

# In-hospital Acute Ischemic Stroke

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Tri-State Stroke Network  
North Carolina Stroke Registry

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Penn Medicine

# Outline

- ◆ The special case of in-hospital stroke
- ◆ Opportunities for QI
- ◆ Case Study
- ◆ Implications for National standards

# In-hospital Ischemic Stroke Population

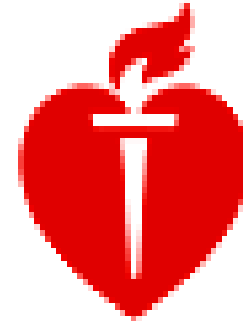
- ◆ Patients admitted for non-stroke diagnosis
- ◆ In-hospital stroke 4-15% of all hospitalized acute stroke cases<sup>1-5</sup>
  - May be underrecorded
- ◆ Mean age 62-78<sup>1, 6</sup>
- ◆ Delayed recognition despite hospitalization<sup>5, 7-11</sup>
- ◆ Less complete stroke care
  - Vascular imaging, Lipid assessment<sup>5</sup>
  - Dysphagia screening, DVT prophylaxis, smoking cessation counseling<sup>12</sup>

1. Kelley RE. Stroke 1986
2. Foulkes MA. Stroke 1988.
3. Azzimondi G. Stroke. 1994.
4. Iguchi Y. J Neurol Sci 2007
5. Farooq MU. Cerebrovasc Dis 2008
6. Nadav L. Cerebrovasc Diseases 2002

7. Alberts et al. Stroke 1993
8. Alvaro et al. Cerebrovasc Disease 2003
9. Nolan CCNQ 2003
10. Blacker DJ Lancet Neurology 2003
11. Dulli D Neuroepidemiology 2007
12. Reeves M. Stroke 2005

# High Risk Population

- ◆ Much information on in-hospital strokes from cardiac and surgical literature\*
- ◆ After certain illnesses or procedures
  - Myocardial Infarction
  - Cardiac Catheterization
  - Cardiothoracic surgery
  - Carotid endarterectomy



\*

Witt et al. The Am Journal of Medicine (2006)  
Spencer et al. Am J Cardiol (2003).  
Szummer et al. European Heart Journal (2005).  
Budaj et al. Circulation (2005)..  
Mooe et al. Stroke (1999).

Khatri and Kasner. Arch Neurol (2006).  
Schwartz et al. J Vasc Surg (1995).  
Stamou et al. Stroke (2001).  
Wolman et al. Stroke (1999).  
Matsen et al. J Vasc Surg (2006).

# Primary Diagnoses

- ◆ **Cardiac (24%)<sup>3</sup>**
  - Inversely, cardiac surgery 2-4%<sup>1</sup>
  - Inversely, cardiac procedure up to 10%<sup>2</sup>
- ◆ **Neurology/Neurosurgery (15%)<sup>3</sup>**
  - Vascular stenosis
  - Aneurysm
- ◆ **Heme/Onc (8%)**
- ◆ **Ortho (7%)**
- ◆ **GI (7%)**

1. Bronster DJ. Curr Cardiol Rep 2006.
2. Selim M. NEJM 2007
3. Farooq M. Cerebrovasc Dis 2008

# Outcome

- ◆ High risk patients
- ◆ Higher inpatient morbidity
  - DVT/PE (1.0 vs 6.4%,  $p=0.01$ )
  - Pneumonia (5.2 vs 15.9%,  $p < 0.01$ )
  - LOS (4 vs 8 days)
- ◆ Poor outcome
  - Functional impairment (36 vs 61% with  $mRS \geq 4$ )
  - In-hospital case fatality (6.9 vs 14.6%)

# Rid the sense of medical futility

- ◆ More contraindications to IV tPA
- ◆ Less likely to get IV tPA
- ◆ Equally if not more likely to undergo endovascular therapy<sup>1, 2</sup> (13-60%)
  - As opposed to 7-11% of ED strokes

1. Farooq, M et al. Cerebrovasc Disease 2008
2. Park S, Schwamm L. (in progress)

# Unique opportunity: Stroke during Cardiac Catheterization

- ◆ Short event to treatment, Fem access in place
- ◆ More likely to have ICA or MCA occlusion
  - IV tPA less likely to help
- ◆ Differences between cardiac and cerebral endovascular procedures
  - Vessels through bony structures
  - Clots can be more difficult to disrupt mechanically
  - Brain is less forgiving of rupture
  - Longer procedures (navigating)
- ◆ Have a plan in place to get the patient endovascular Rx

Sankaranarayanan R Journal of Invasive Cardiology 2007

# Assumptions

- ◆ Advantage of proximity
- ◆ Medical staff and neuro-imaging
- ◆ Earlier discovery, assessment, and treatment

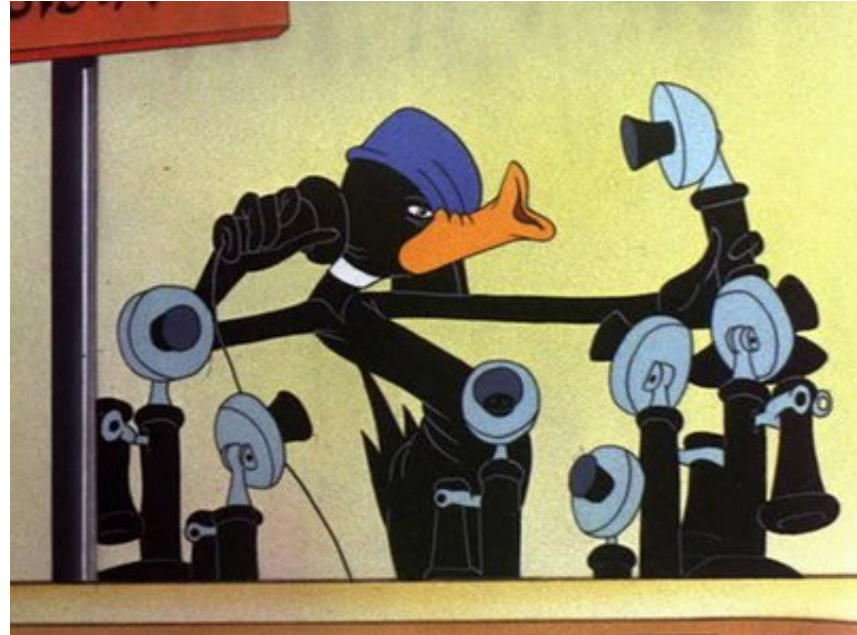
Alberts et al. Stroke (1993).

Azzimondi G. Stroke (1994).

Blacker DJ. Lancet Neurology (2003)

# Clerical & Mundane Tasks

- ◆ Assess the patient
- ◆ “Clear the scanner”
- ◆ Orders in CPOE
- ◆ Learn history of patient & stroke
- ◆ Confirm labs are available or sent
- ◆ Obtain, reconstitute tPA (unfamiliar)
- ◆ Performing in parallel rather than in series via a team approach



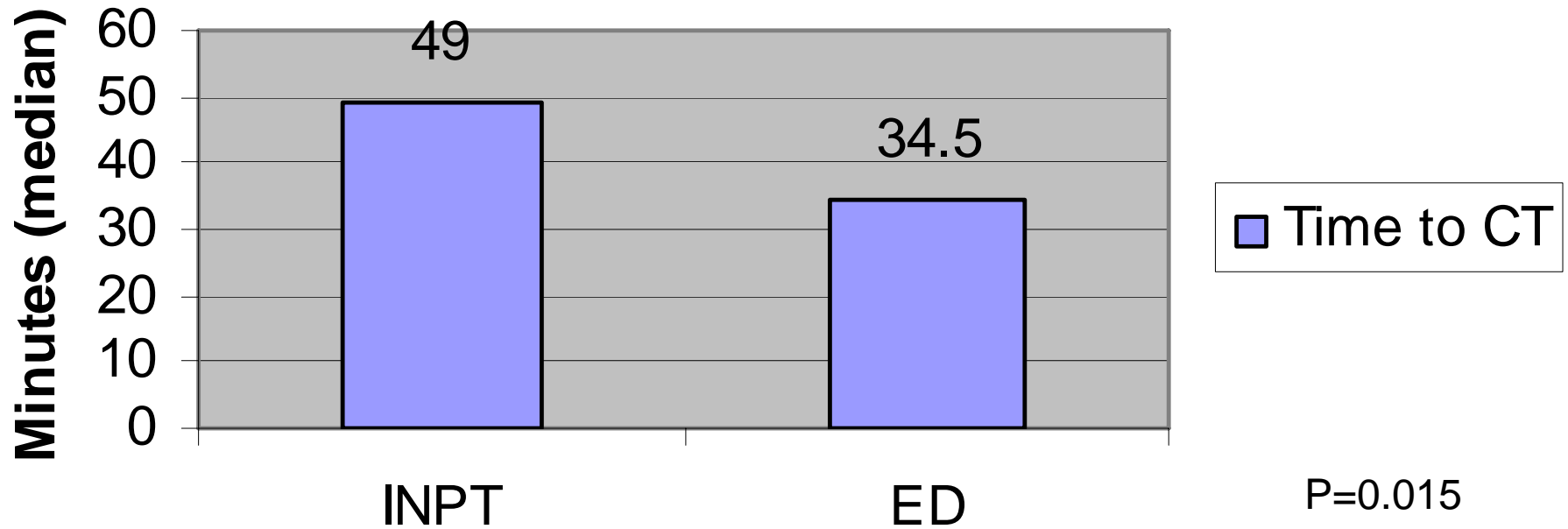
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# Goal: 25 minutes from Order to CT

Time to CT



Park S, Schwamm L (in progress)

# MGH Comprehensive Stroke Center

- ◆ In-house Stroke Neurologists 24/7
- ◆ Interventionalists (Radiology, Neurology, Neurosurgery)
- ◆ 18-bed Neurocritical Care Unit
- ◆ Telestroke Hub (23 spoke hospitals)
- ◆ Acute Stroke Quality Task Force
  - Focus on ED QI
- ◆ Acute response to In-hospital strokes was found to be lacking

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# Case Study: In-hospital Stroke QI

- ◆ The #s warranted a QI measure
  - 24.4% of all ischemic stroke patients (62/254 in 2 yrs)
    - As compared to 4-15% in literature

Park S & Schwamm L. (In progress)

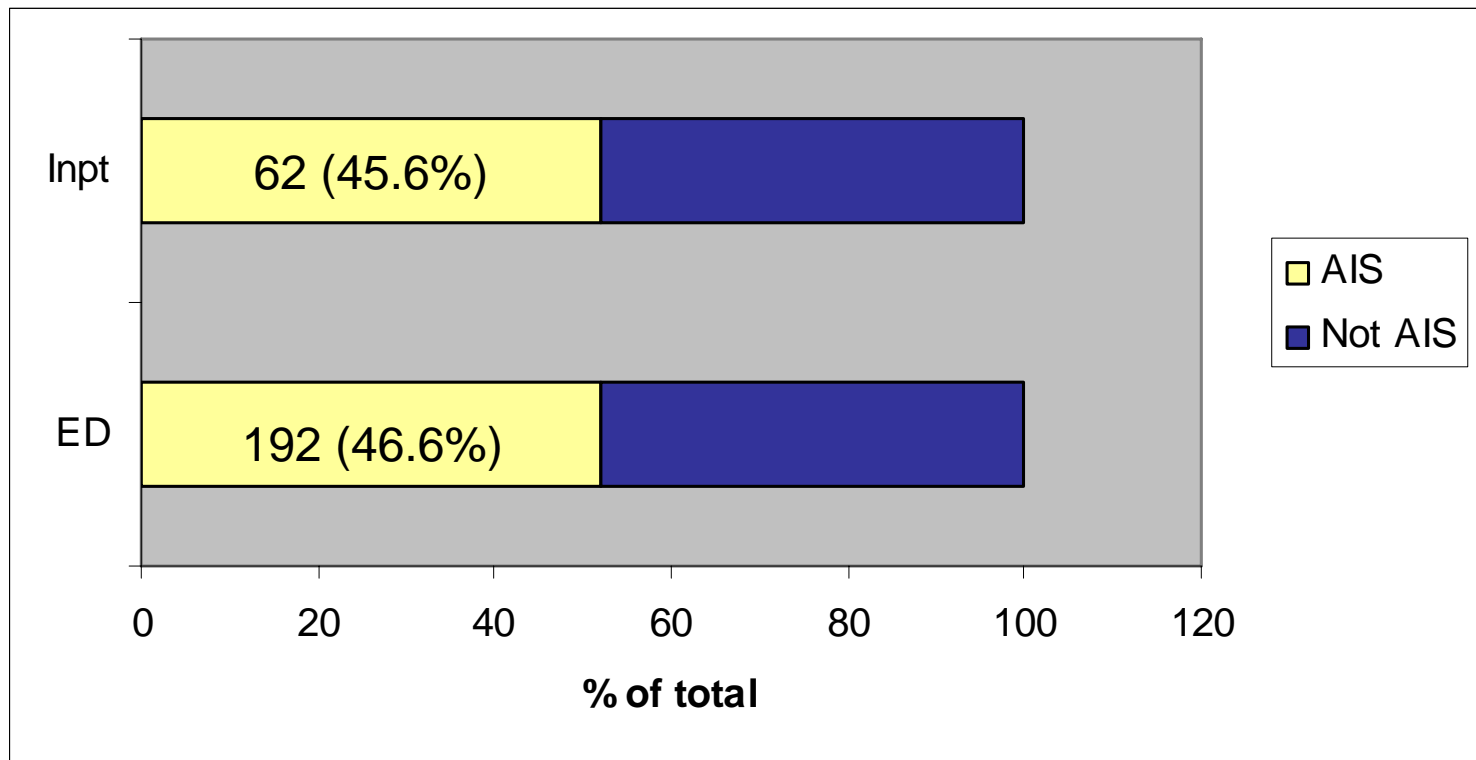
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# Web-enabled prospective log

- ◆ 548 consults recorded in the MGH Acute Stroke Log from 1/05-12/06 (2 years)
  - 136 from the Inpatient Setting
  - 412 from the ED Setting



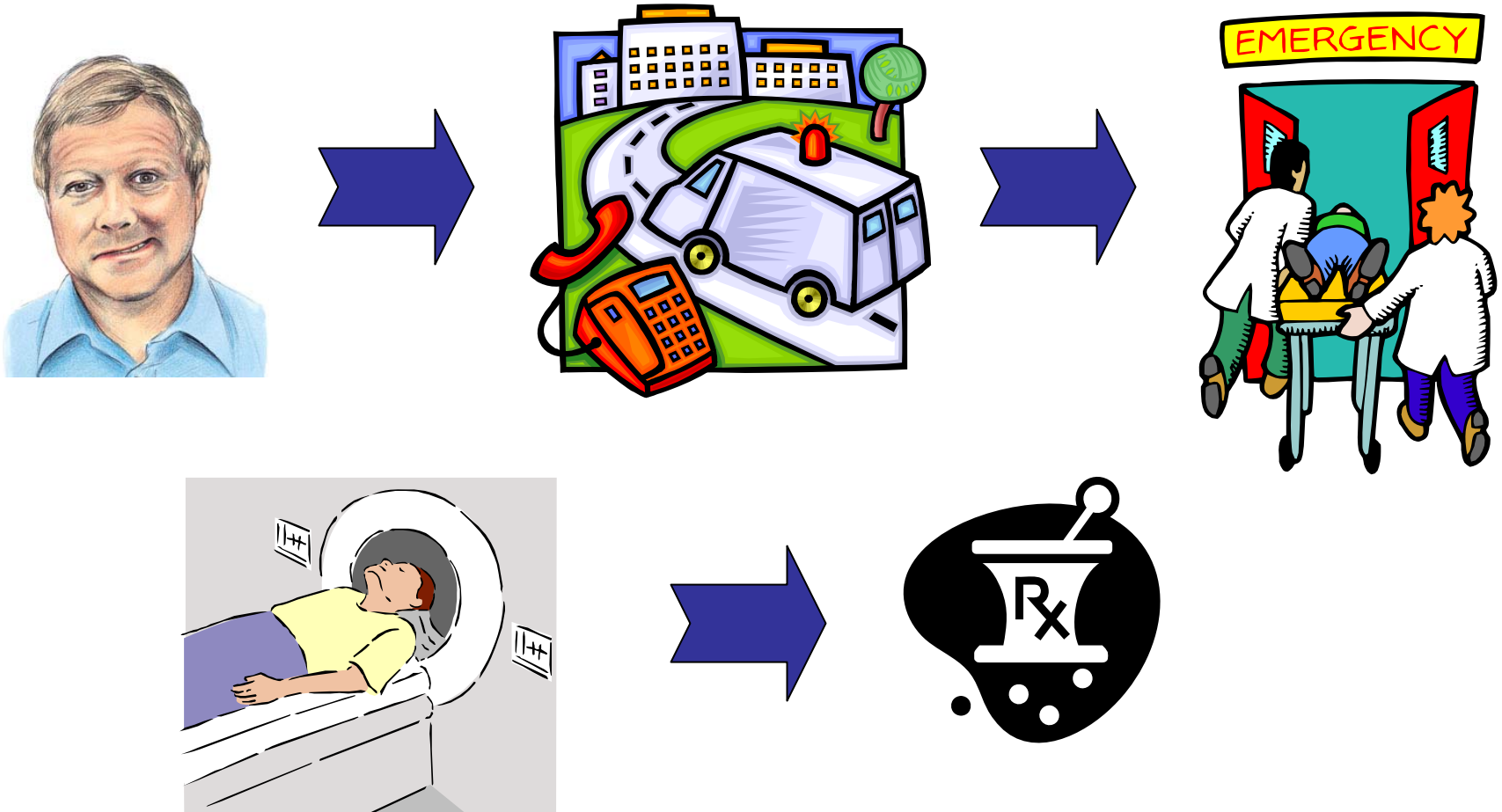
# Comprehensive Stroke Center

- ◆ Case Study: Massachusetts General Hospital
- ◆ The #s warranted a QI measure
  - 24.4% of all ischemic stroke patients (62/254 in 2 yrs)
    - As compared to 4-15% in literature
  - Yield (“quality” of consult) is consistent with ED consults
  - “Non ischemic strokes” were turning out to be neuro emergencies anyway

Park S & Schwamm L. (In progress)

# Rethink approach: the In-hospital stroke victim

Stroke response tailored for entry through the ED



# Theory of Relativity

## ◆ Training is solidified by repetition

- Higher volume
- Streamlined
- Smaller pool of potential team members
- Targeting QI measures easier



## ◆ Is there something to be learned from the ED approach that can apply?

# Root cause analysis

- ◆ Half the solution was defining the problem
- ◆ Some easy fixes, Some harder
- ◆ Process-based:
  - Identified key players, locations, duties
  - Observations, Interviews, Group discussions
  - Broke down process into key actions
  - Designed resource-neutral process incorporating key actions in parallel
  - Trials with Test Patients | Feedback
  - Educated around new process hospital-wide
  - Initiated new process – iterative feedback/revamping

# Contributing Factors to Overall Delay

- ◆ Lack of symptom recognition
- ◆ Delay to calling Stroke Fellow
- ◆ Delay to CT scan
- ◆ Delay to Therapy

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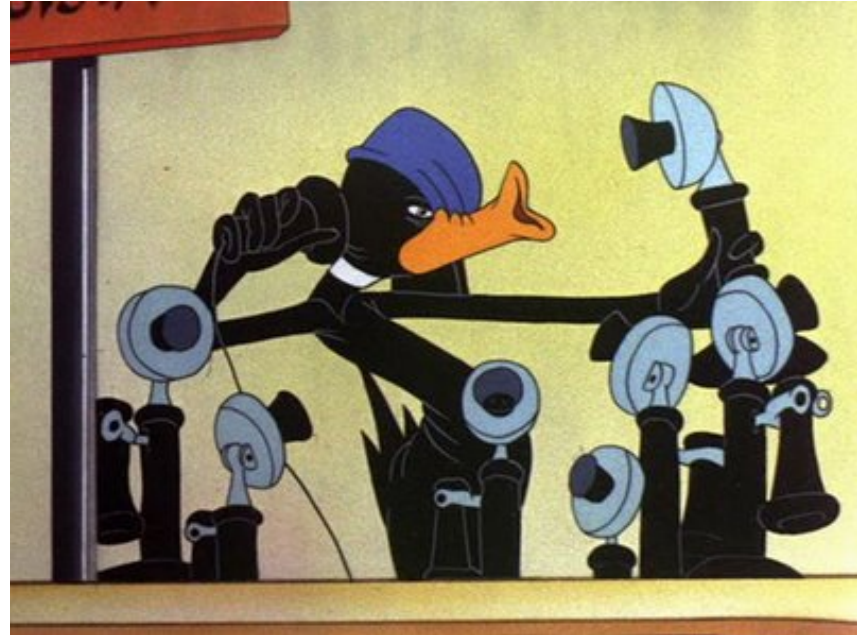
- ◆ Lack of symptom recognition
- ◆ Delay to calling Stroke Fellow
- ◆ Delay to CT scan
- ◆ Delay to Therapy

# Delay to CT scan & Therapy: RCA

- ◆ Paging system was too complex
- ◆ Separate Inpatient Neuroradiology Fellow
  - Workflow included outpatient scans
- ◆ CT scanner designation
  - Inpatients traditionally went to non-ED scanner
- ◆ Single person performing tasks in series
- ◆ Traveling monitor & O2 nasal cannula protocol
- ◆ Elevator wait time
- ◆ CPOE
- ◆ Pharmacy checks
- ◆ Availability of tPA outside of ED
- ◆ Nursing unfamiliarity with administration
- ◆ Lack of family members
- ◆ Labs & IVs

# Clerical & Mundane Tasks

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# The Problems

Paging system was too complex	
Separate Inpatient Neuroradiology Fellow Workflow included outpatient scans	
CT scanner designation	
Single person performing tasks in series	
Traveling monitor & O2 nasal cannula protocol	
Elevator wait time	
CPOE Pharmacy checks Availability of tPA outside of ED Nursing unfamiliarity with administration	
Lack of family members	
Labs & Ivs	

# Some solutions

Paging system was too complex	Simplified paging system; Group pager
Separate Inpatient Neuroradiology Fellow Workflow included outpatient scans	Directed to ED Neuroradiology Fellow
CT scanner designation	Directed to ED CT scanner
Single person performing tasks in series	Team approach; Group pager; Resource neutral
Traveling monitor & O2 nasal cannula protocol	Clarified protocol
Elevator wait time	Code key obtained
CPOE Pharmacy checks Availability of tPA outside of ED Nursing unfamiliarity with administration	Team approach tPA bag Code pharmacist Neurology resident
Lack of family members	Team approach; phone
Labs & Ivs	Team approach; IV nurse



# Lessons Learned

- ◆ Recognizing workarounds as targets for improvement
  - Calling a respiratory code to get the pharmacist
  - Overcoming mundane barriers to efficiency
    - rapid neuroimaging
  - Negotiating access to endovascular therapy
- ◆ Simply re-organizing communication can have significant impact

# Rapid Response Neuro Code Teams

- ◆ Needs vary depending on hospital setting
- ◆ Assess needs and resources
- ◆ Consider incremental value of first fixing what can be fixed in resource-neutral ways
- ◆ Have an algorithm in place
  - For rapid assessment
  - For drip
  - For ship

# Implications for National Standards

- ◆ **Comprehensive Stroke Center**
  - (getting QI to internal patients)
- ◆ **Primary Stroke Center**
  - (referral, drip and ship)
- ◆ **Non-Stroke Center**
  - (referral, drip and ship)
- ◆ **For the larger stroke system**

- ◆ “Mode of arrival” is not entirely helpful
- ◆ Distinguish patients with in-hospital strokes from patients who arrived through ED
- ◆ Record which service they originated from



# Penn Medicine

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Hospital of the University of Pennsylvania