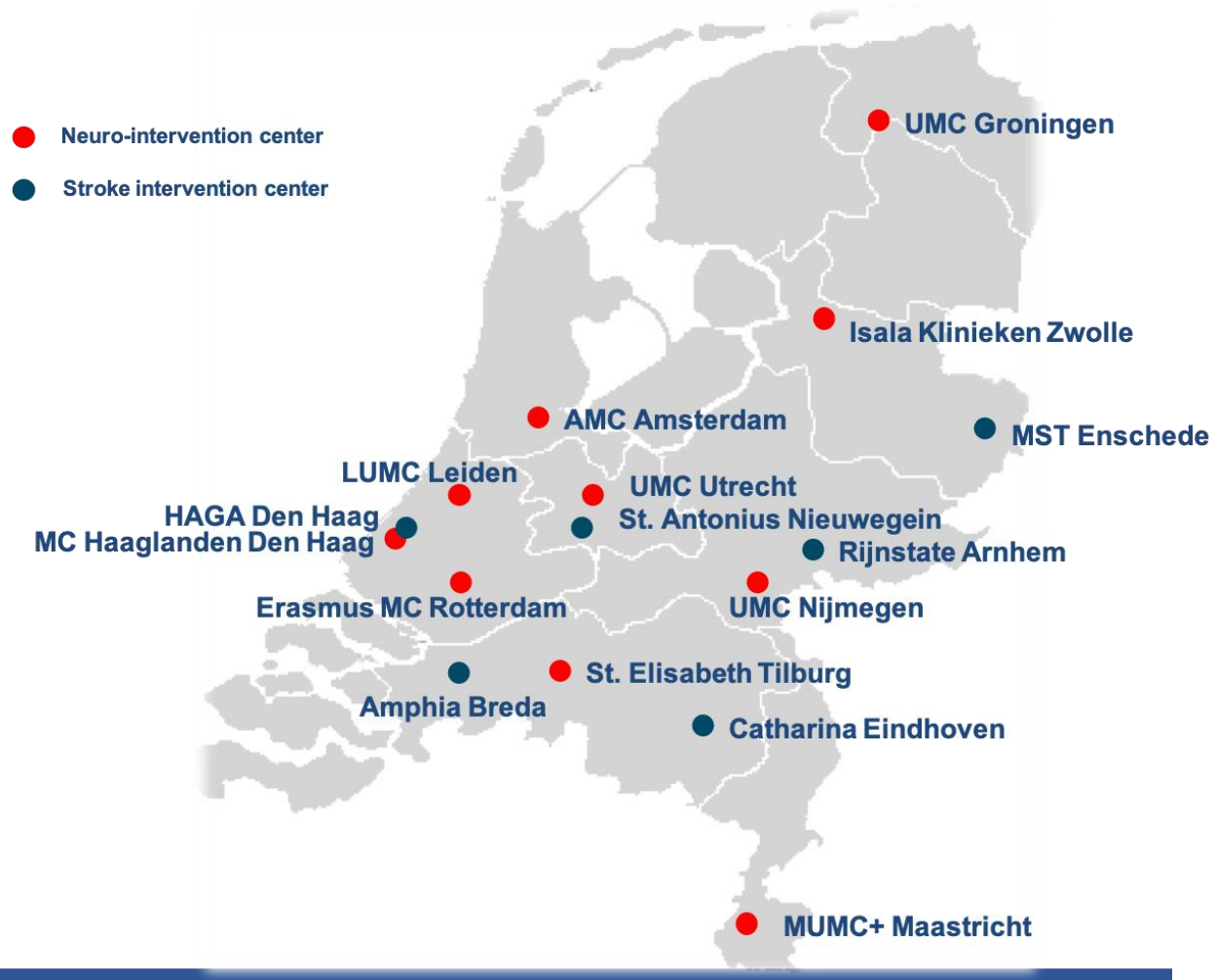
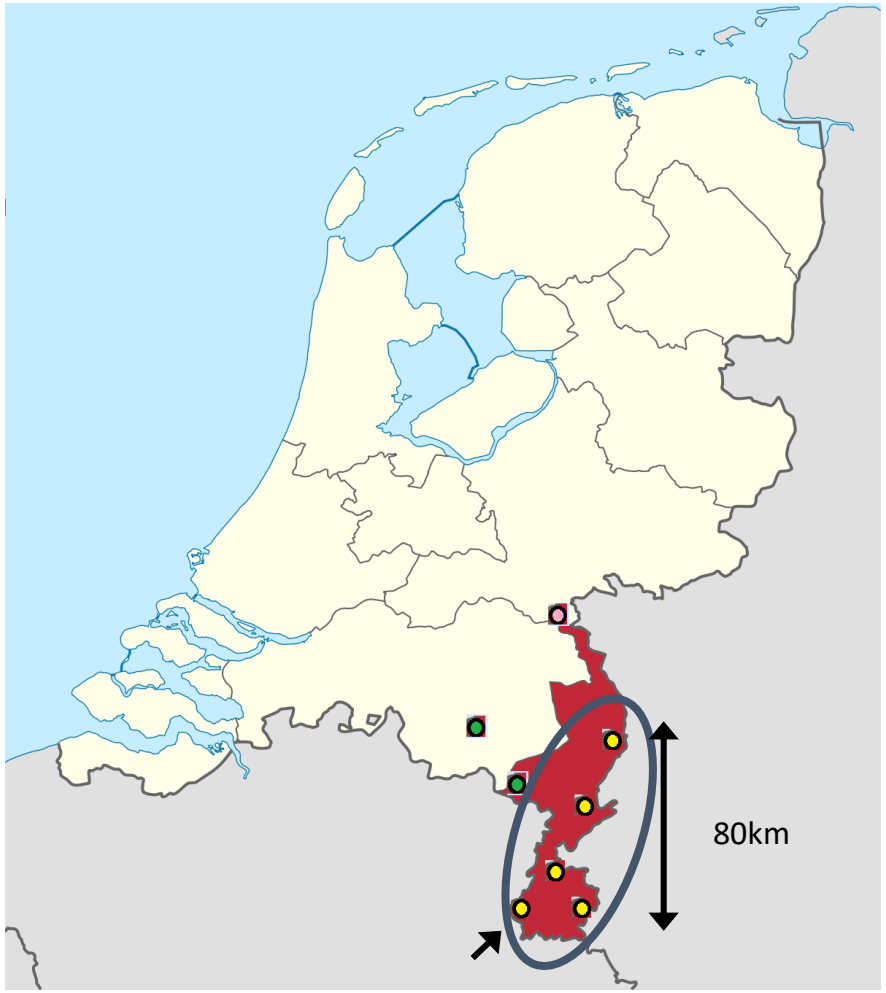
# The Maastricht experience



# Limburg

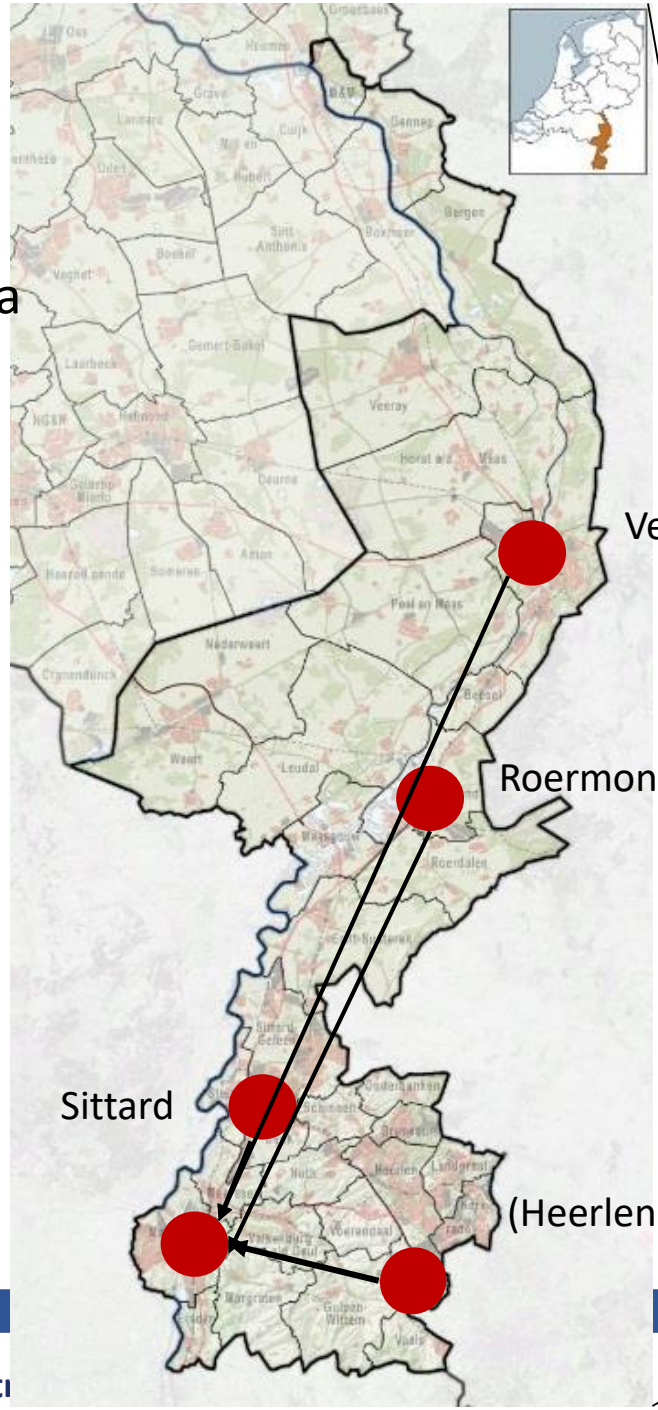



# Our situation

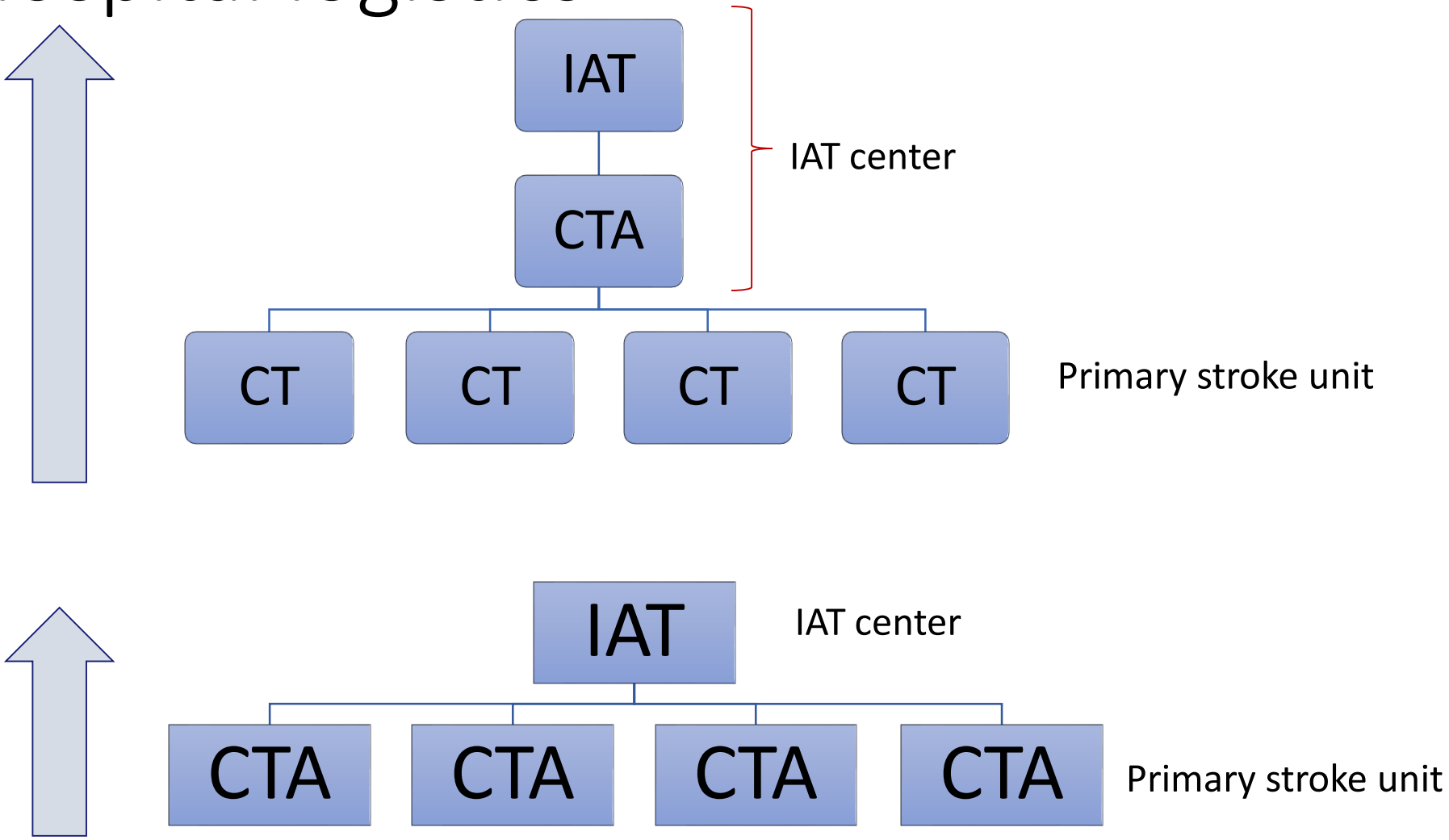
- **1 milion inhabitants**
- **4 primary stroke centers**
  **1 comprehensive stroke center**
- **about 1750 ischemic strokes/year**
- **25% IVT (80-100/center/year)**
- **5 -10 % IAT (100-150/year)**
- **Drip-ship method**

# Limburg

- 900.000 catchment area
- 150 endovascular treatments/year
- 5 hospitals
- 1 IA stroke centre
- 5 interventional stroke radiologists

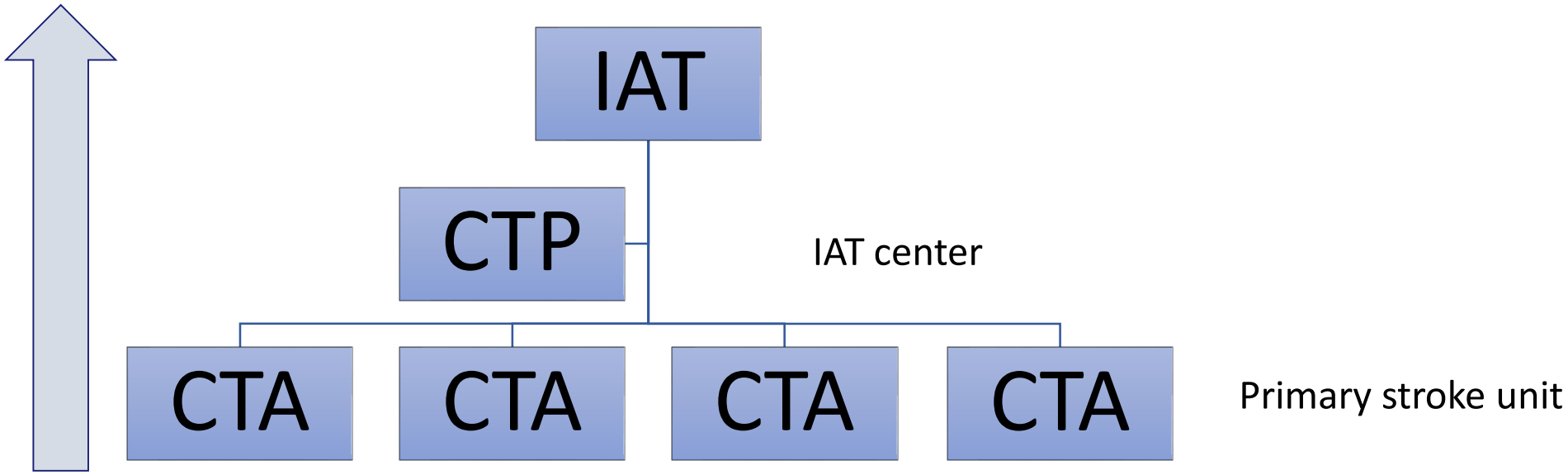



# Pre hospital logistics



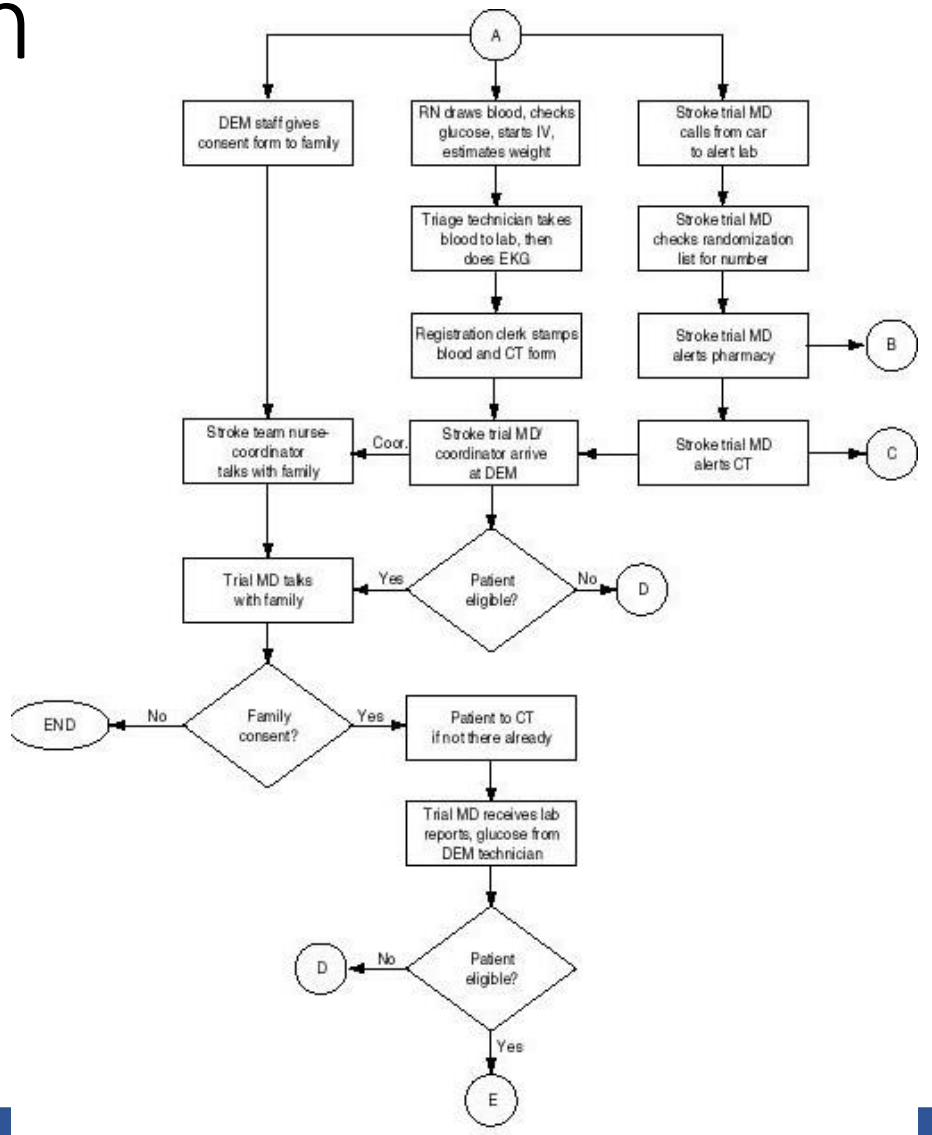
# Pre hospital logistics

Patients arriving 6 – 24 hrs after onset:

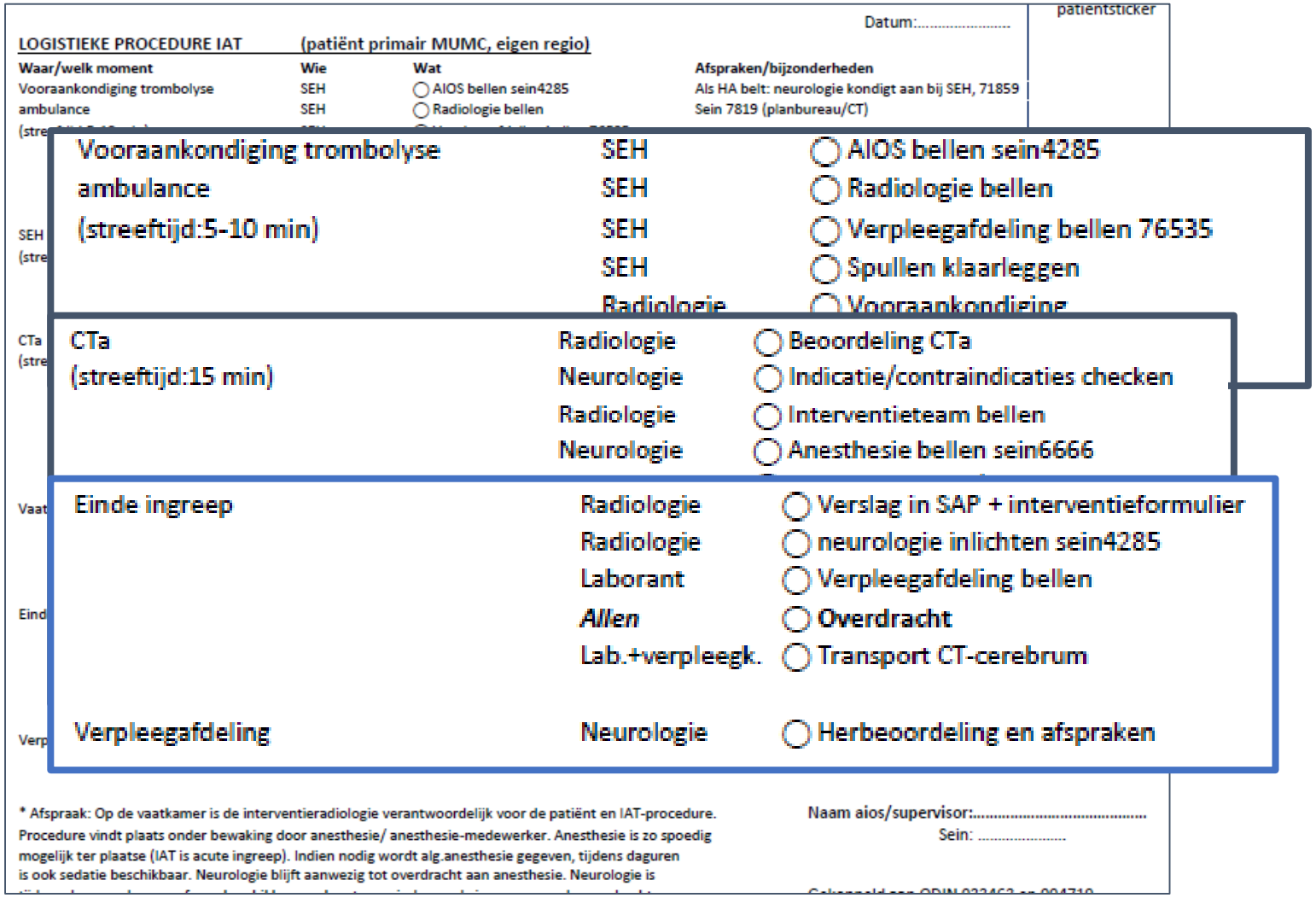


# In-hospital organization

- IAT protocol
  - Task list for every ‘team-member’



# Task List



Datum:.....

patientsticker

LOGISTIEKE PROCEDURE IAT (patiënt primair MUMC, eigen regio)

| Waar/welk moment | Wie | Wat | Afspraken/bijzonderheden |
|---|---|---|---|
| Vooraankondiging trombolyse | SEH | ◯ AIOS bellen sein4285 | Als HA belt: neurologie kondigt aan bij SEH, 71859 |
| ambulance | SEH | ◯ Radiologie bellen | Sein 7819 (planbureau/CT) |
| (streeftijd:5-10 min) | SEH | ◯ Verpleegafdeling bellen 76535 | |
| | SEH | ◯ Spullen klaarleggen | |
| | Radiologie | ◯ Vooraankondiging | |
| CTa (streeftijd:15 min) | Radiologie | ◯ Beoordeling CTa | |
| | Neurologie | ◯ Indicatie/contraindicaties checken | |
| | Radiologie | ◯ Interventieteam bellen | |
| | Neurologie | ◯ Anesthesie bellen sein6666 | |
| Einde ingreep | Radiologie | ◯ Verslag in SAP + interventieformulier | |
| | Radiologie | ◯ neurologie inlichten sein4285 | |
| | Laborant | ◯ Verpleegafdeling bellen | |
| | *Allen* | ◯ **Overdracht** | |
| | Lab.+verpleegk. | ◯ Transport CT-cerebrum | |
| Verpleegafdeling | Neurologie | ◯ Herbeoordeling en afspraken | |

* Afspraak: Op de vaatkamer is de interventieradiologie verantwoordelijk voor de patiënt en IAT-procedure. Procedure vindt plaats onder bewaking door anesthesie/ anesthesie-medewerker. Anesthesie is zo spoedig mogelijk ter plaatse (IAT is acute ingreep). Indien nodig wordt alg.anesthesie gegeven, tijdens daguren is ook sedatie beschikbaar. Neurologie blijft aanwezig tot overdracht aan anesthesie. Neurologie is

Naam aios/supervisor:.....

Sein: .....

Key words:

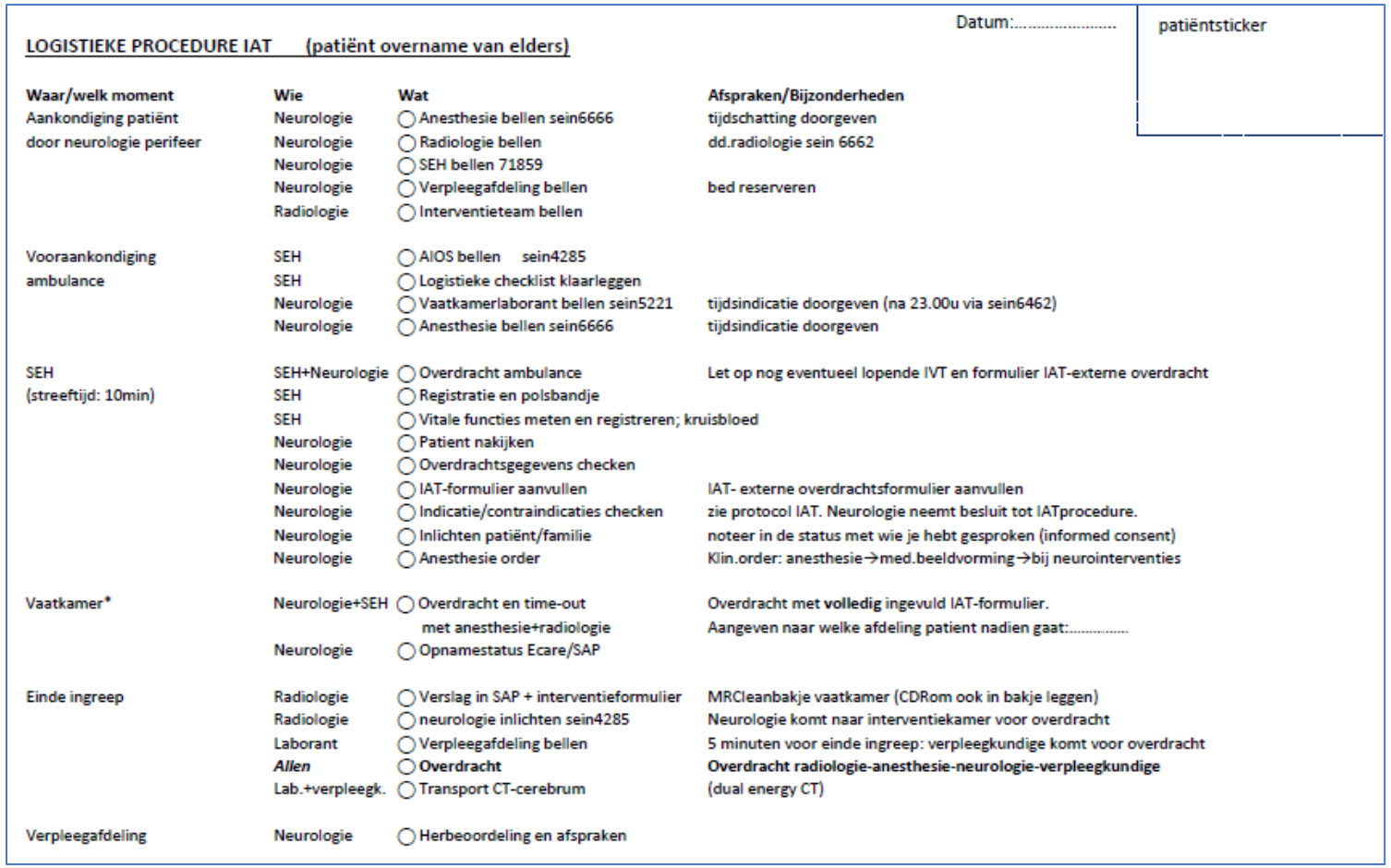
Prenotification

Parallel processing

# In-hospital organization

- IAT protocol
    - Task list for every ‘team-member’
- Benchmark times
    - Door to imaging, Imaging to groin puncture, etc
    - Personel on call times (max ‘driving’ time)

# In-hospital organization



Datum:.....

patiëntsticker

**LOGISTIEKE PROCEDURE IAT (patiënt overname van elders)**

| Waar/welk moment | Wie | Wat | Afspraken/Bijzonderheden |
|---|---|---|---|
| Aankondiging patiënt | Neurologie | ◯ Anesthesie bellen sein6666 | tijdschatting doorgeven |
| door neurologie perifeer | Neurologie | ◯ Radiologie bellen | dd.radiologie sein 6662 |
| | Neurologie | ◯ SEH bellen 71859 | |
| | Neurologie | ◯ Verpleegafdeling bellen | bed reserveren |
| | Radiologie | ◯ Interventieteam bellen | |
| Vooraankondiging | SEH | ◯ AIOS bellen sein4285 | |
| ambulance | SEH | ◯ Logistieke checklist klaarleggen | |
| | Neurologie | ◯ Vaatkamerlaborant bellen sein5221 | tijdsindicatie doorgeven (na 23.00u via sein6462) |
| | Neurologie | ◯ Anesthesie bellen sein6666 | tijdsindicatie doorgeven |
| SEH | SEH+Neurologie | ◯ Overdracht ambulance | Let op nog eventueel lopende IVT en formulier IAT-externe overdracht |
| (streeftijd: 10min) | SEH | ◯ Registratie en polsbandje | |
| | SEH | ◯ Vitale functies meten en registreren; kruisbloed | |
| | Neurologie | ◯ Patient nakijken | |
| | Neurologie | ◯ Overdrachtsgegevens checken | |
| | Neurologie | ◯ IAT-formulier aanvullen | IAT- externe overdrachtsformulier aanvullen |
| | Neurologie | ◯ Indicatie/contraindicaties checken | zie protocol IAT. Neurologie neemt besluit tot IATprocedure. |
| | Neurologie | ◯ Inlichten patiënt/familie | noteer in de status met wie je hebt gesproken (informed consent) |
| | Neurologie | ◯ Anesthesie order | Klin.order: anesthesie→med.beeldvorming→bij neurointerventies |
| Vaatkamer* | Neurologie+SEH | ◯ Overdracht en time-out met anesthesie+radiologie | Overdracht met **volledig** ingevuld IAT-formulier. Aangeven naar welke afdeling patient nadien gaat:..... |
| | Neurologie | ◯ Opnamestatus Ecare/SAP | |
| Einde ingreep | Radiologie | ◯ Verslag in SAP + interventieformulier | MRCleanbakje vaatkamer (CDRom ook in bakje leggen) |
| | Radiologie | ◯ neurologie inlichten sein4285 | Neurologie komt naar interventiekamer voor overdracht |
| | Laborant | ◯ Verpleegafdeling bellen | 5 minuten voor einde ingreep: verpleegkundige komt voor overdracht |
| | ***Allen*** | ◯ **Overdracht** | **Overdracht radiologie-anesthesie-neurologie-verpleegkundige** |
| | Lab.+verpleegk. | ◯ Transport CT-cerebrum | (dual energy CT) |
| Verpleegafdeling | Neurologie | ◯ Herbeoordeling en afspraken | |

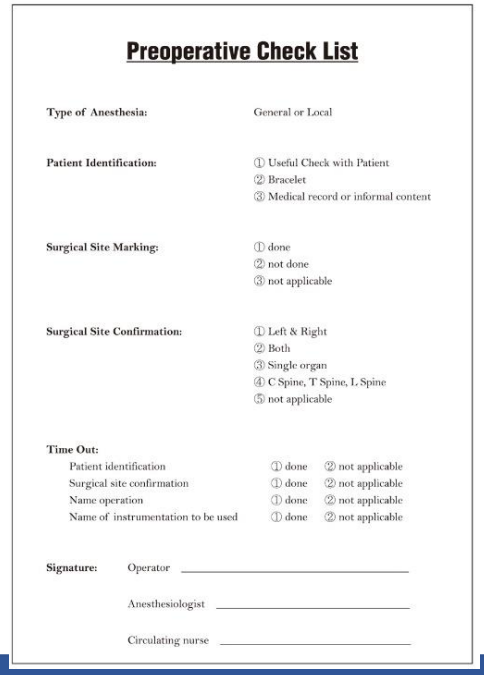
- Our results:
- **door-to-groin 37 min**

# In-hospital organization

- IAT protocol
  - Task list for every ‘team-member’
- Benchmark times
  - Door to imaging, Imaging to groin puncture, etc
  - Personel on call times (max driving time)
- Process evaluation
  - Internal (monthly/quarterly): cases, times, complications, etc
  - External: Registry, regional/national meetings, literature

# Treatment

- IAT protocol
  - Requirements: Materials, drugs, etc
  - Checklist: Imaging, patient information, allergies etc



**Preoperative Check List**

**Type of Anesthesia:** General or Local

**Patient Identification:**
① Useful Check with Patient
② Bracelet
③ Medical record or informal content

**Surgical Site Marking:**
① done
② not done
③ not applicable

**Surgical Site Confirmation:**
① Left & Right
② Both
③ Single organ
④ C Spine, T Spine, L Spine
⑤ not applicable

**Time Out:**

| | | |
|---|---|---|
| Patient identification | ① done | ② not applicable |
| Surgical site confirmation | ① done | ② not applicable |
| Name operation | ① done | ② not applicable |
| Name of instrumentation to be used | ① done | ② not applicable |

**Signature:** Operator _____

Anesthesiologist _____

Circulating nurse _____

# Treatment

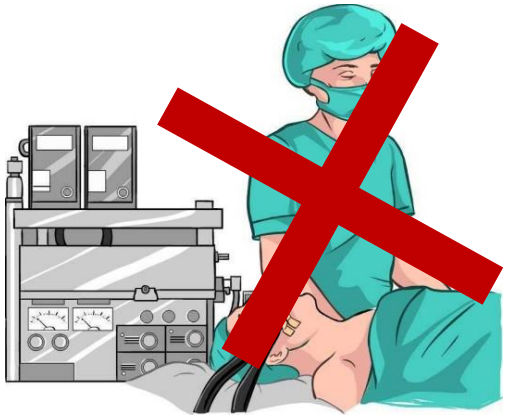
- IAT protocol
  - Requirements: Materials, drugs, etc
  - Checklist: Imaging, patient information, allergies etc
- Fixed set ready
  - Variations per physician
  - Variations per patient

# Treatment

- IAT protocol
  - Requirements: Materials, drugs, etc
  - Checklist: Imaging, patient information, allergies etc
- Fixed set ready
  - Variations per physician
  - Variations per patient
- Treatment strategies

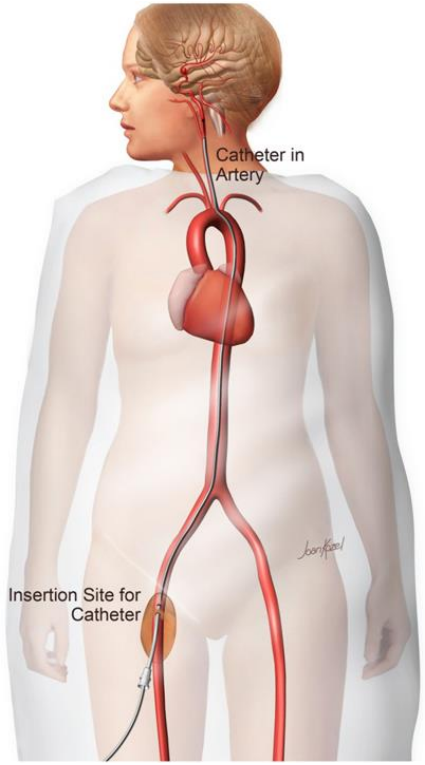
# Treatment

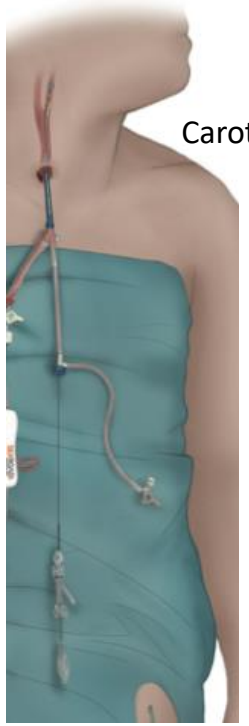
- Avoid General Anesthesia (GA)
  - If GA needed, keep Blood Pressure high

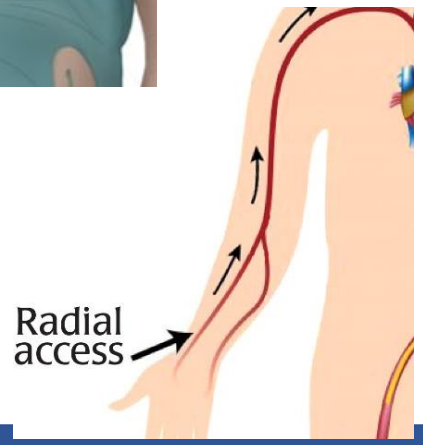


# Treatment

- Avoid General Anesthesia (GA)
  - If GA needed, keep Blood Pressure high
- Groin access
  - Radial access
  - Direct carotid access



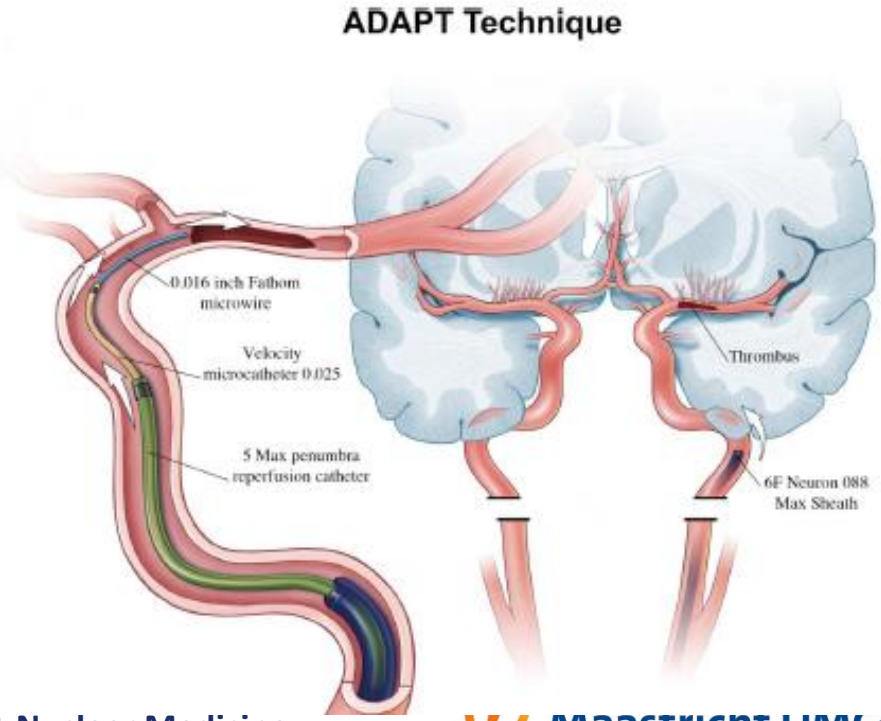



# Treatment

- Avoid General Anesthesia (GA)
  - If GA needed, keep Blood Pressure high
- Groin access
  - Radial access
  - Direct carotid access
- Use Balloon guide

# Treatment

- Avoid General Anesthesia (GA)
  - If GA needed, keep Blood Pressure high
- Groin access
  - Radial access
  - Direct carotid access
- Use Balloon guide
- Intermediate catheter
  - Support
  - Distal aspiration



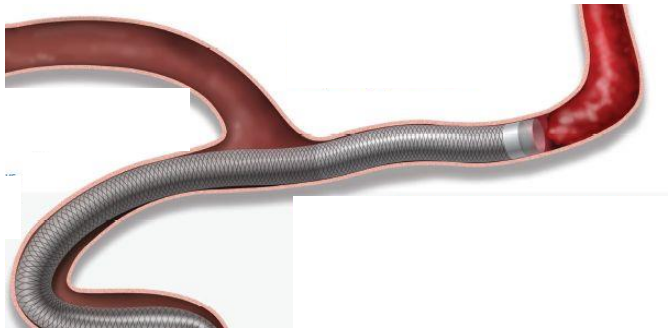
# Treatment

- Always use aspiration / flow reversal

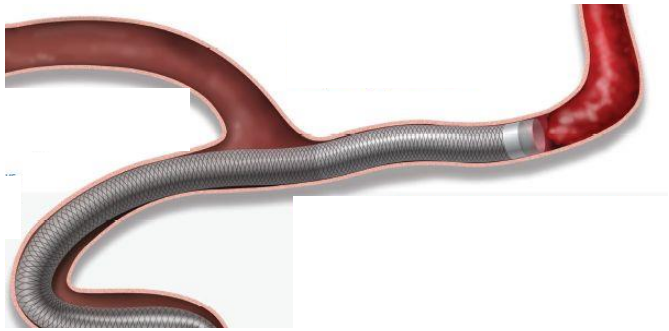
# Treatment strategy Maastricht

# Treatment

1. Aspiration



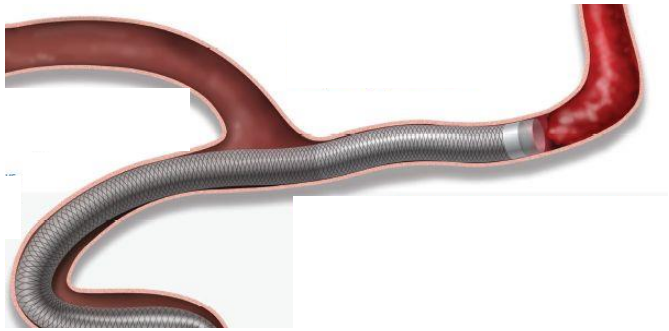
# Treatment



1. Aspiration

2. Stentretriever (Embotrap)
   - With distal aspiration (“Solumbra” technique)
   - Remove microcatheter

# Treatment



1. Aspiration

2. Stentretriever (Embotrap)
   - With distal aspiration (“Solumbra” technique)
   - Remove microcatheter

3. Larger stentretriever
   - Solitaire 6mm
   - Trevo 6mm

# Case

- 55 yo woman
- NIHSS 12
- Onset ro groin time 4.5 hrs
- Right M2 occlusion

# Case


2 attempts with aspiration (Sofia 5 Fr)

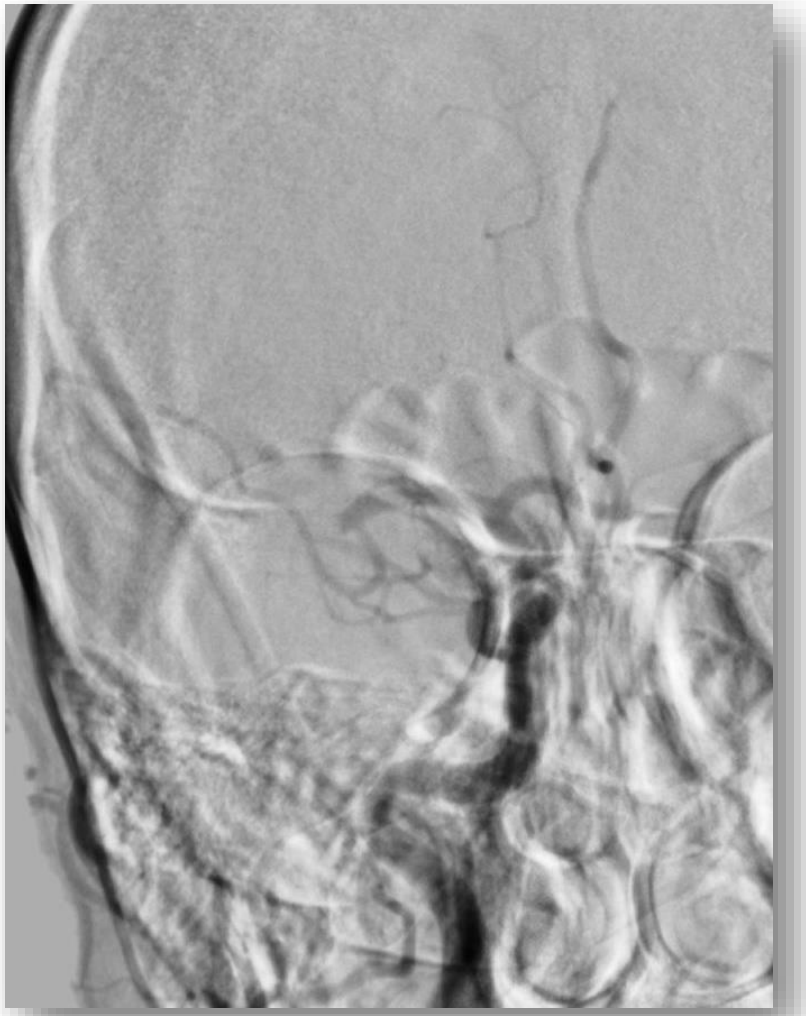
First attempt with Revive

# Case

Revive was too proximal

Second attempt with Revive

# Case

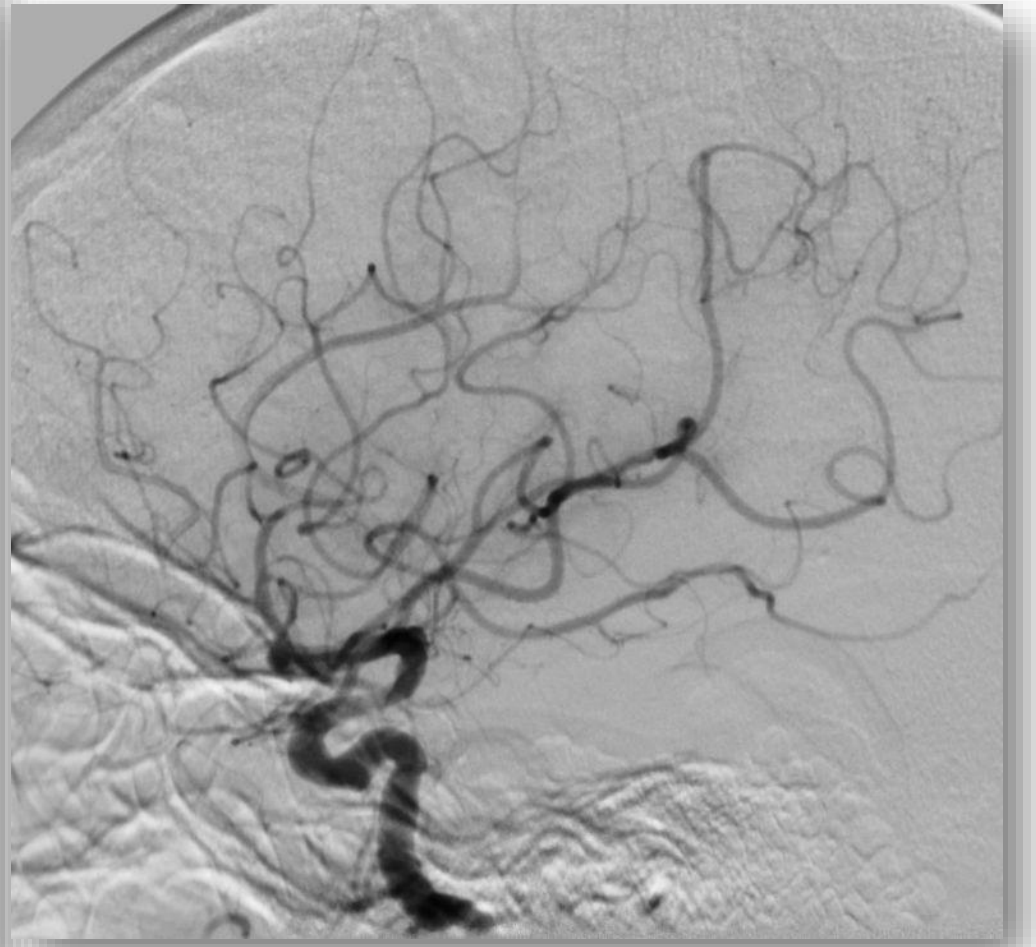


After third attempt with Revive

Next step: Solitaire 6 mm

# Case

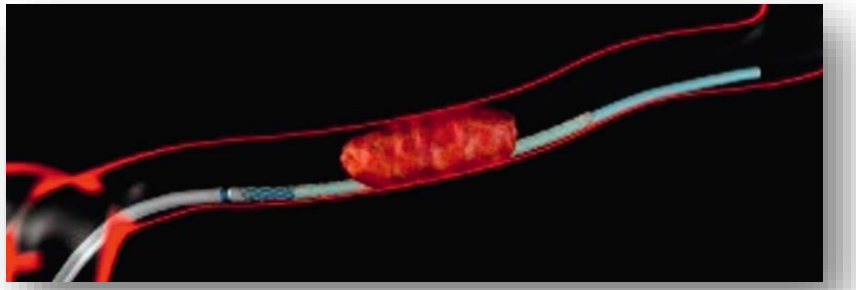
After first attempt with Solitaire 6mm

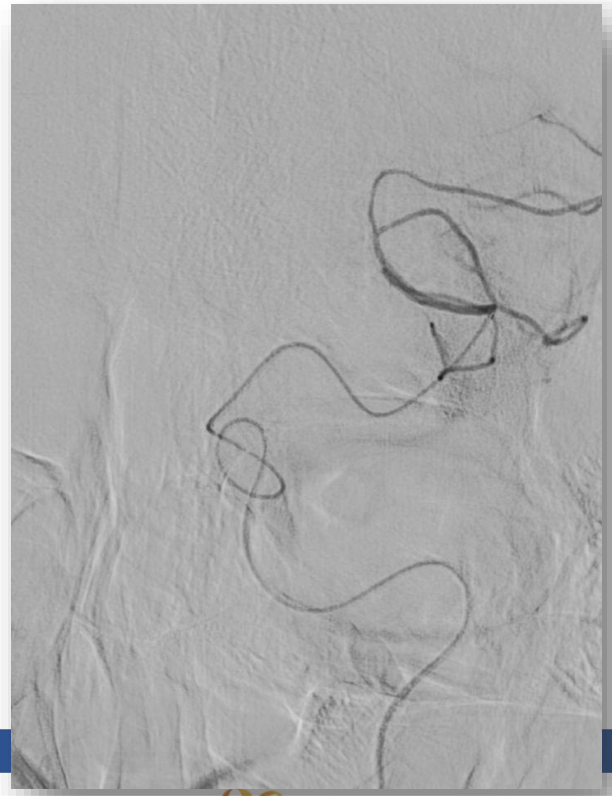


TICI 3

# Technique

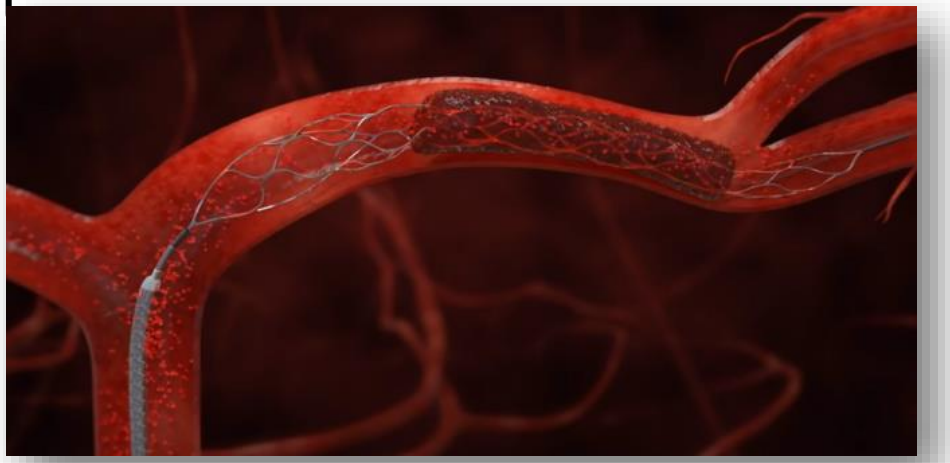
- Pass clot with microcatheter only (‘wireless’)





# Technique

- Pass clot with microcatheter only (‘wireless’)
- Place stent in and *distal* from clot



# Technique

- Pass clot with microcatheter only (‘wireless’)
- Place stent in and *distal* from clot
- Leave stent deployed for min 3 minutes

# Technique

- Pass clot with microcatheter only (‘wireless’)
- Place stent in and *distal* from clot
- Leave stent deployed for min 3 minutes
- Inflate balloon on guide catheter

# Technique

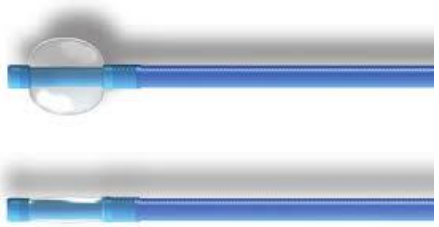
- Pass clot with microcatheter only (‘wireless’)
- Place stent in and *distal* from clot
- Leave stent deployed for min 3 minutes
- Inflate balloon on guide catheter
- Remove stent under continuous aspiration
  - On balloon guide
  - On intermediate catheter

# Technique

- Pass clot with microcatheter only (‘wireless’)
- Place stent in and *distal* from clot
- Leave stent deployed for min 3 minutes
- Inflate balloon on guide catheter
- Remove stent under continuous aspiration
- Aspirate (rest thrombus) from guide catheter

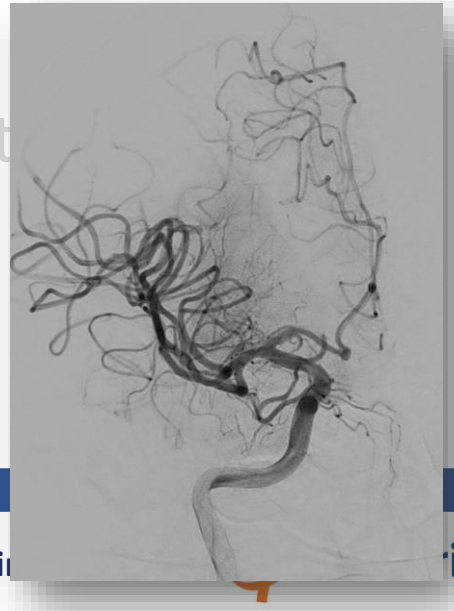
# Technique

- Pass clot with microcatheter only (‘wireless’)
- Place stent in and *distal* from clot
- Leave stent deployed for min 3 minutes
- Inflate balloon on guide catheter
- Remove stent under continuous aspiration
- Aspirate (rest thrombus) from guide
- Desufflate balloon



# Technique

- Pass clot with microcatheter only (‘wireless’)
- Place stent in and *distal* from clot
- Leave stent deployed for min 3 minutes
- Inflate balloon on guide catheter
- Remove stent under continuous aspiration
- Aspirate (rest thrombus) from guide cathet
- Desufflate balloon
- Make control angiogram



# Technique

- Pass clot with microcatheter only (‘wireless’)
- Place stent in and *distal* from clot
- Leave stent deployed for min 3 minutes
- Inflate balloon on guide catheter
- Remove stent under continuous aspiration
- Aspirate (rest thrombus) from guide catheter
- Desufflate balloon
- Make control angiogram
- Repeat if necessary

# Posterior circulation

- No balloon guide catheter
  - 6 Fr Envoy XB straight

# Thank you

- Questions?