

# Telemedicine to Facilitate Specialized Stroke Care in Local Hospitals.

## The German Experience

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# Disclosures

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## Funding:

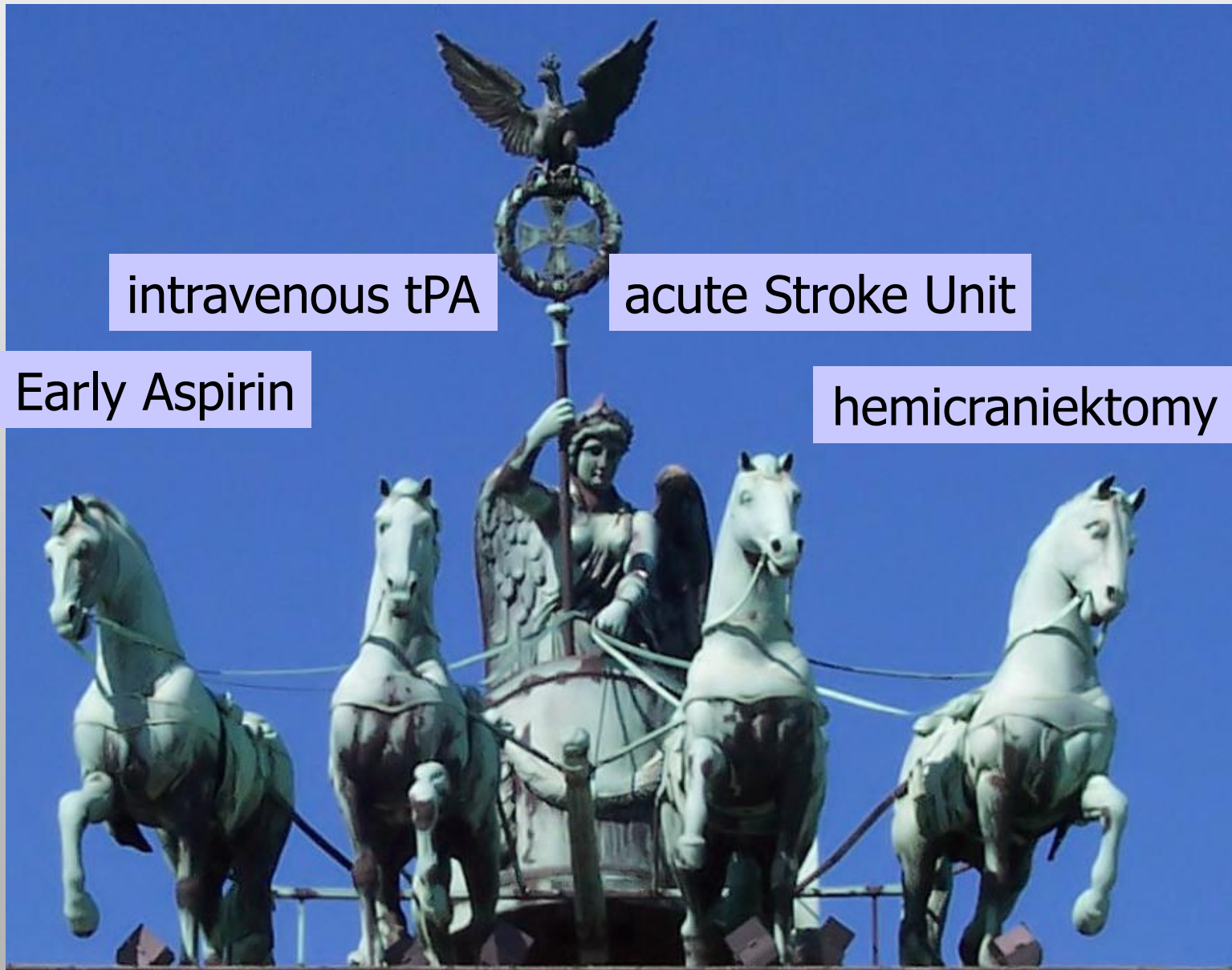
*TEMPiS* was funded by

- Bavarian health insurance companies
- Bavarian State Ministry for Social Affairs
- German Stroke Foundation
- Federal Ministry for Education and Research

Received speaker's fees (together <\$10,000 over last 3 years)

- Boehringer Ingelheim Pharma GmbH
- MEYTEC GmbH

# The four war horses of Stroke Care



intravenous tPA

acute Stroke Unit

Early Aspirin

hemicraniectomy

# WHO-Helsingborg-Declaration 1995:

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Target for 2005:

All patients with acute stroke should have access to care in specialized stroke units or from stroke teams

## Across the borders:

### We struggle to fulfill the recommendation

Stroke

(*Stroke*. 2007;38:2985.)

#### Facilities Available in European Hospitals Treating Stroke Patients

Didier Leys, MD, PhD; E. Bernd Ringelstein, MD, PhD; Markku Kaste, MD, PhD; Werner Hacke, MD, PhD  
for the Executive Committee of the European Stroke Initiative

- 11.4% of 448 hospitals met criteria of Stroke Units
- 3.3% of all stroke patients received thrombolysis

# Stroke expertise is not available

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- In many general hospitals without stroke/neurology departments
- In rural areas
- During nighttimes and weekends



**Access to „state of the art“ stroke care  
only**

**for a minority of stroke patients**

# Is there a real need for telemedicine?

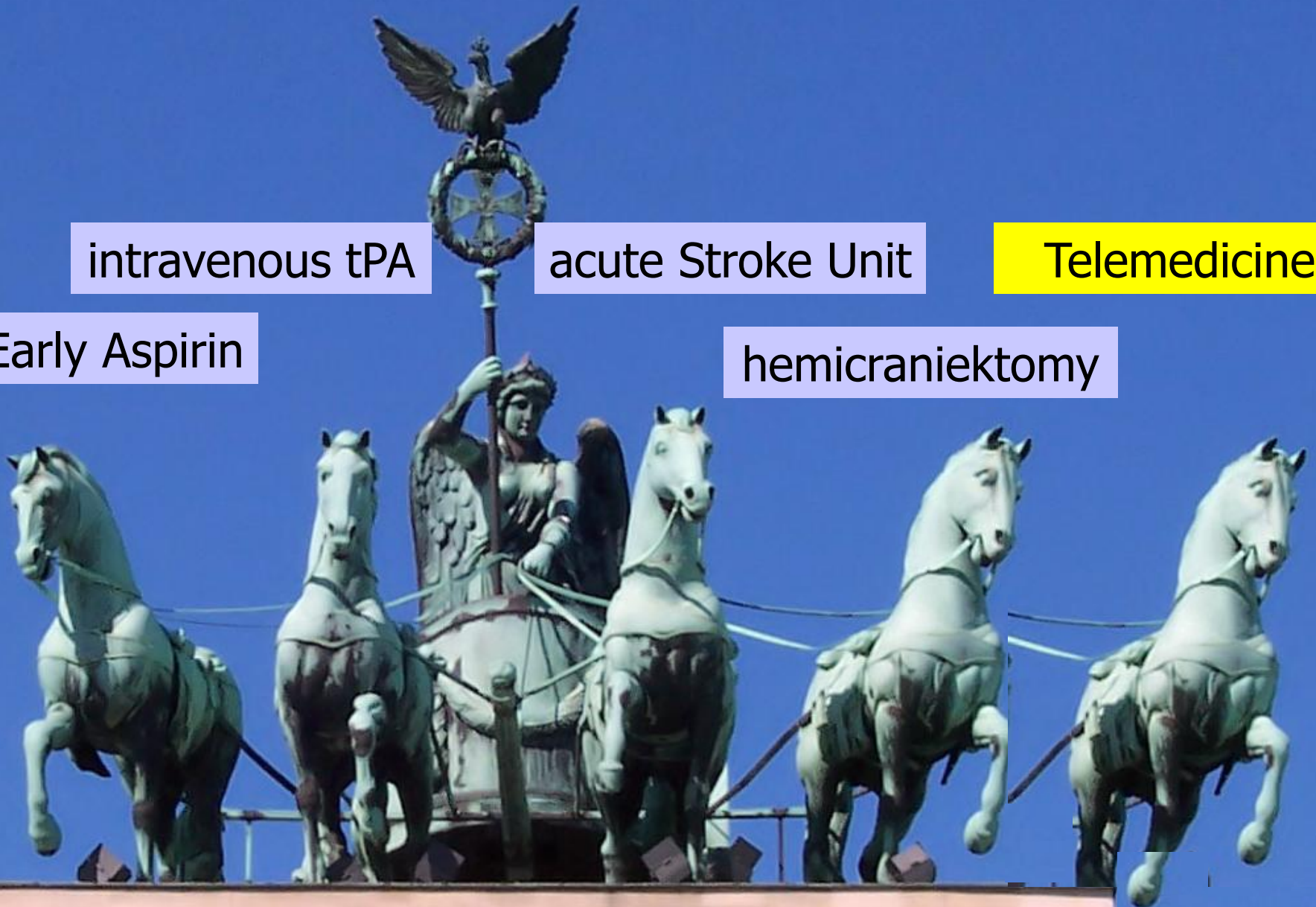
intravenous tPA

acute Stroke Unit

Telemedicine?

Early Aspirin

hemicraniectomy

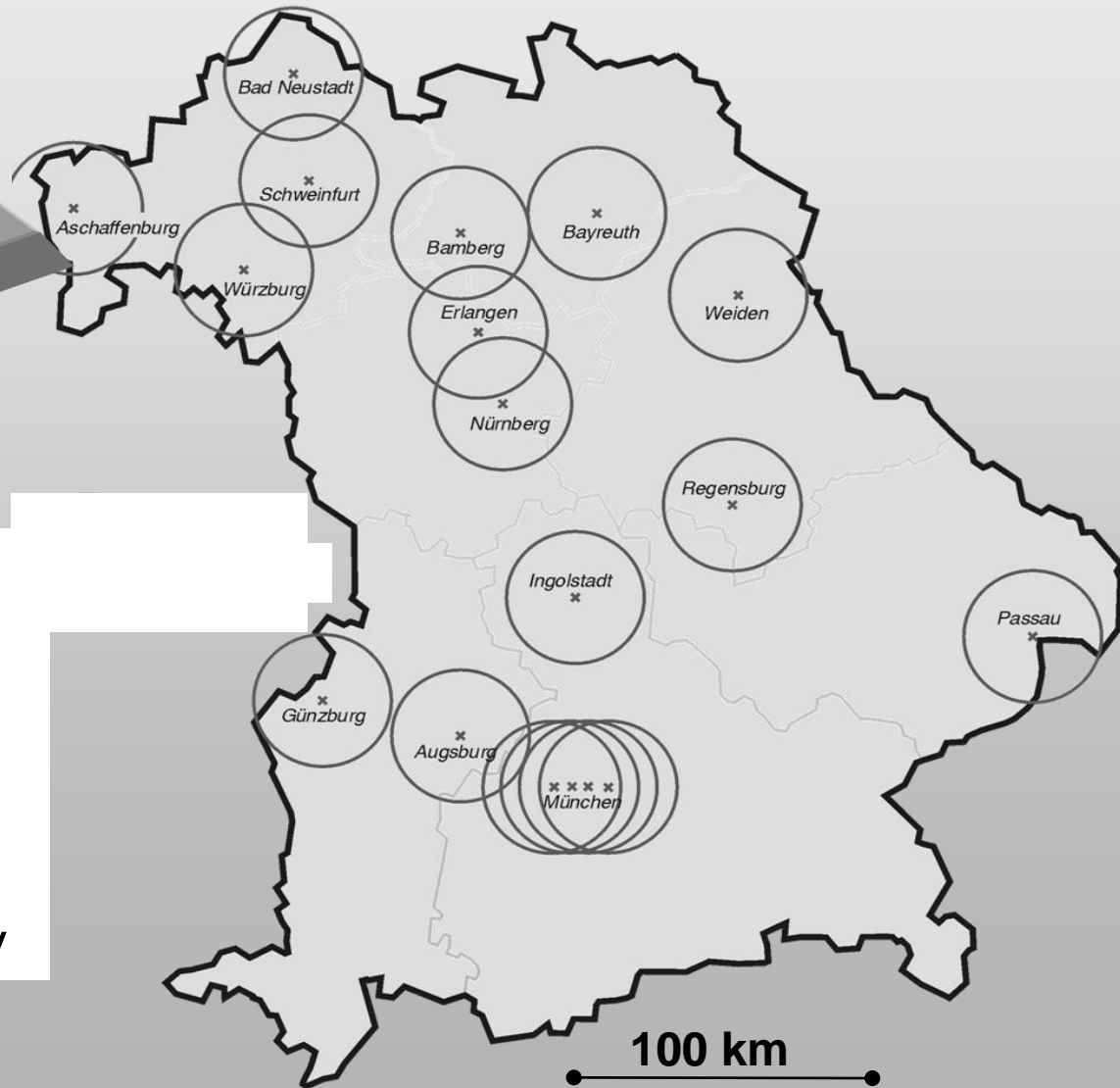


# Background



Germany

STROKE UNITS  
IN BAVARIA



100 km

## Stroke Care in General Hospitals

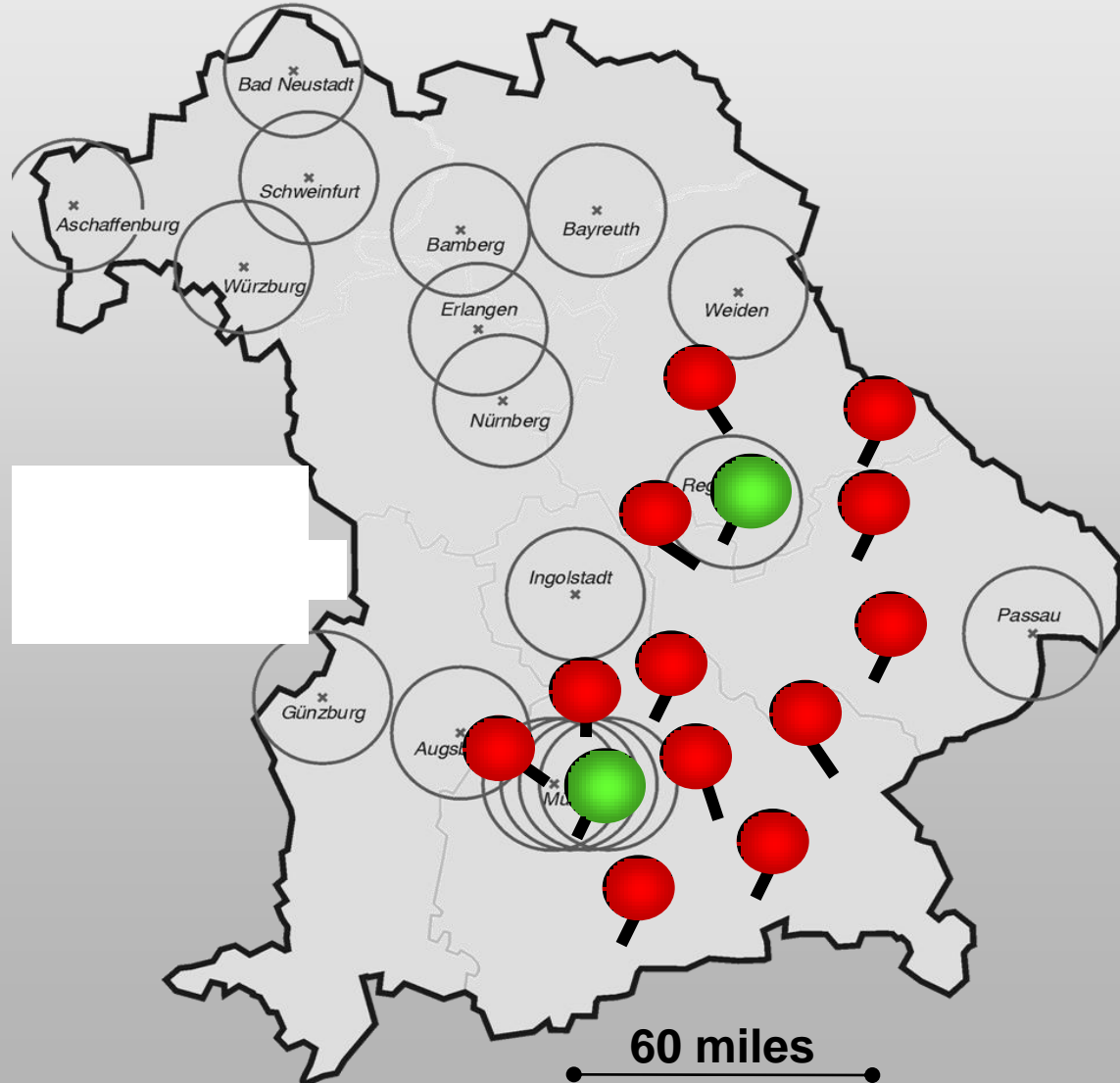
- No specialized stroke wards
- 3-month-mortality ~20%
- Thrombolysis only occasionally

# The Telemedical Project for integrative Stroke Care



STROKE UNITS  
IN BAVARIA

  
TEMPIS



1. Specialized stroke wards in each hospital
  - 24 hour availability of diagnostics/monitoring
  - Stroke teams
  - Standardized stroke care protocols
2. Comprehensive stroke training for all staff members
3. Continuous quality management
4. Telemedicine network
  - with 24 hour service (week-by-week rotation)
  - High speed data transmission

# Teleconsultation – Service

## Community Hospital



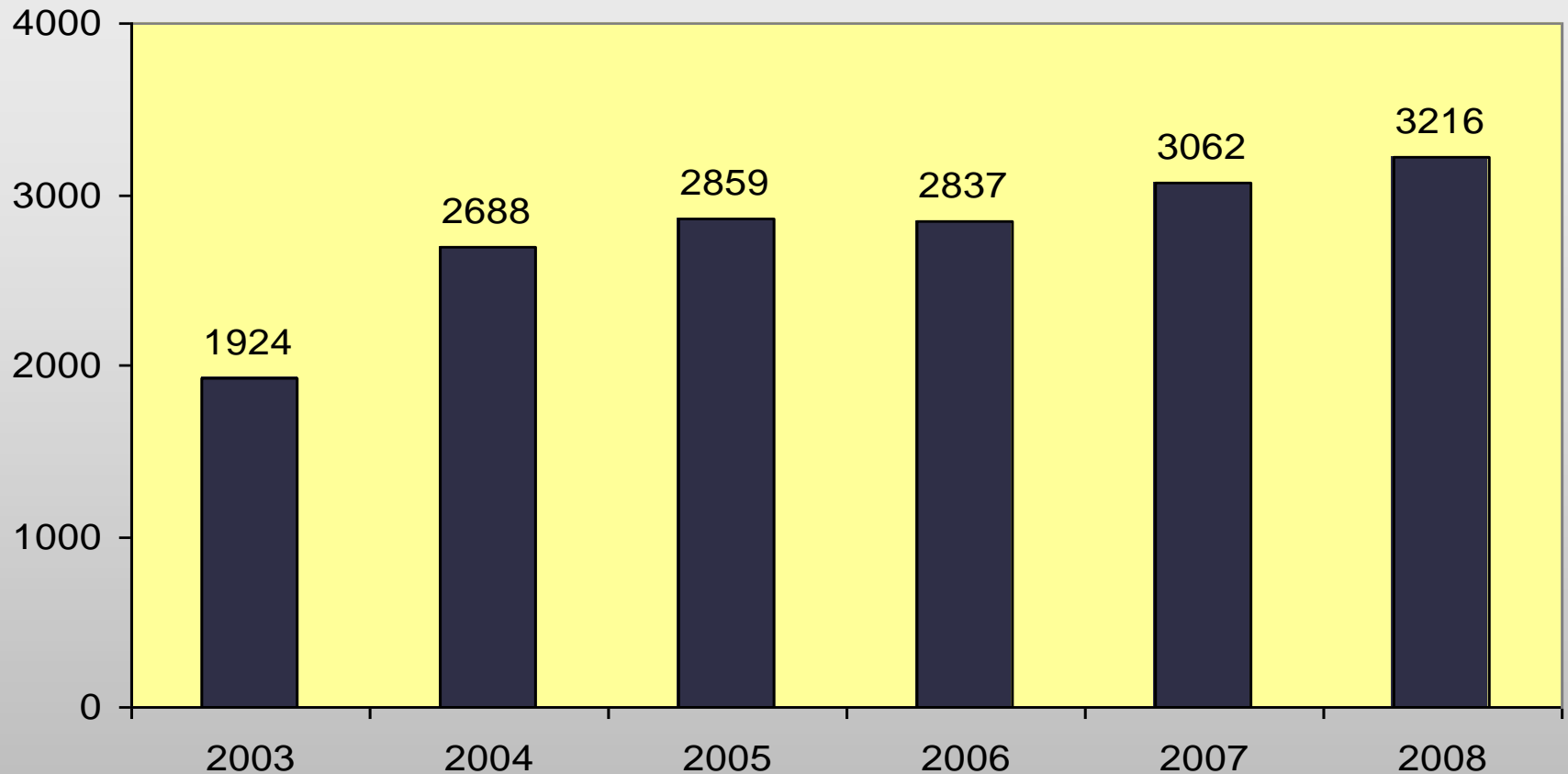
DSL

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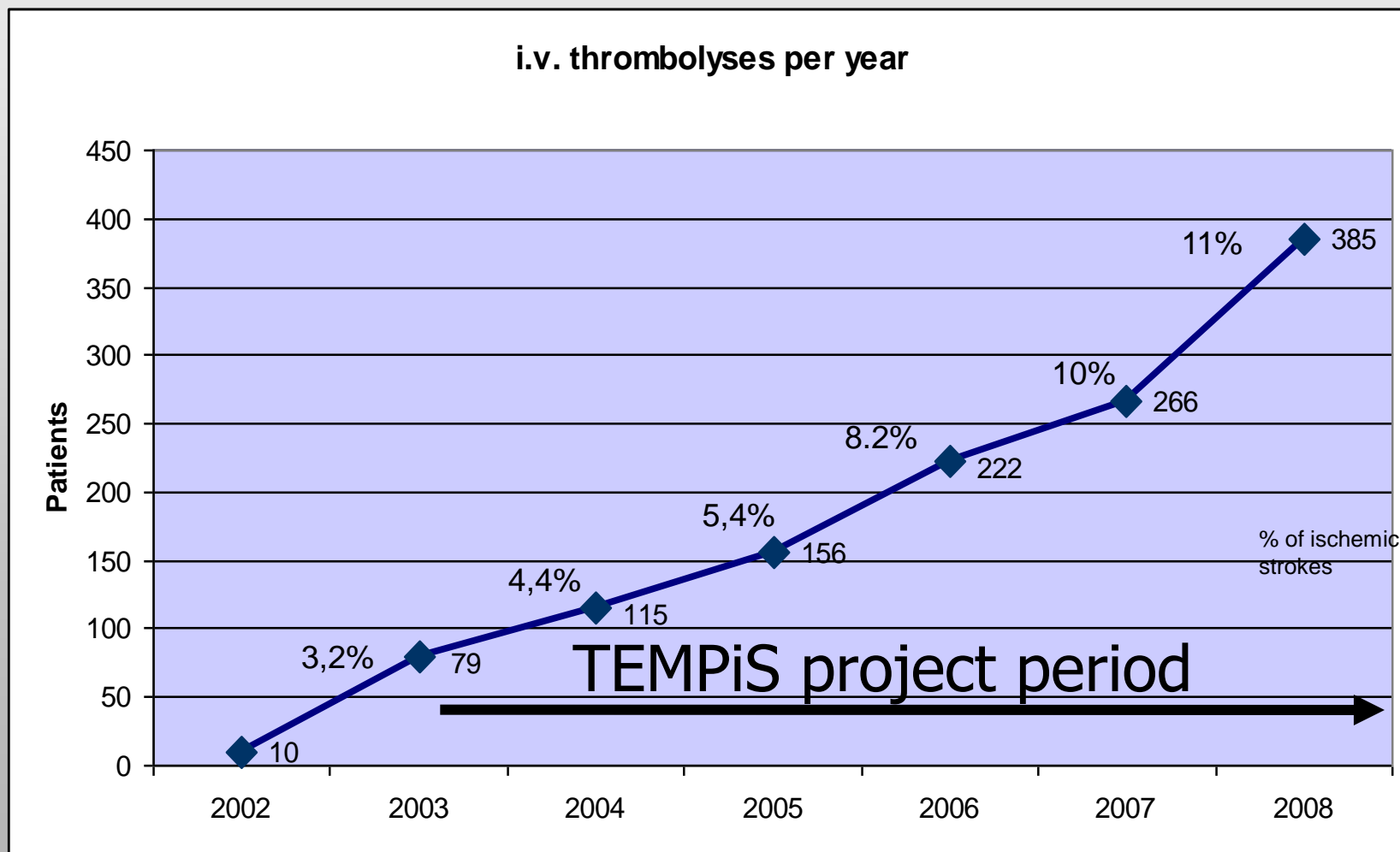
## Academic Stroke Center

# Teleconsultations per year



**~50% of all stroke admissions**

➤ 2002-2007



	<b>Cleveland</b>	<b><i>TEMPiS</i></b> <i>2003-2005</i>	<b>Pooled RCTs</b>	<b>SITS- MOST</b>
<b>Number</b>	70	<b>329</b>	464	6483
<b>Age</b> (mean)	69	<b>72</b>	70	68
<b>NIH-SS</b> (median)	n.a.	<b>12</b>	13	12
<b>Symptomat. hemorrhage*</b>	15.7%	<b>5.5%</b>	8.6%	7.3%
<b>3-month mortality</b>	n.a.	<b>11.2%<sup>#</sup></b>	17.3%	11.3%

\*NINDS-definition

<sup>#</sup>2003-2004

Audebert H, Kukla C, Clarmann S et al. Stroke 2005

Audebert H, Kukla C, Vatankhah B et al. Stroke 2006

Schwab S, Vatankhah B, Kukla C et al. Neurology 2007

# Evaluation of the network effects on overall outcome

## Funded by

- o German Stroke Foundation
- o Competence Network Stroke (BMBF)
- o Bavarian State and Health Insurances

Effects of the implementation of a telemedical stroke network

Audebert H, Schenkel J, Heuschmann PU et al. Lancet Neurol, 2006;5:742-48

## **Matched hospitals**

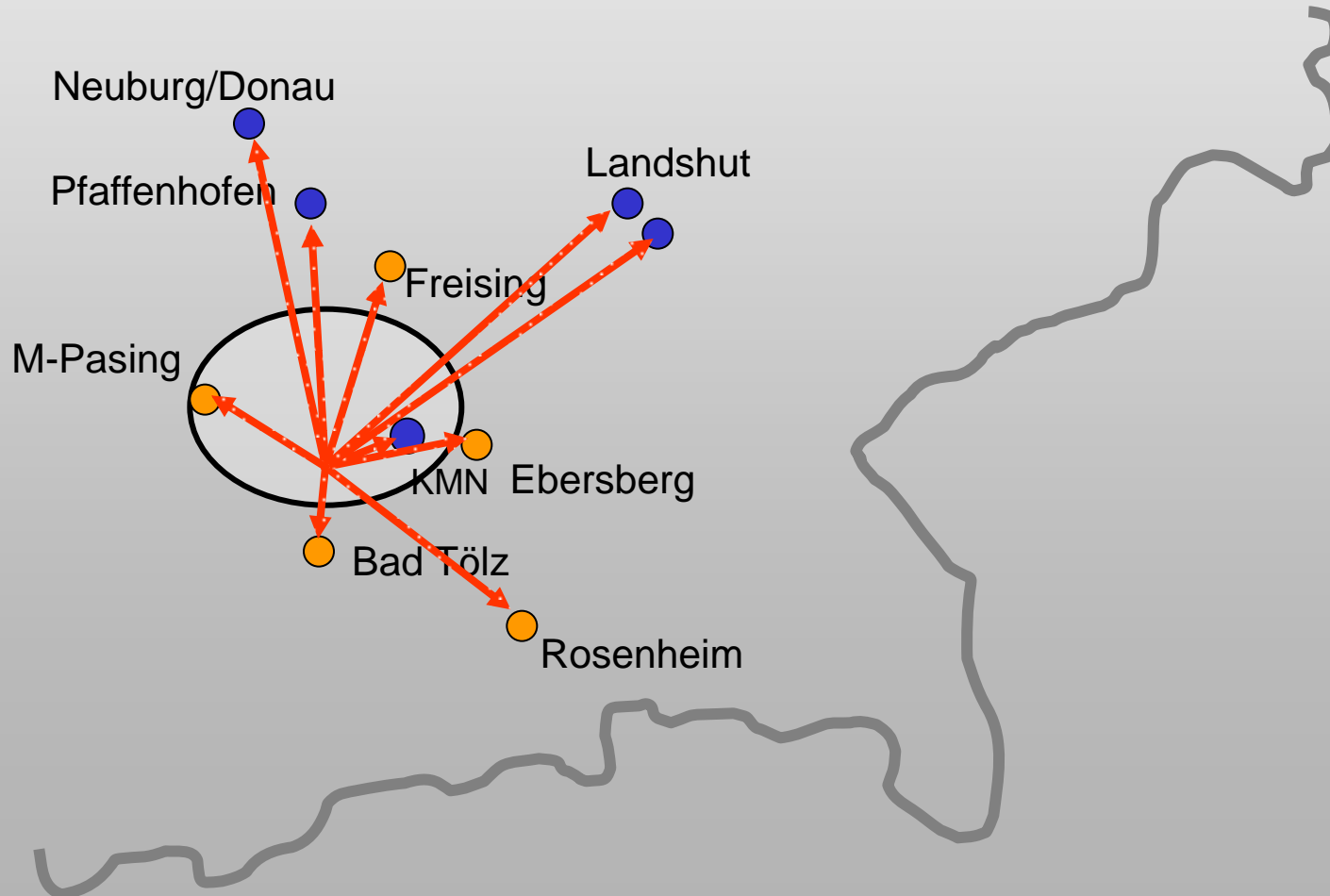
5 TEMPiS-network-hospitals and 5 other hospitals

comparable in



- ▶ size
- ▶ catchment area
- ▶ in-hospital infrastructure
- ▶ diagnostic techniques
- ▶ distance to next stroke center

Inclusion of all acute stroke patients previously living at home between July 2003 and March 2005

## Daily inclusion and on-site Monitoring



# Demographics and Subtypes

	TEMPiS	Control group
Numbers	<b>1938</b>	<b>1122</b>
Gender	 <b>49%</b>	 <b>53%</b>
Age [Mean, years]	<b>72.7</b>	<b>72.9</b>
Marital status	<b>43%</b>	<b>43%</b>
Ischemic	<b>88%</b>	<b>86%</b>
Hemorrhagic	<b>10%</b>	<b>11%</b>

# Stroke severity and risk factors

	TEMPiS	Control group	p
Stroke severity (severe-very severe)	<b>20%</b>	<b>19%</b>	--
Hypertension	<b>75%</b>	<b>72%</b>	0.13
Diabetes	<b>22%</b>	<b>29%</b>	<0.01
Atrial fibrillation	<b>24%</b>	<b>22%</b>	0.28
Prior stroke	<b>17%</b>	<b>23%</b>	<0.01

# Quality of Acute Stroke Care

	TEMPiS	Control group
Systemic tPA	<b>4.6%</b>	<b>0.4%*</b>
Rapid brain imaging	<b>74%</b>	<b>32%*</b>
Speech therapy	<b>82%</b>	<b>10%*</b>
Test of swallowing dysfunction	<b>73%</b>	<b>51%*</b>
In-hospital stay [days]	<b>10.7</b>	<b>11.9*</b>
External transfers	<b>11%</b>	<b>11%</b>

# Outcome after 3 months



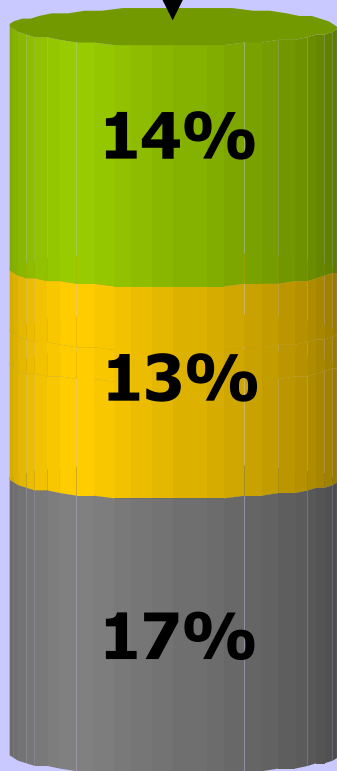
**0-1**  
no significant  
disability



**2-3**  
slight to moderate  
disability



**4-5**  
moderate  
to severe disability

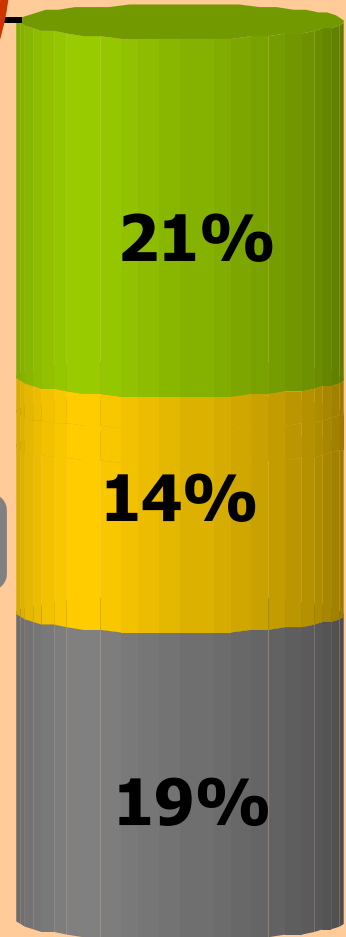


**TEMPiS**  
N=1971

**Disability**

**Institution**

**Mortality**

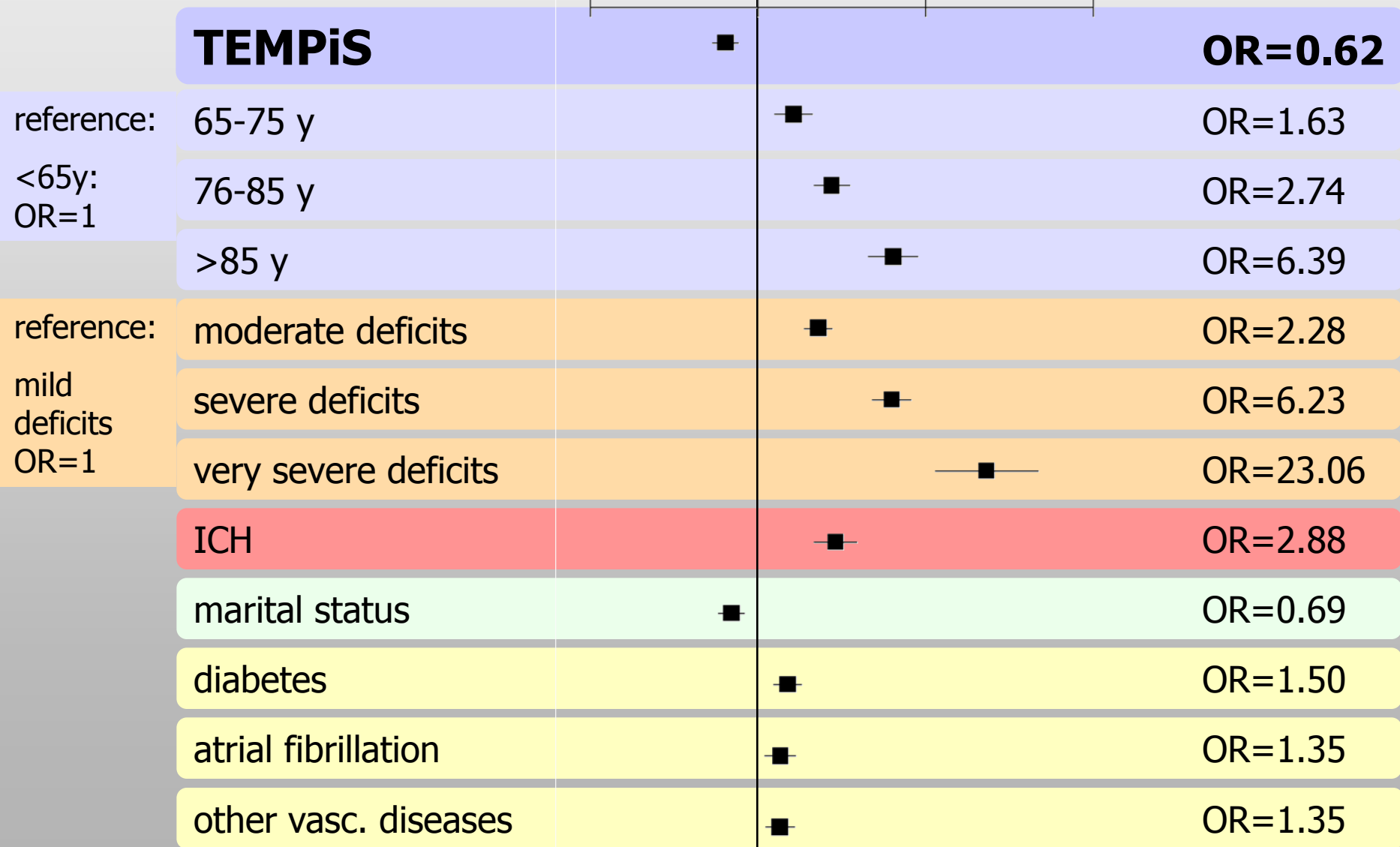


**Control group**  
N=1151

# After correction for possible confounders: Odds Ratios for Poor Outcome

(death + institutional care + disability)

0 1 10 100

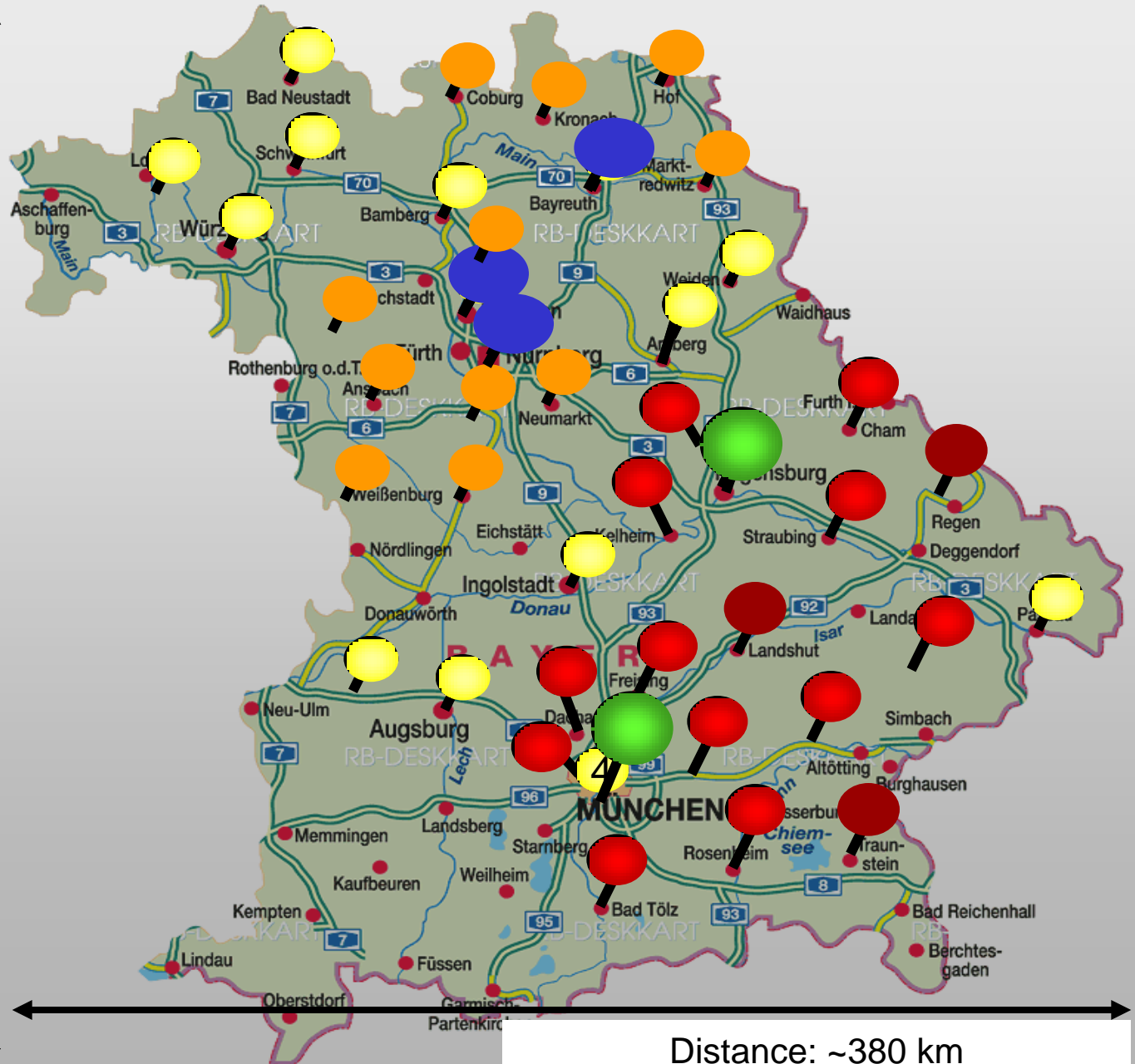


# Stroke Units in Bavaria 2008

12 million inhabitants

Distance: ~380 km

80 – 90% population coverage



Distance: ~380 km

# Lessons learned

- ✓ Telestroke is effective in
  - ✓ Remote stroke evaluation
  - ✓ Transfer of stroke expertise
  - ✓ Increase of i.v. tPA treatments
- ✓ Telestroke better if used within Stroke Unit concept
- ✓ Need for quality management
- ✓ More comprehensive systems need substantial reimbursement → savings in post-stroke care

## 1. Scalability

- Hubs
  - 2000-3500 teleconsultations per year
  - 10-15 hospitals to manage
- Spokes
  - Specialized facility → >200 strokes/year
  - Max. distance to hub ~150 miles

## 2. Reimbursement

- for telemedicine
- for quality management program
- for augmented medical staff

# What is the role of telemedicine?

Intravenous tPA

Acute Stroke Unit

Early Aspirin

Hemicraniectomy



# The true role of telestroke:



... to build a bridge to real world of stroke care