

# *Moving from Feasibility to Clinical Practice: TeleStroke supports a Statewide Stroke Center System*

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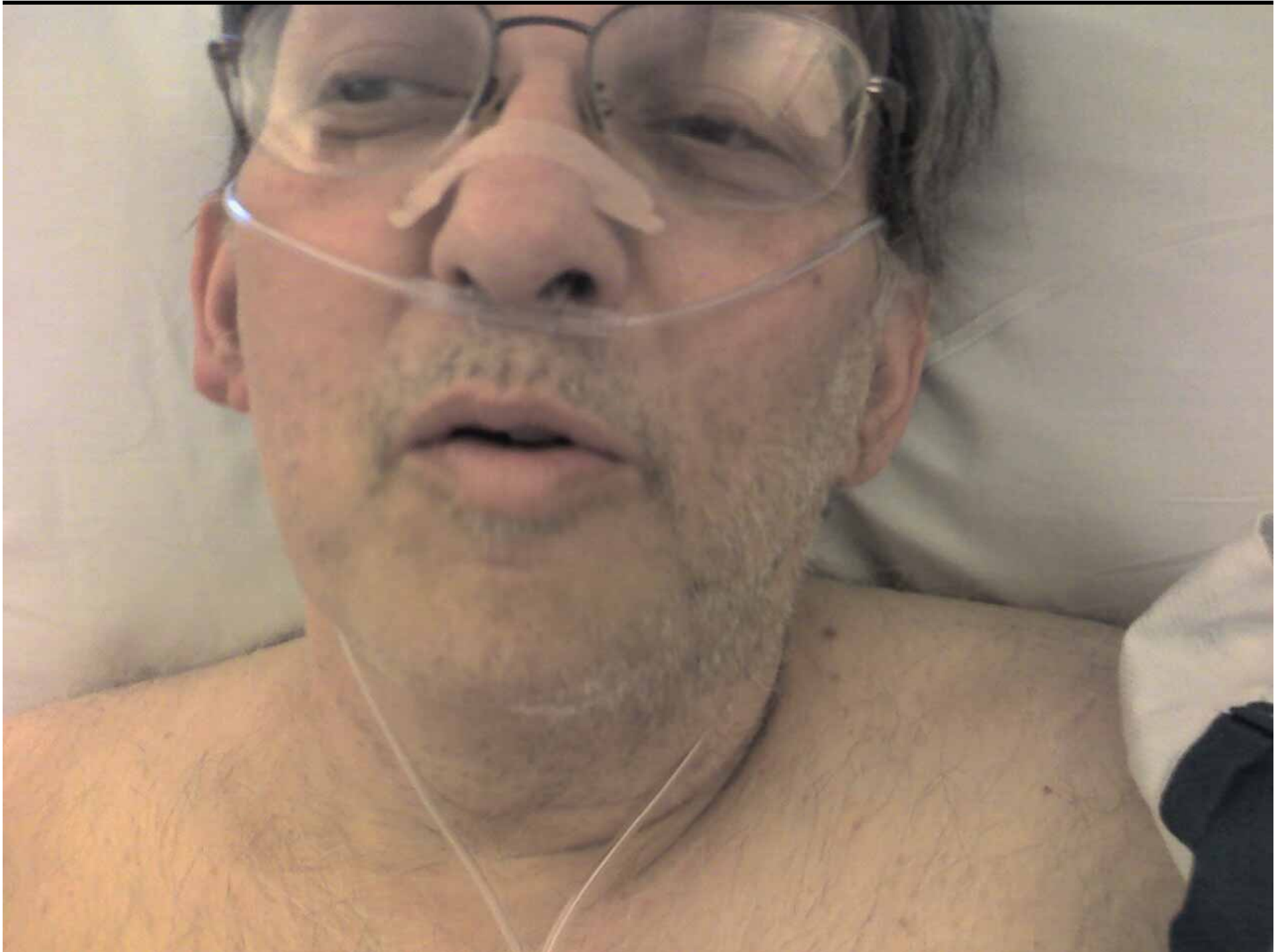
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Director, TeleStroke & Acute Stroke Services**

**Massachusetts General Hospital  
BOSTON, MA USA**

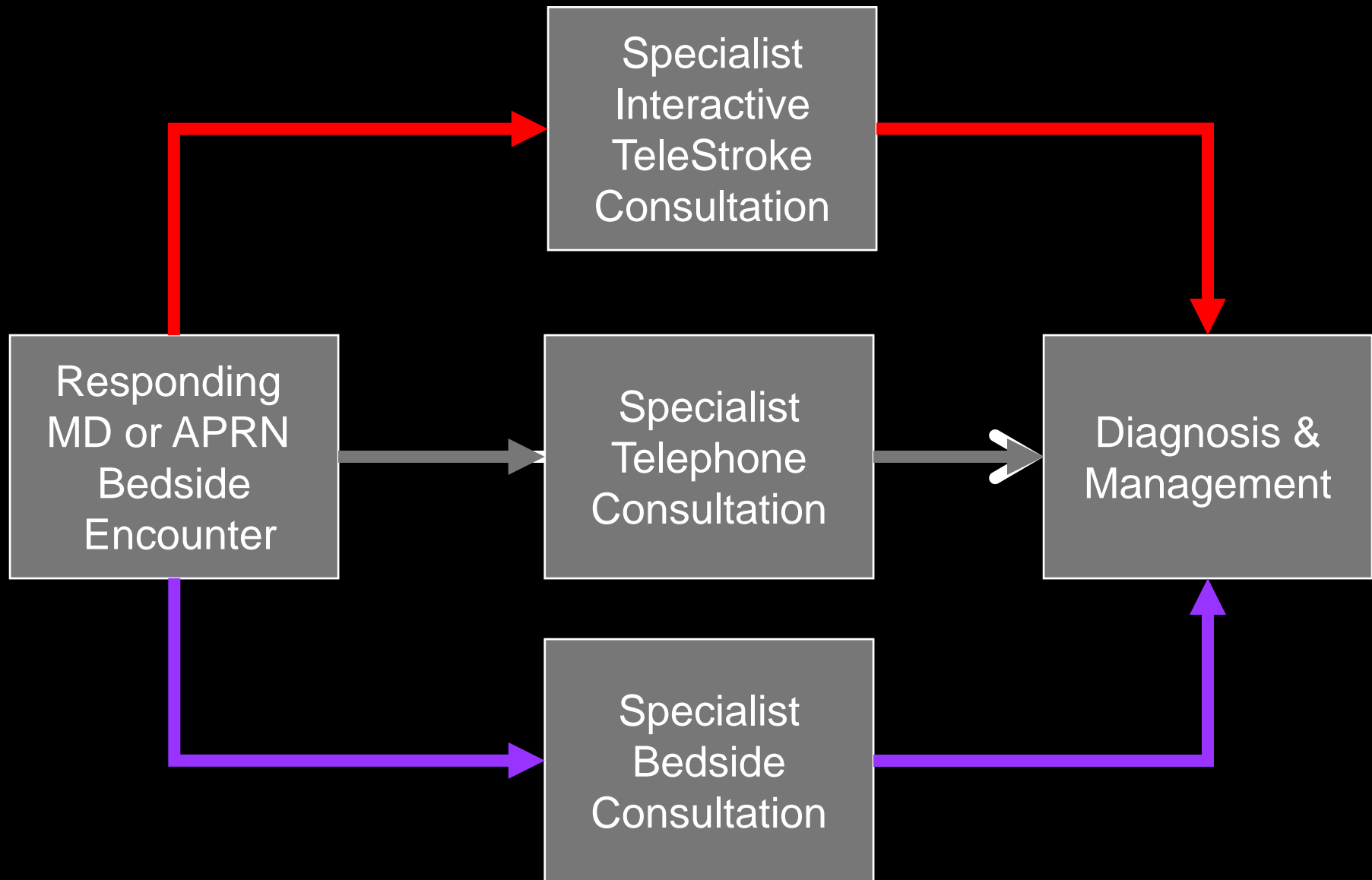


# Why TeleStroke?

- Evaluate and treat more patients
- Level the playing field for smaller hospitals and limited neurologist coverage
- Cost effective sustainable way to staff a low frequency, high impact event
- Concentrate the expertise (high volume providers but at low volume sites)
- Standardize care across the state
- Supports Stroke Centers
- Access to more treatment options via transfers



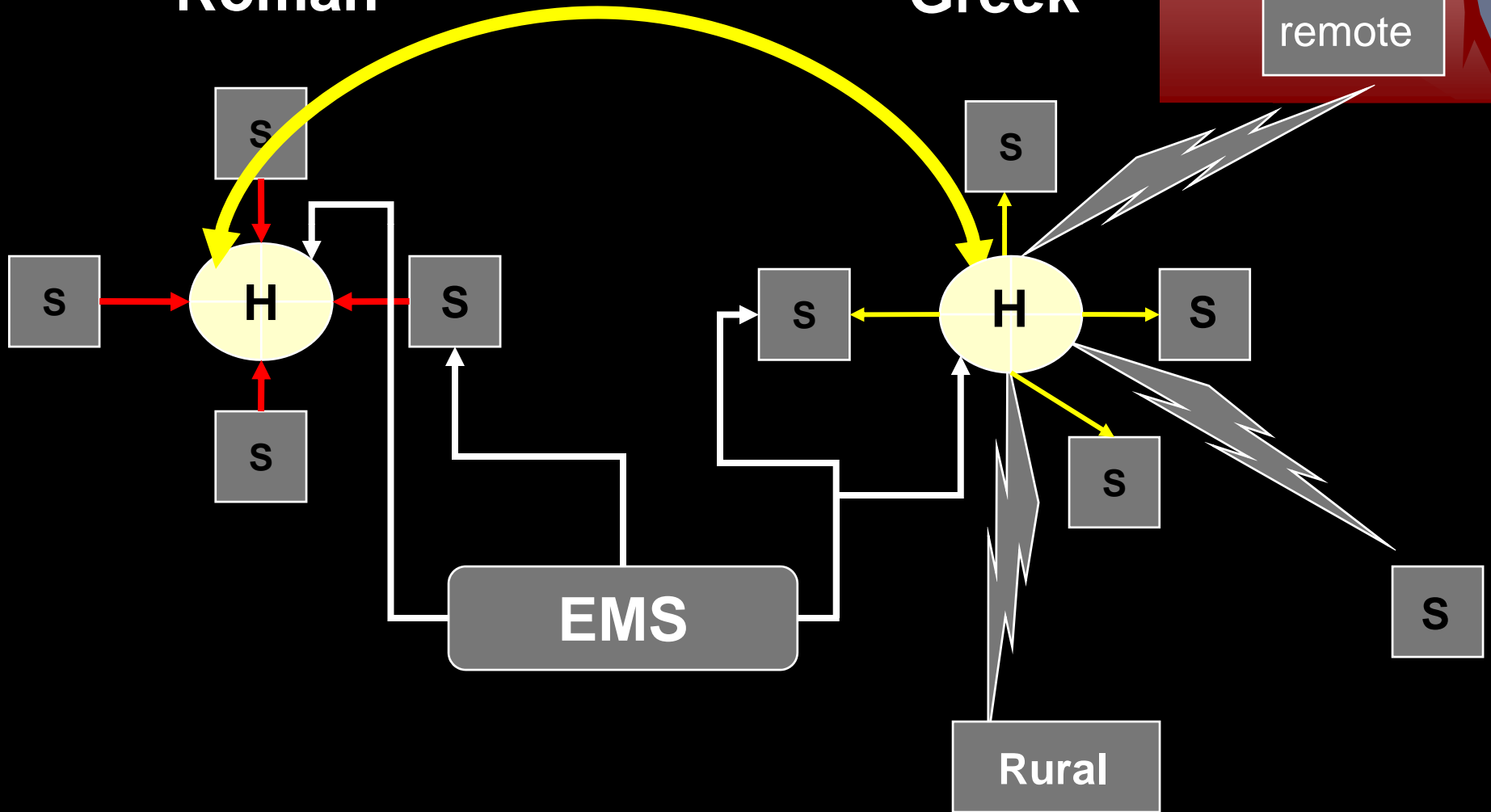
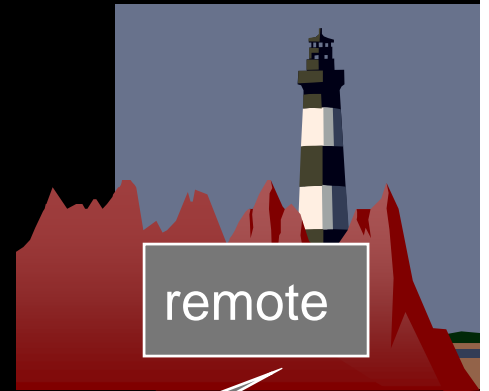
# Specialist Consultation Paradigms



# Stroke Team Designs

“Roman”

“Greek”



***“Never, ever, think outside the box”***



*“Never, ever, think outside the box.”*

# The “TeleStroke” Paradigm

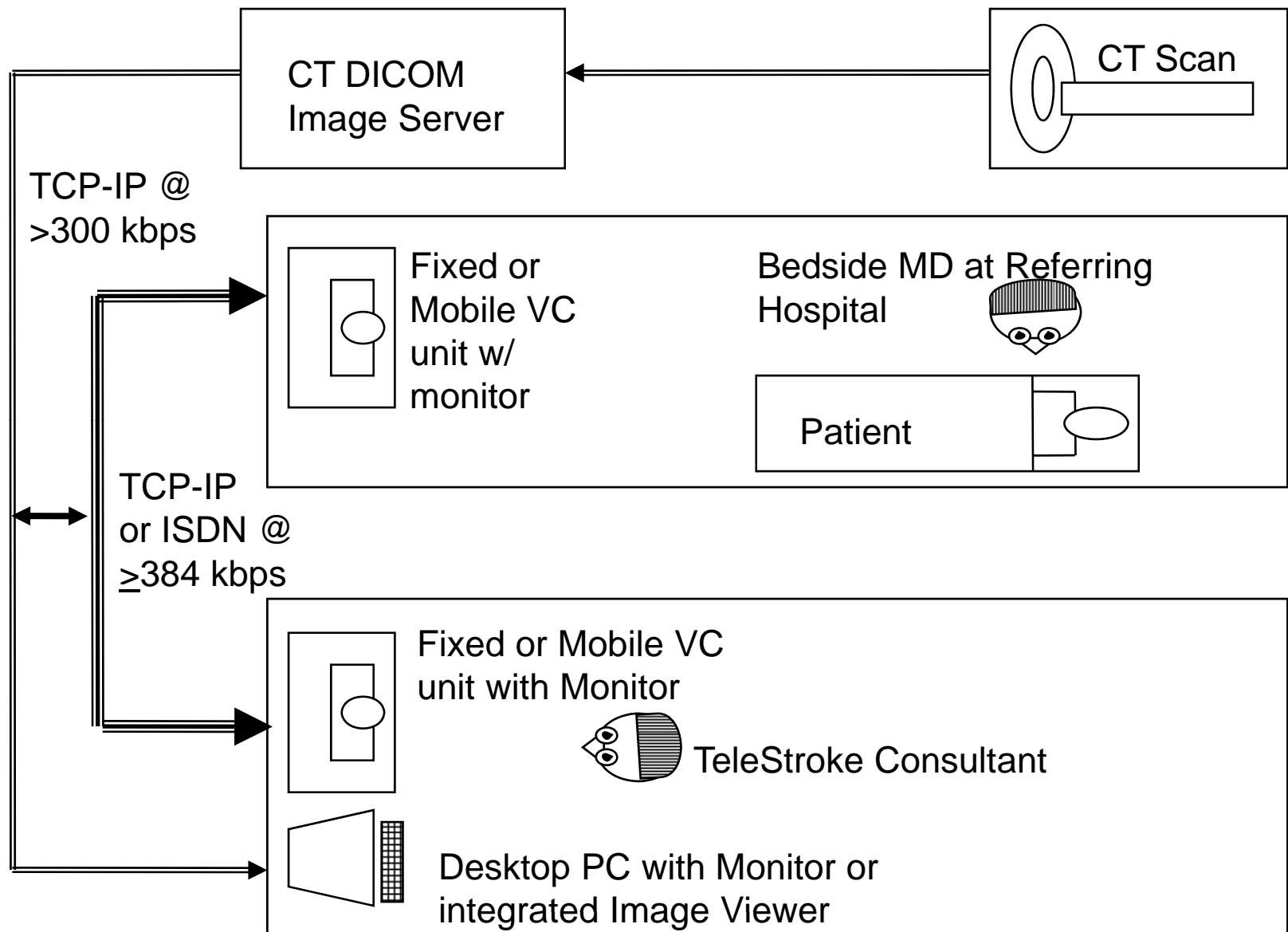
## Bedside Stroke Encounter

- Review history
- NIHSS
- Review Head CT
- Discuss Diagnosis & plan with MD & family



## TeleStroke Encounter

- Review history
- NIH<sup>T</sup>SS
- Review Head CT w/Teleradiology
- Discuss Diagnosis & plan w/MD & Family



## TeleStroke Audiovisual VTC Link

## Feasibility of remote exam: NIH<sup>T</sup>SS

- Validity of NIH<sup>T</sup>SS in sub-acute patients over a TeleStroke link<sup>1</sup>
- Ability to perform real-time NIH<sup>T</sup>SS with high inter-rater reliability<sup>2-4</sup>

<sup>1</sup>Shafqat S. *Stroke*. 1999;30:2141-2145

<sup>2</sup>Craig JJ. *J Telemed Telecare*. 1999;5:177-181

<sup>3</sup>Wang S. *Stroke*. 2003;34:e188-191

<sup>4</sup>Handschu R. *Stroke*. 2003;34:2842-2846





MGH TeleStroke

## CT interpretation for tPA exclusions

- Ability to identify exclusions to IV tPA in real-time<sup>5</sup>
- Neurologist vs. radiologist readers<sup>2,4</sup>
- Low-cost browser-based systems for DICOM image review
- High mortality among CT protocol violators treated with tPA<sup>1,3</sup>

<sup>1</sup>Hacke. *JAMA*. 1995;274(13):1017-25.

<sup>2</sup>Schriger DL. *JAMA*. 1998;279:1293-1297

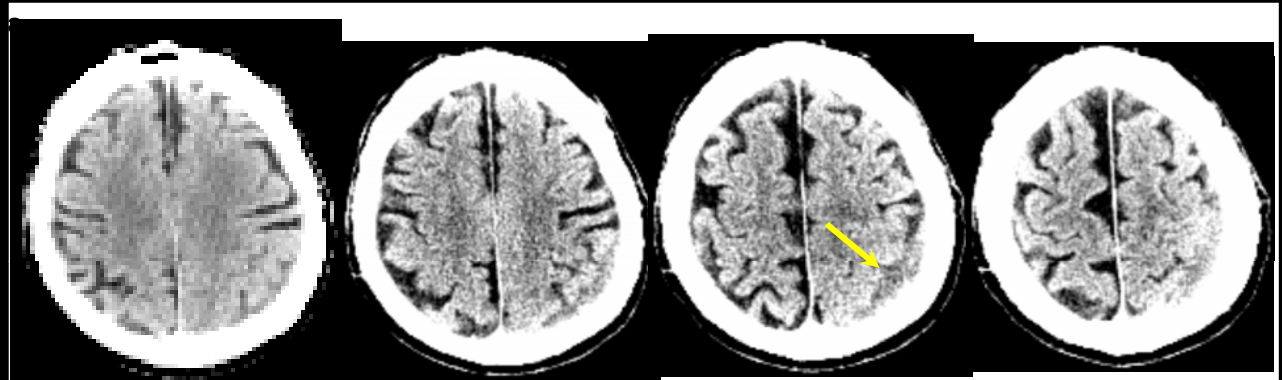
<sup>3</sup>Buchan AM. *Neurology*. 2000;54:679-684

<sup>4</sup>Johnston KC. *Telemed J E Health*. 2003;9:227-233

<sup>5</sup>Schwamm LH. *Acad Emerg Med*. 2004;11:1193-1197

# Representative Scans

**Subtle SDH**



**Early CT change**





## Imaging Conclusions

- Stroke neurologist interpretation of compressed non-contrast CT on desktop system was identical to Neuroradiologist for determining imaging criteria in t-PA eligibility
- Conclusion: Reducing the number of physician experts required to support acute stroke care may increase the likelihood of therapy

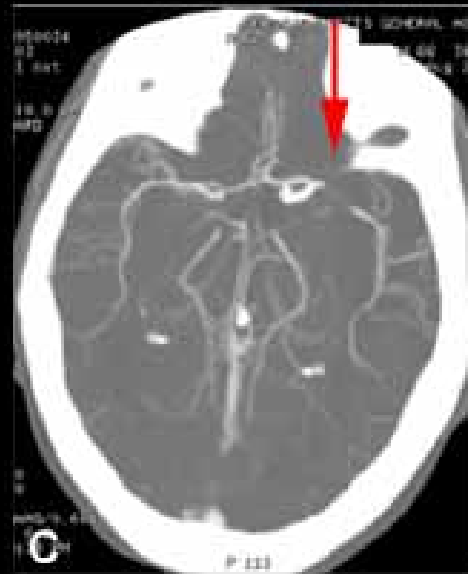
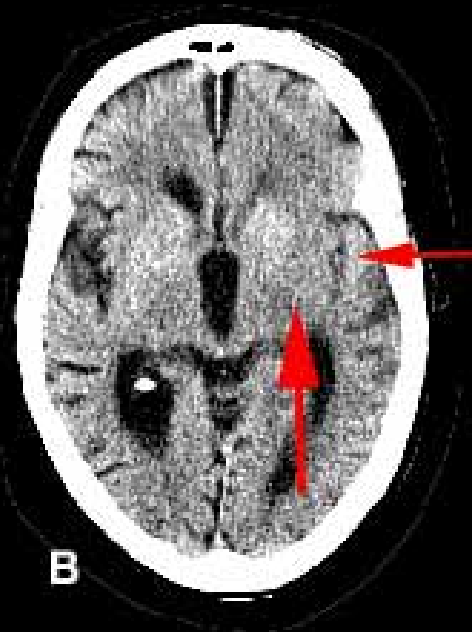
# Reliability of remote CT reading

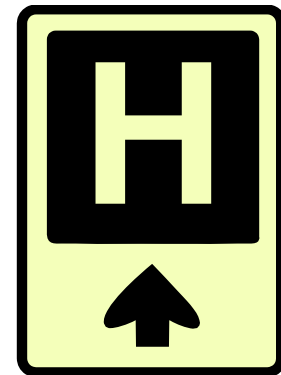
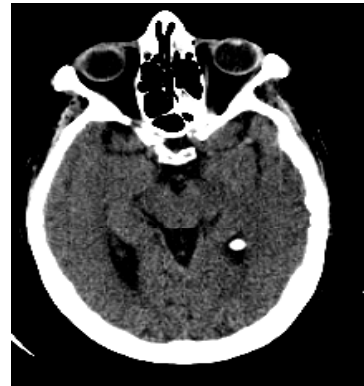
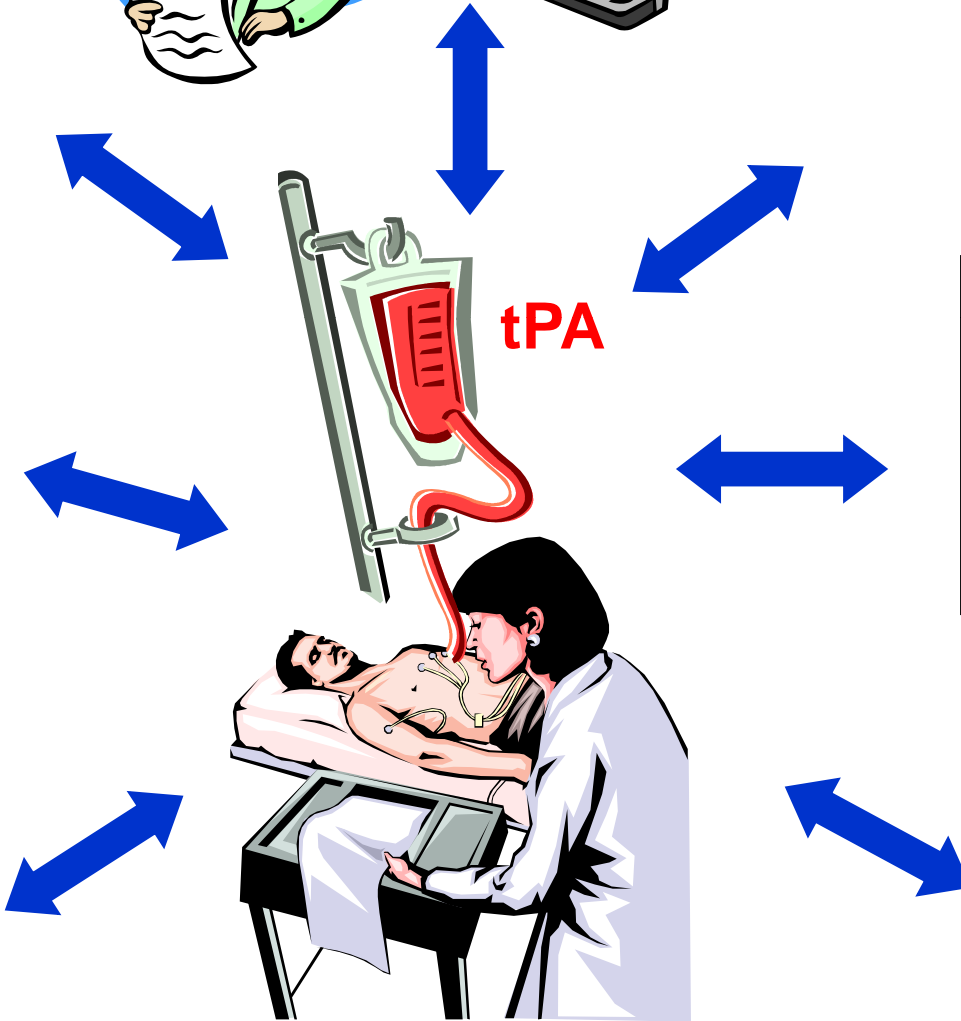
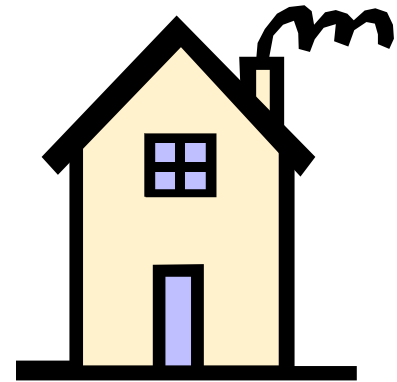
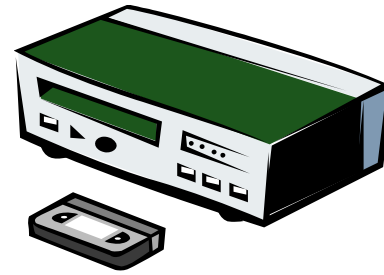
- Subsequently validated by others
- Readily available technology in use at most hospitals
- Easily accessible off hours at many sites
- Browser based, centralized



1<sup>st</sup> tPA case  
by MGH-  
TeleStroke:

88 RHBM  
with acute  
onset  
aphasia and  
hemiparesis  
at outlying  
hospital





**Distributed Access**



**ABOUT US**

**PATIENT CARE**

**EDUCATION**

**RESEARCH**

**PROTOCOLS**

**RESOURCES**

**SITEMAP**

### The Stroke Service at Massachusetts General Hospital

The Stroke Service Unit is composed of full-time Neurologists with special expertise in cerebrovascular disease.

Our patient care mission is to establish and provide the highest standard of care for patients with cerebrovascular disease.

Learn more [about us](#).



#### MAKING APPOINTMENTS

To schedule routine consult requests **please call the Stroke Service Office at 617-726-8459**. The office is open from Monday through Friday 9AM to 5PM.

- ▶ [Making appointments](#)
- ▶ [Patient Care services](#)
- ▶ [Our Staff](#)

#### EDUCATIONAL VIDEO



This **video simulation of an Emergency stroke evaluation** illustrates the care of patients with acute stroke by the MGH Acute Stroke team.

- ▶ [Watch Video](#)
- ▶ [Other Resources](#)

#### RESEARCH SPOTLIGHT



**BrainGate research well on its way ...**

- ▶ [BrainGate2 website](#)
- ▶ [Video \(CBS\)](#)
- ▶ [Read \(CBS\)](#)
- ▶ [Current research](#)

#### IN THE NEWS



**The MGH Neurology Department placed 4th in US News Neurology /**

NeuroSurgery rankings for 2007.

- ▶ [Neurology rankings](#)
- ▶ [Hospital Honor Roll](#)
- ▶ [Other News articles](#)

# PARTNERS TELESTROKE CENTER



MASSACHUSETTS  
GENERAL HOSPITAL



BRIGHAM AND  
WOMEN'S HOSPITAL

## MEMBER LOGIN

Username

Password

Login

[ [Sign-Up](#) | [Lost my password](#) ]



*The TeleStroke Center*  
your connection to world-class stroke care

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### ABOUT TELESTROKE



Through telemedicine, stroke specialists from Brigham and Women's Hospital and Massachusetts General Hospital can examine patients at your hospital to help diagnose the patient's ailment and recommend a plan of care. [ [About TeleStroke](#) ]

### OUR SERVICES



By joining the Partners TeleStroke network, your hospital will receive 24-hour acute stroke expertise-on-demand, as well as the added expertise of a world renowned stroke center. [ [Our Services](#) ]

### IN THE NEWS



CBS News:

#### Timing Key For Stroke Recovery

Dr. Jon LaPook looks at two drugs, one made from bat venom, that can limit the damage from a stroke if they're administered fast enough. [ [In the News](#) ]

### GRAND ROUNDS / CME



Latest Conference:

#### Stroke - Current Best Practice

By Mary Amatangelo MS APRN-BC  
CCRN CEN

January, 31, 2007 @ 3:30 PM

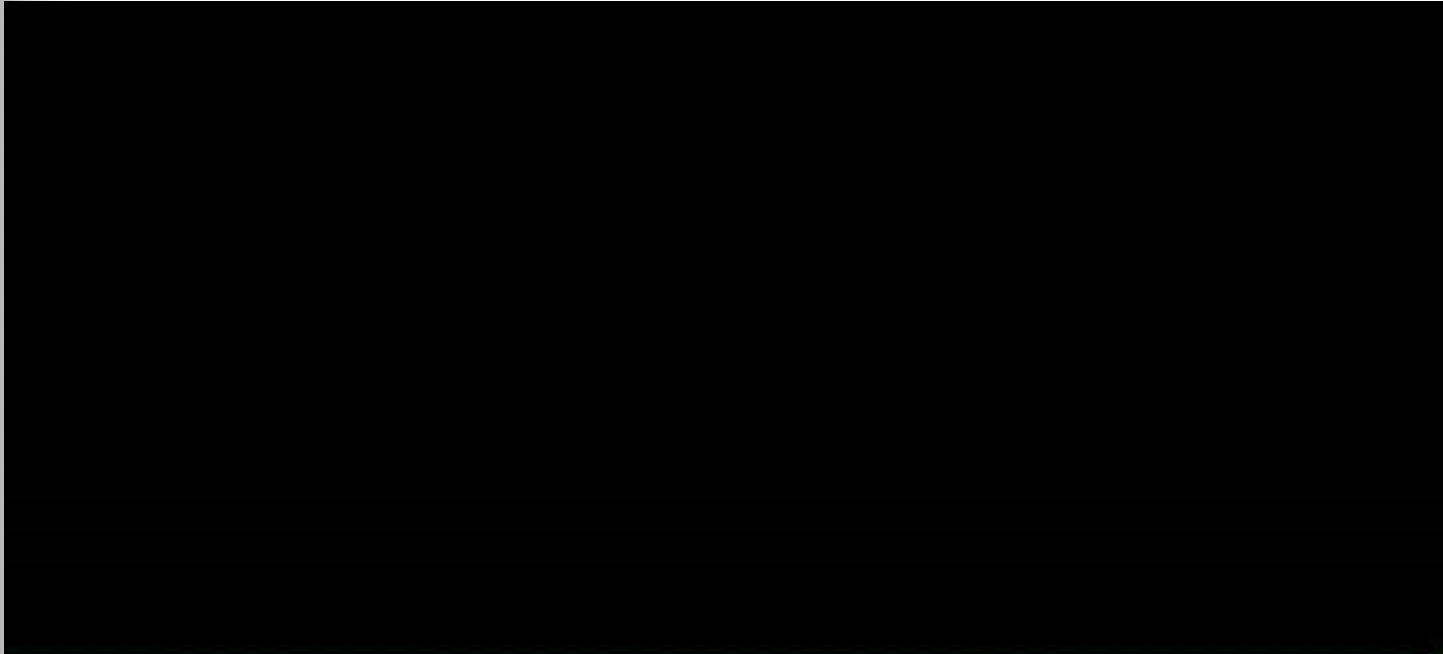
[ [Grand Rounds](#) ]

[www.TeleStrokeCenter.com](http://www.TeleStrokeCenter.com)

# Confirming the “reported” exam...



Actual picture quality during consultation is better than can be shown in powerpoint clips



# NIHSS 5: Motor Arm

JH #5 2/27/04

## Expect the unexpected...

- Chief Complaint is intermittent Left Arm Drift and Weakness
- Use of simultaneous interpretation





**NIHSS #5: Motor Arm**  
**MVH #32**

# User Satisfaction with TeleStroke

- Patients
- Emergency Physicians
- Stroke Experts

<sup>1</sup>Schwamm LH. *Acad Emerg Med*.  
2004;11:1193-1197

<sup>2</sup>Craig J. *J Telemed Telecare*. 1999;5:237-241

<sup>3</sup>Wiborg A. *Stroke*. 2003;34:2951-2956

# Excluding Stroke Mimics



MGH TeleStroke

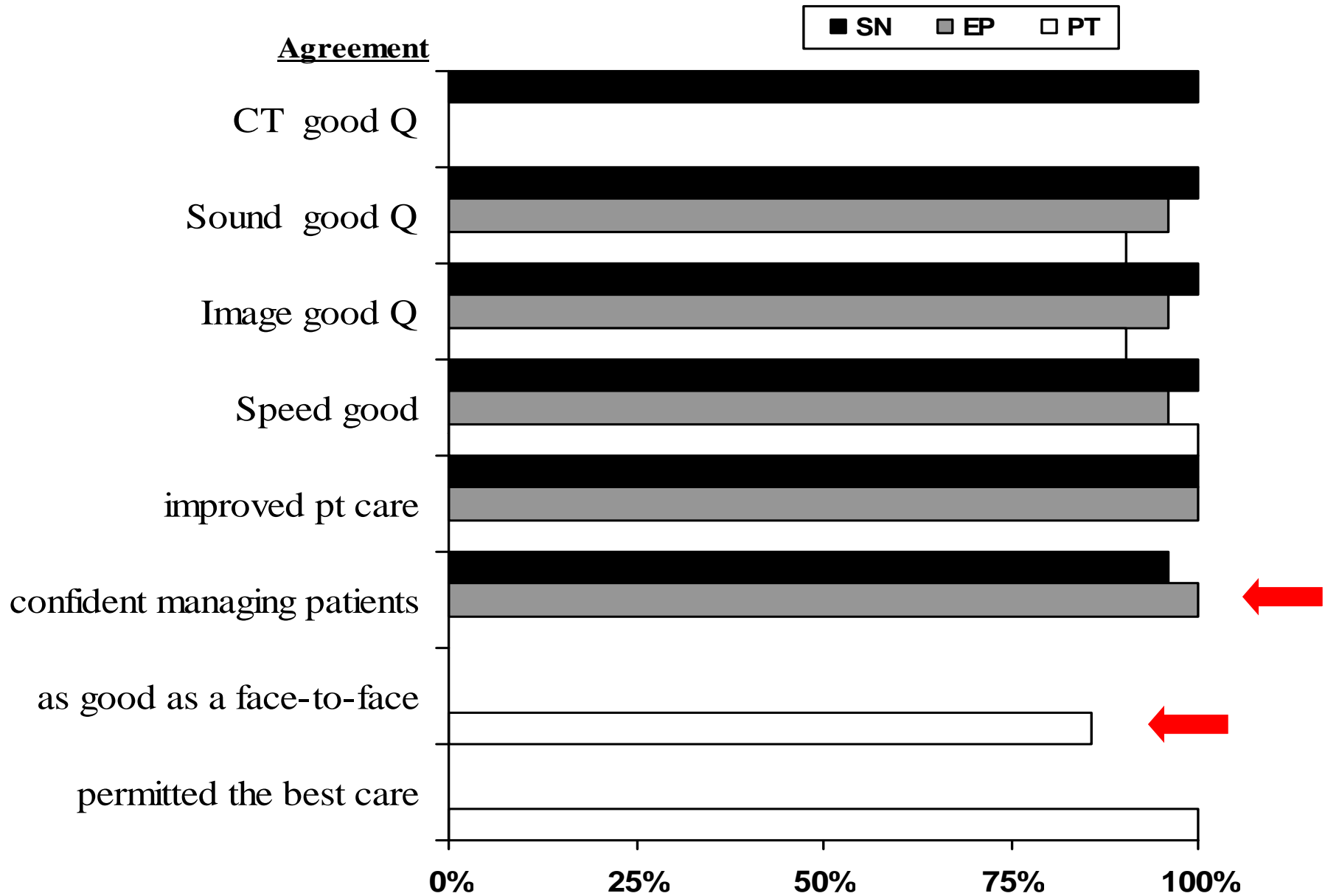
**Doctor & Patient comments**  
JH #6 4/13/04

Everyone should have a  
spokesperson like this...



MGH TeleStroke

**Patient/Family comments**  
MVH #25 10/25/02



# National Recommendations 2005

## ASA Policy Recommendations

### Recommendations for the Establishment of Stroke Systems of Care

#### Recommendations From the American Stroke Association's Task Force on the Development of Stroke Systems

##### Task Force Members

Lee H. Schwamm, MD; Arthur Pancioli, MD; Joe E. Acker III, EMT-P, MPH, MS;  
Larry B. Goldstein, MD; Richard D. Zorowitz, MD; Timothy J. Shephard, PhD(c), CNRN, CNS;  
Peter Moyer, MD, MPH; Mark Gorman, MD; S. Claiborne Johnston, MPH, MD, PhD;  
Pamela W. Duncan, PhD; Phil Gorelick, MD; Jeffery Frank, MD; Steven K. Stranne, MD, JD;  
Renee Smith, MPA; William Federspiel, BA; Katie B. Horton, RN, JD;  
Ellen Magnis, MBA; Robert J. Adams, MD

**Stroke 2005;36(3):690-703; Circulation 2005;111(8):1078-91**

# A Stroke System should

- be standardized regionally but **customized locally**
- Address the needs of **neurologically underserved** areas to make sure every patient has ensure **access** to a primary stroke center and more comprehensive services
- Incorporate **telemedicine**, and ground or **aeromedical transport** to help facilitate these linkages between hospitals and patients



# MASS DPH regulations

- Worked with MA Dept of Public Health and Hosp Association
  - Point of entry plan for EMS
  - regulations to license hospitals as primary stroke services
  - Requires full hospital commitment and adherence to NINDS guidelines
  - Mandatory reported data collection and QI
  - Consensus measures of performance



Data elements: For acute stroke patients who arrived in ED <3 hrs after sx onset:

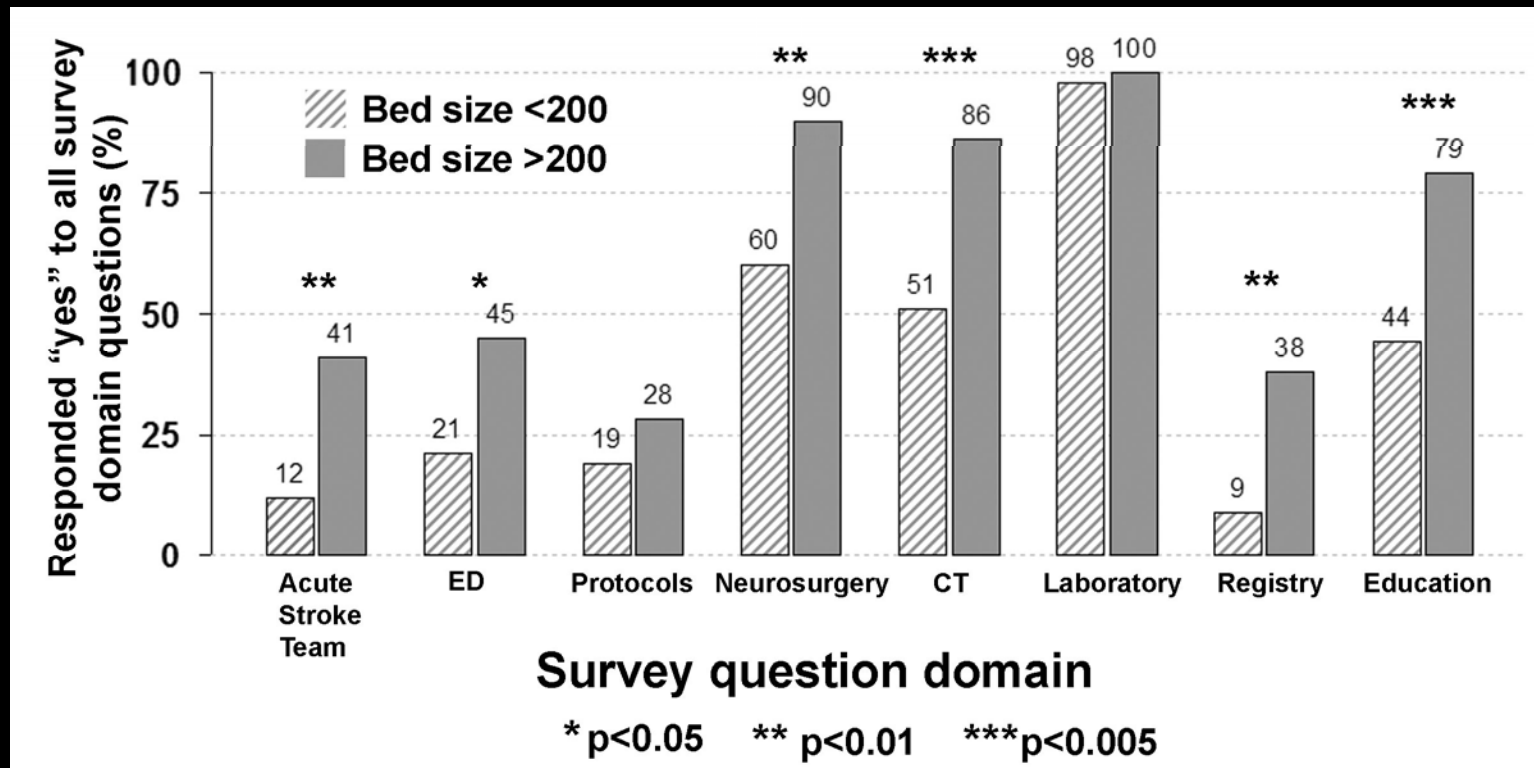
- Age, Gender & Race
- Date and time of
  - stroke symptom onset or time last seen well
  - patient arrival at Emergency Department
  - completion of initial brain imaging (CT or MR)
  - IV t-PA bolus
- If IV t-PA not given, reason documented
- Discharge destination
- Internal review of complications of tPA

# EMS requirements

- Train **dispatchers** on the signs and symptoms of stroke
- Train Emergency Medical Personnel in basic stroke **recognition** and primary stroke service designation
- Ascertain time of symptom **onset** in all strokes
- Provide advance **notification** to hospitals of possible stroke patient transport



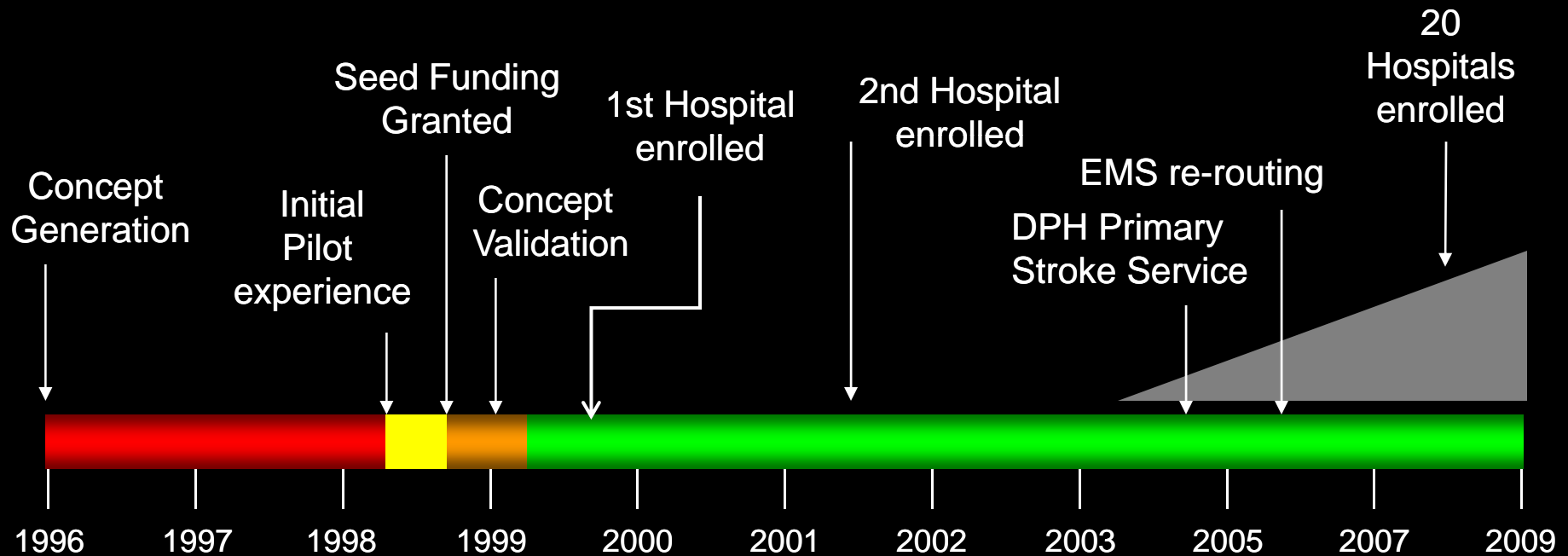
# Smaller bed size and rural hospitals are less likely to have acute stroke resources



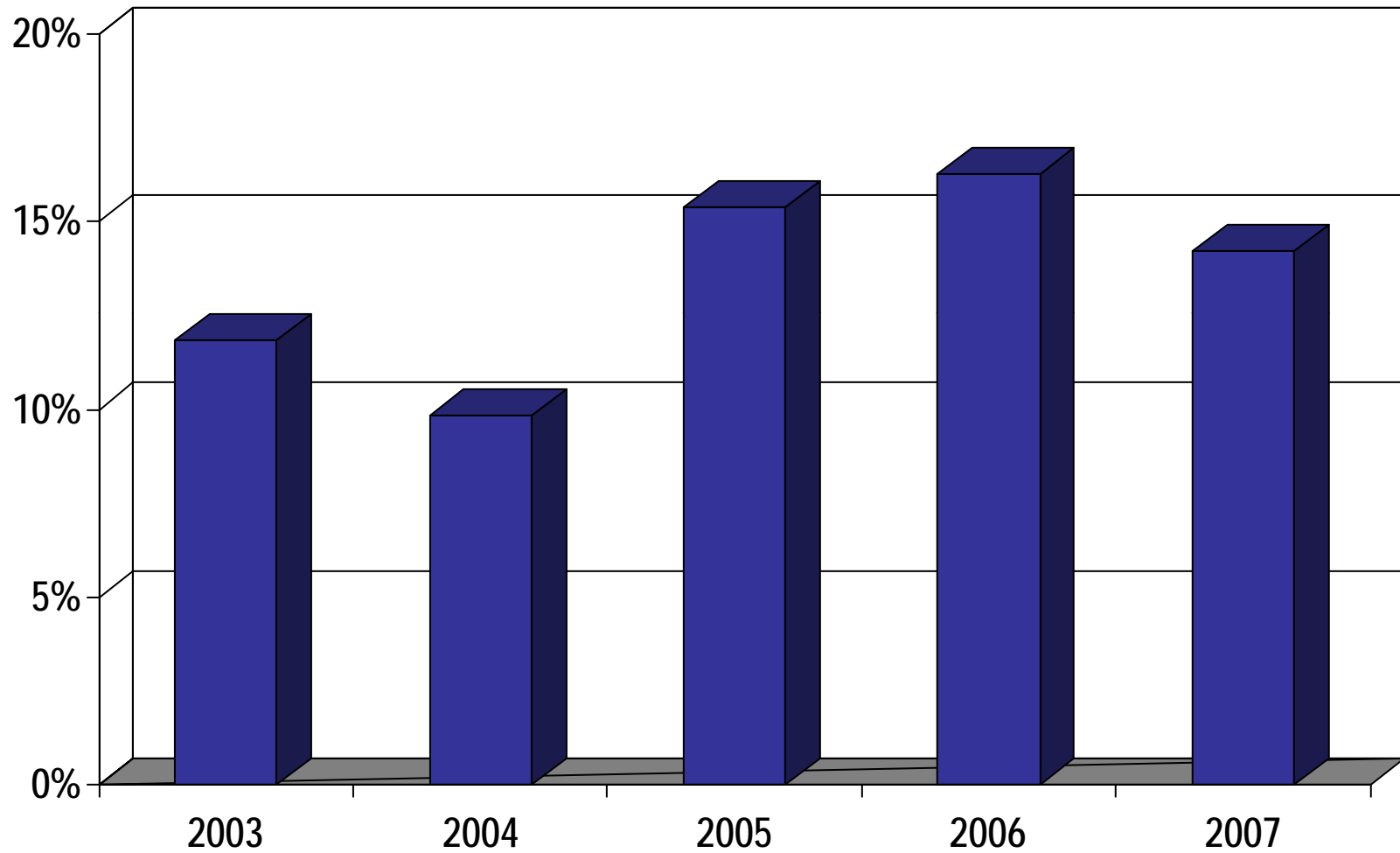
- Smaller hospitals (<200 beds, 43/72) more likely rural hospitals (p<0.0001).
- Smaller hospitals, surveyed in 2003, less likely to express interest in achieving state-based designation as a Primary Stroke Service (p=0.01).

Data presented at 2006 International Stroke Conference, Orlando, FLA.

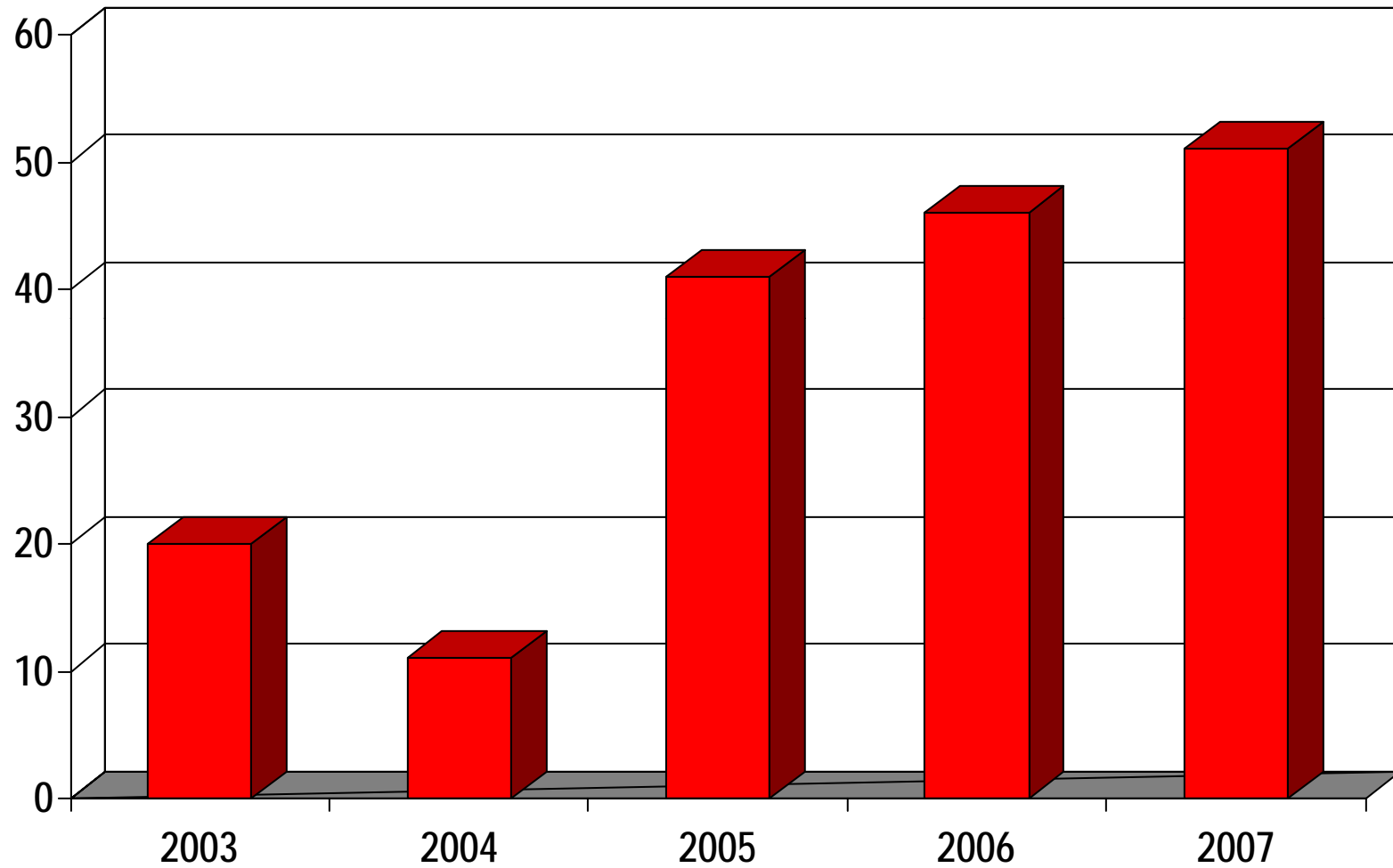
# MGH TeleStroke Center History



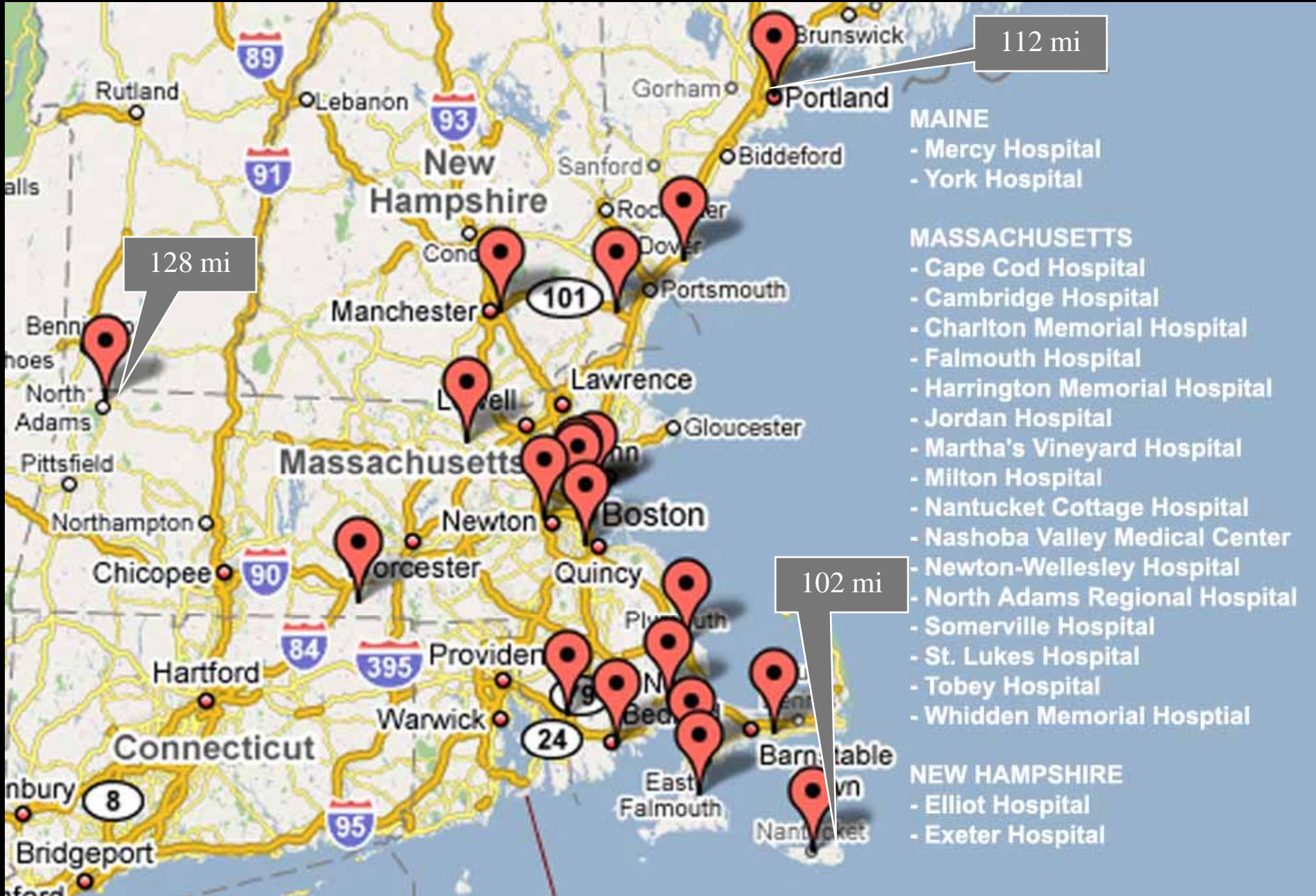
## % Patients receiving any IV thrombolysis



## % Patients Admitted MGH Receiving Thrombolysis at OSH



# Distribution of Partners TeleStroke Center Hospitals



## Effect of Primary Stroke Service (PSS) on tPA use

Variable	Pre-PSS (%)	Post-PSS (%)	P Value
IV tPA when Onset to ED Arrival $\leq$ 2 hr	40.0	63.7	.0004
IV tPA when Onset to ED Arrival $\leq$ 3 hr	31.2	53.3	.0001
reason for no IV tPA	83.4	92.0	.0003

Data before re-routing (PrePSSr: 2004-Q4 to 2005-Q2) were compared to after re-routing (PostPSSr: 2005-Q3 to 2006-Q2) by means of Chi-square or Fisher's exact test.

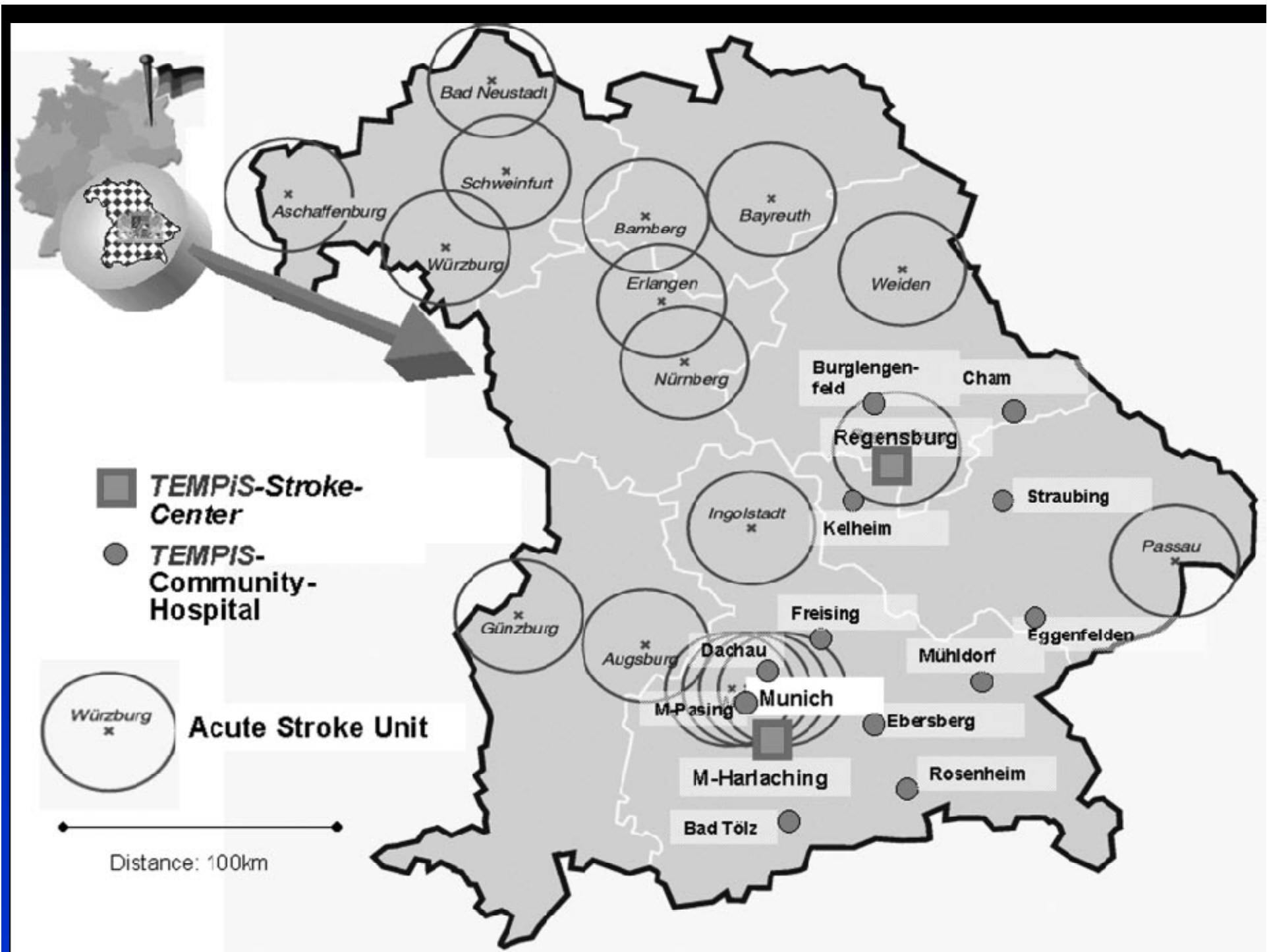
# Current Network

## Locally

- 21 Community Hospitals in three states; 6 new pending
- 2 Tertiary Hubs in Boston
- 13 +5 Acute Stroke Staff, 8 Fellows
- IRB approval for enrollment and clinical trial intervention via TeleStroke

## Nationally

- Swedish Medical Center, Seattle WA
- Yale New Haven, UVA, INTEGRIS
- 4 Hubs across South, West pending



# TEMPiS Results: No difference between remote and tertiary care

**Table 2** Favorable functional outcome and mortality after 3 and 6 months

	Telemedical group	Stroke center group	OR (95% CI)	p Value
<b>3 months</b>				
mRS 0/1 (%)	38.2	33.7	1.2 (0.7-2.0)	0.258
BI 95/100 (%)	45.1	40.1	1.3 (0.8-2.1)	0.197
Survival rate (%)	88.8	88.6	1.0 (0.7-1.4)	0.550
Any cerebral hemorrhage in deceased patients	6/24	3/17	0.6 (0.2-2.6)	0.391
<b>6 months</b>				
mRS 0/1 (%)	39.5	30.9	1.5 (0.9-2.4)	0.095
BI 95/100 (%)	47.1	44.8	1.1 (0.6-1.8)	0.443
Survival rate (%)	85.8	87.1	0.9 (0.5-1.8)	0.448

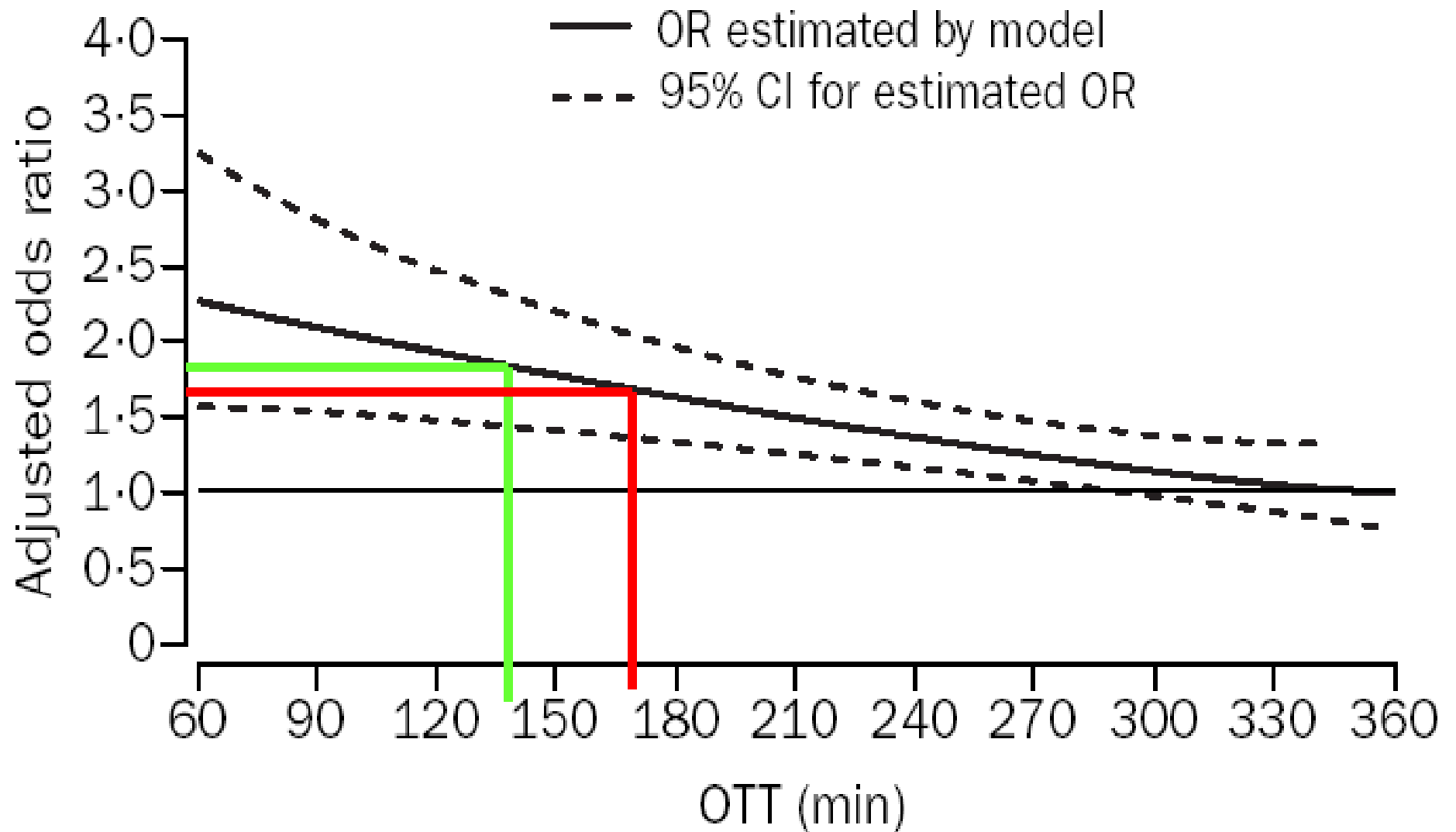
Differences between the telemedical and stroke center group regarding mortality rate and favorable functional outcome. The evaluation of the modified Rankin Scale (mRS) and Barthel Index (BI) based on the amount of returned questionnaires.

Schwab et al, *Neurology* 2007;69:898-903

# Comparison of TeleStroke and Conventional Care

Stroke Center	Patient Population	Sample	Symptom-to-Door (min)	Door-to-Consult (min)	Consult-to-Needle (min)	Symptom-to-Needle (min)
MGH (TeleS)	Rural	Received tPA(n=6)	← 36 →	← 70 →	← 36 →	= 142
REACH (TeleS)	Rural	Received tPA (n=12)	← 71 →	← 45 →	← 18 →	= 134
TEMPiS (TeleS)	Rural	Received tPA (n=106)	← 65 →	← 15 →	← 61 →	= 141
Ontario* (Tx-tPA)	Rural	Received tPA (n=23)	← 34 →	← 89 →	← 49 →	= 172
Houston (Conv)	Urban	Received tPA (n=269)	← 67 →	← 70 →		= 137

# Usual (ship & drip) vs. TeleStroke (drip & ship)



# Telemedicine for Primary Stroke Centers & IV tPA

- Virtual Acute Stroke Team
- Facilitate stroke clinical trials
- Improve subacute stroke care
- Develop regional approaches to stroke management
- Few US hospitals would meet full criteria for a PSC



*"Bad news, Phil—due to federal funding cutbacks, we can't afford to put your head back on."*

# Financial Sustainability

- Costs of infrastructure
- Costs of labor and maintenance
- Reimbursement restrictions
- Single payer vs. **multiple payers**
- Cost savings of tPA delivery/case and of avoiding inappropriate use
- Government funding vs. **shared-cost model**
- **Regulations** requiring **Stroke Center Status**
- **CMS** P4P, Core measures, PCRI

# Human Resources Sustainability

- Make **incentives** to practice TeleStroke
- Provide adequate funds to help struggling hospitals, especially rural locations
- Change Medicaid regulations to cover regardless of originating site
- Reduce licensure and credentialing barriers
- Promote collaboration to increase number of providers
- Avoid redundancy of coverage
- Dual use of technology to support education, networking, etc.

# Malpractice: Always a risk

- Archiving of consults
- Coverage of TeleStroke activities by insurance carrier
- Cost of not providing tPA evaluation capabilities (lawsuits and lost opportunities)
- Almost all suits have been for failing to inform or provide tPA rather than complications of Rx

# Teleneurology: It's more than just stroke...

- **Stroke**
- General Neurology
- Epilepsy
- Sleep
- Rehabilitation
- Neuroradiology
- Clinical Neurophysiology
- Pediatric Neurology
- Developing World
- Education & Training

