# Kaiser Redwood City – Stroke Redesign Project

The world has changed … and we need to change as well!


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# The Challenge in the Age of Endovascular Stroke Treatment (EST)

- Deliver IV t-PA as efficiently as possible
- Rapidly select patients with Large Vessel Occlusion (LVO) for endovascular treatment
- Rapidly retrieve clots

# Why Now? Our world changed at ISC this year …

| | |
|---|---|
| Prior to ISC 2015 | • No proven role for endovascular therapy (this was a rare treatment option) |
| February 2015 (ISC) | • 4 studies with proof of superiority of endovascular therapy for large vessel occlusions post IV t-PA |
| TODAY | • Endovascular therapy is the standard of care!<br>  • Rapid evaluation – CTA for most if not all strokes<br>  • Rapid treatment with IV t-PA → then rapid endovascular therapy |



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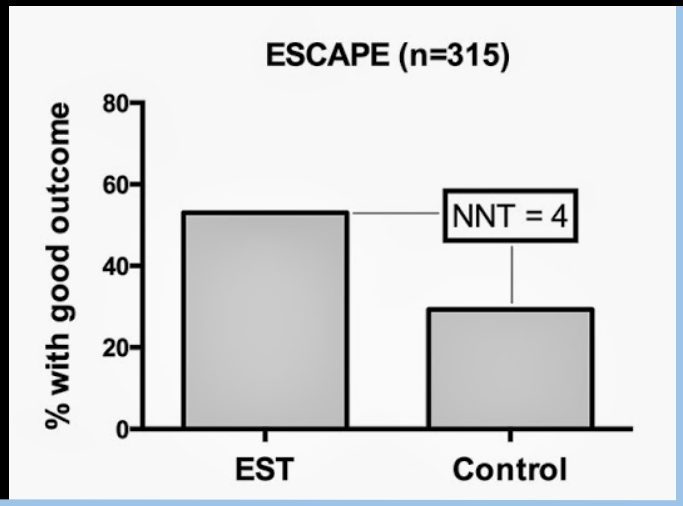
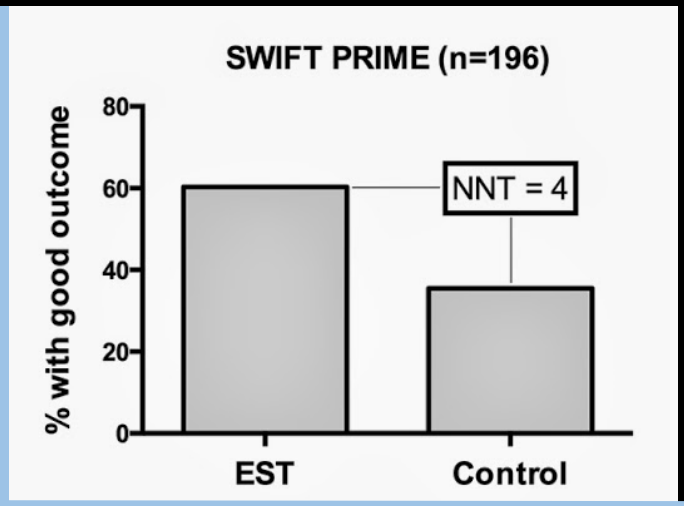
## Four different studies highlighting the superiority of endovascular therapy for large vessel occlusions post IV t-PA

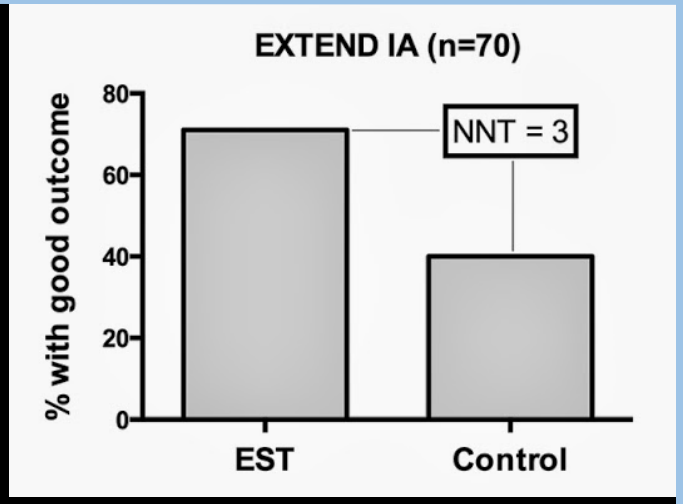
- 12 Hours
- Anterior Circ
- Standard vs Standard + EST
- Small Core (ASPECTS)
- Good collaterals
- 73% tPA

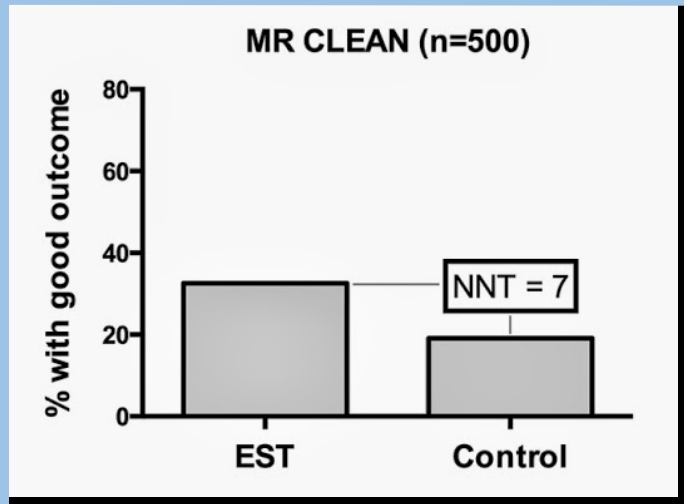



- 6 Hours
- Anterior Circ
- tPA vs. tPA+EST
- Small Core (Perfusion → ASPECTS)
- 100% tPA

- 6 Hours
- Anterior Circ
- tPA vs. tPA+EST
- Small Core (CTP)
- 100% tPA




- 6 Hours
- Anterior Circ
- Standard vs Standard + EST
- No core or collateral assessment
- 87% tPA

# Current Door to Drug Performance Nationally

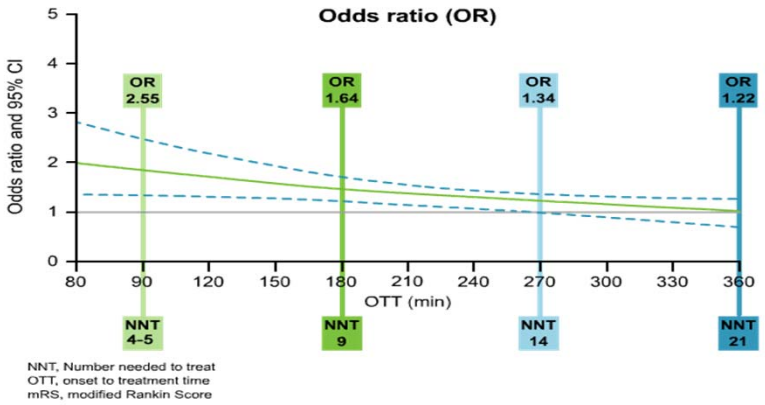
**In USA, 2-5% of all stroke patients get IV t-PA but about 30% would benefit if treated promptly**

**The current "Gold Standard" is to give IV t-PA**

- **Within 60 min. for at least 75% of patients**
- **Within 45 min. for at least 50% of patients**

**BUT the goal is to reduce door-to-needle times as much as possible**

**Teleneurology increasingly is improving door-to-needle times**




**2 million nerve cells die per minute!**

**For every 15 minutes**

- **More patients go home**
- **Fewer patients are disabled**
- **Less days are spent in the hospital**



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# Possible Solution: Field-Based Diversion

- **LAMS (or other) paramedic-directed diversion**
  - Field based diversion is untested
  - Over-triage by paramedics is the norm
  - Many more patients are treated by IV t-PA than endovascular therapy
    - More patients (96-87%) will be disadvantaged (driven past closer center) than helped

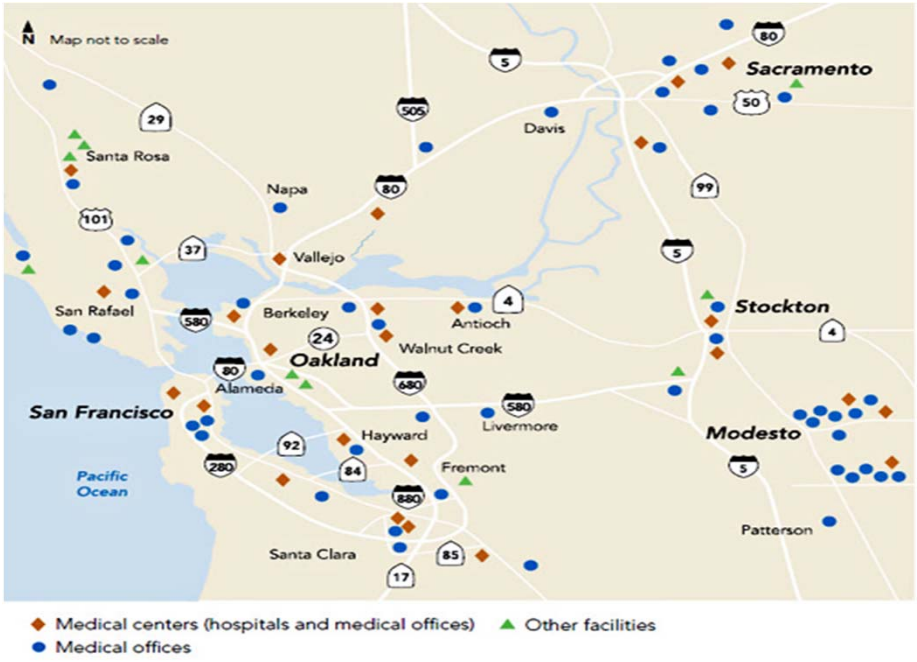
# Possible Solution: Rapid Treatment and Transfer

- Very rapid IV t-PA
- Very rapid CTA
- Very rapid transfer

- If you can treat, evaluate, and transfer faster than or as fast as treatment at a CSC, *why* would you ever consider anything else?

# Kaiser Permanente Northern California (KPNC)

- 3.8 million members
- 21 Medical Centers
- 17,000 square miles
- > 8000 physicians
- 75 neurologists
- Thousands of ED MD's + RN's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# KPNC Acute Stroke Care

- Every KPNC hospital is primary stroke certified
- Each hospital with its own stroke alert process
- DTN variable among hospitals but across all medical centers 60% in 60 minutes
- Endovascular times vary widely by location


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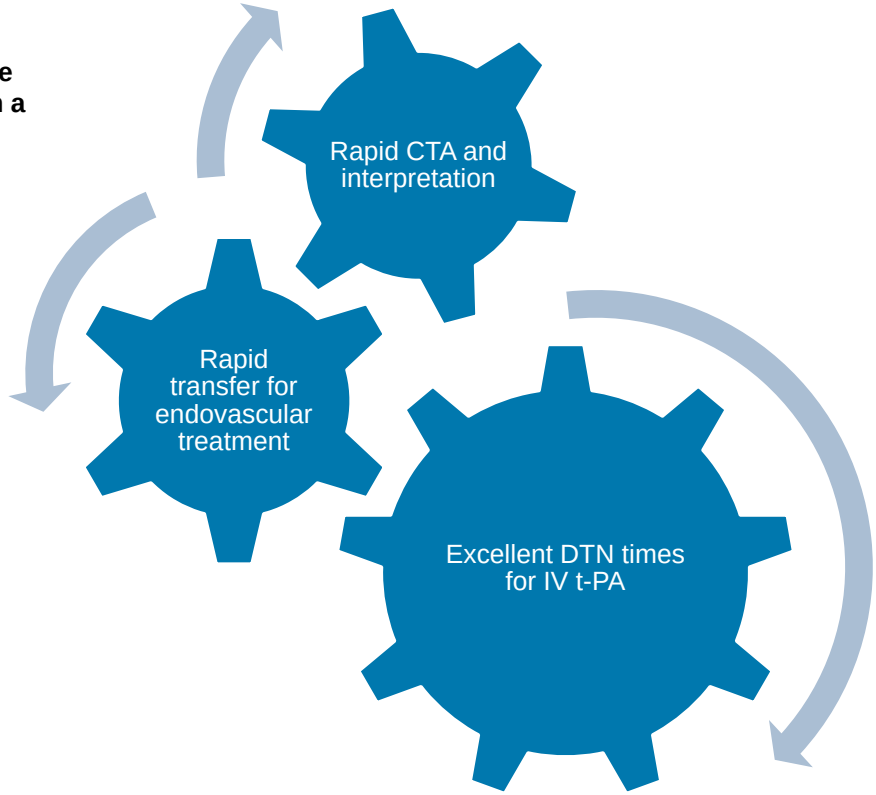
# What Would Take …

- Achieving “world class” (15- 20 minutes) door to needle (DTN) times?
- Obtaining very rapid CTA performance and interpretation?
- Treating, evaluating, and transferring for endovascular therapy in less than 45 minutes?

**Overarching goal is appropriate evaluation, treatment, and transfer as quickly as could be achieved with primary field-based diversion**

# What Will Allow Us to Provide World-Class Stroke Care?

**KP NCAL has between 2250-4500 stroke patients per year that could benefit from a redesigned system!**




*If we can build this systematically and consistently we will deliver world class stroke care!*



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# Helsinki Model – *Neurology*, 2012

ARTICLES

## Reducing in-hospital delay to 20 minutes in stroke thrombolysis

Atte Meretoja, MD, PhD, MSc (StrokeMed)
Daniel Strbian, MD, PhD
Satu Mustanoja, MD, PhD, MSc (StrokeMed)
Turgut Tatlisumak, MD, PhD
Perttu J. Lindsberg, MD, PhD
Markku Kaste, MD, PhD

Correspondence & reprint requests to Dr. Meretoja: atte.meretoja@fimnet.fi

ABSTRACT

**Objectives:** Efficacy of thrombolytic therapy for ischemic stroke decreases with time elapsed from symptom onset. We analyzed the effect of interventions aimed to reduce treatment delays in our single-center observational series.

**Methods:** All consecutive ischemic stroke patients treated with IV alteplase (tissue plasminogen activator [tPA]) were prospectively registered in the Helsinki Stroke Thrombolysis Registry. A series of interventions to reduce treatment delays were implemented over the years 1998 to 2011. In-hospital delays were analyzed as annual median door-to-needle time (DNT) in minutes, with interquartile range.

**Results:** A total of 1,860 patients were treated between June 1995 and June 2011, which included 174 patients with basilar artery occlusion (BAO) treated mostly beyond 4.5 hours from symptom onset. In the non-BAO patients, the DNT was reduced annually, from median 105 minutes (65–120) in 1998, to 60 minutes (48–80) in 2003, further on to 20 minutes (14–32) in 2011. In 2011, we treated with tPA 31% of ischemic stroke patients admitted to our hospital. Of these, 94% were treated within 60 minutes from arrival. Performing angiography or perfusion imaging doubled the in-hospital delays. Patients with in-hospital stroke or arriving very soon from symptom onset had longer delays because there was no time to prepare for their arrival.

**Conclusions:** With multiple concurrent strategies it is possible to cut the median in-hospital delay to 20 minutes. The key is to do as little as possible after the patient has arrived at the emergency room and as much as possible before that, while the patient is being transported. *Neurology*® 2012;79:306–313

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# Helsinki Model in Detail

**Helsinki Model for Stroke Evaluation**

- EMS Pre-notification (stroke MD directly)
- History during transport
- Chart started, patient registered before arrival
- Lab/CT alerted
- t-PA ordered/mixed before arrival (for high prob)
- Transfer Directly to CT/MRI Scanner
- Blood draw on CT table, POC testing
- Examination by stroke neurologist in CT
- Stroke neurologist reads CT
- t-PA bolus on CT table
- No advanced imaging before t-PA



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# Is This Replicable? Helsinki → Melbourne

## Helsinki model cut stroke thrombolysis delays to 25 minutes in Melbourne in only 4 months

Atte Meretoja, MD, PhD, MScStrokeMed
Louise Weir, RN, NP, GradCertStrokeMgt, MANP
Melissa Ugalde, RN, GradCertNeurosci
Nawaf Yassi, MBBS, BSc(Med), FRACP
Bernard Yan, MBBS, FRACP
Peter Hand, MD, FRACP
Melinda Truesdale, MBBS, GradDipHSM, FACEM
Stephen M. Davis, MD, FRACP
Bruce C.V. Campbell, MBBS, BMedSc, PhD, FRACP

**ABSTRACT**

**Objective:** To test the transferability of the Helsinki stroke thrombolysis model that achieved a median 20-minute door-to-needle time (DNT) to an Australian health care setting.

**Methods:** The existing "code stroke" model at the Royal Melbourne Hospital was evaluated and restructured to include key components of the Helsinki model: 1) ambulance prenotification with patient details alerting the stroke team to meet the patient on arrival; 2) patients transferred directly from triage onto the CT table on the ambulance stretcher; and 3) tissue plasminogen activator (tPA) delivered in CT immediately after imaging. We analyzed our prospective, consecutive tPA registry for effects of these protocol changes on our DNT after implementation during business hours (8 AM to 5 PM Monday–Friday) from May 2012.

**Results:** There were 48 patients treated with tPA in the 8 months after the protocol change. Compared with 85 patients treated in 2011, the median (interquartile range) DNT was reduced from 61 (43–75) minutes to 46 (24–79) minutes ($p = 0.040$). All of the effect came from the change in the in-hours DNT, down from 43 (33–59) to 25 (19–48) minutes ($p = 0.009$), whereas the out-of-hours delays remain unchanged, from 67 (55–82) to 62 (44–95) minutes ($p = 0.835$).

**Conclusion:** We demonstrated rapid transferability of an optimized tPA protocol to a different health care setting. With the cooperation of ambulance, emergency, and stroke teams, we succeeded in the absence of a dedicated neurologic emergency department or electronic patient records, which are features of the Finnish system. The next challenge is providing the same service out-of-hours.

*Neurology*® 2013;81:1071–1076

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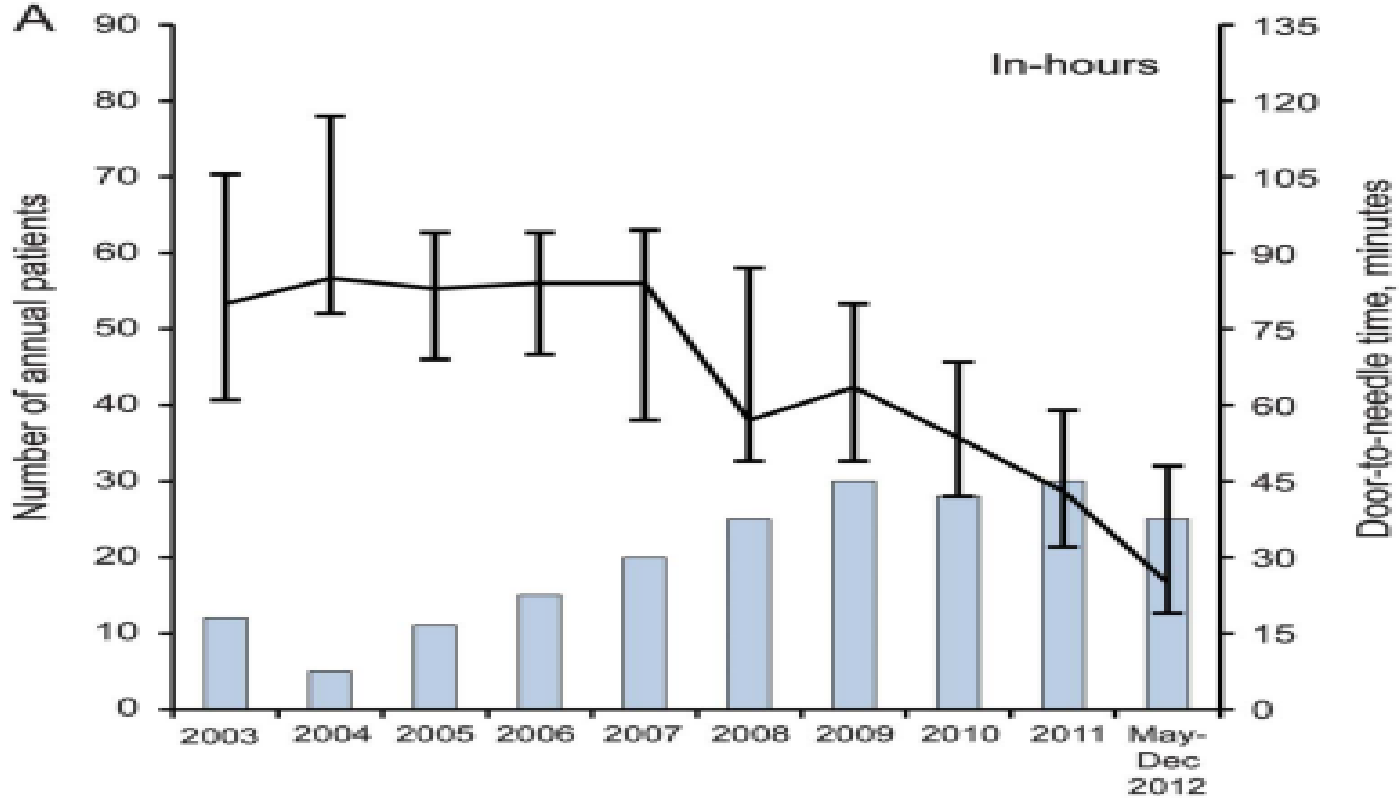
# Is This Replicable? Helsinki → Melbourne

**Melbourne's results when they applied the Helsinki model …**




But … this only works with a stroke neurologist on site



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# How Do We Ensure Access to Stroke Neurologists?

- Teleneurology is the answer!
- Manned by stroke neurologists



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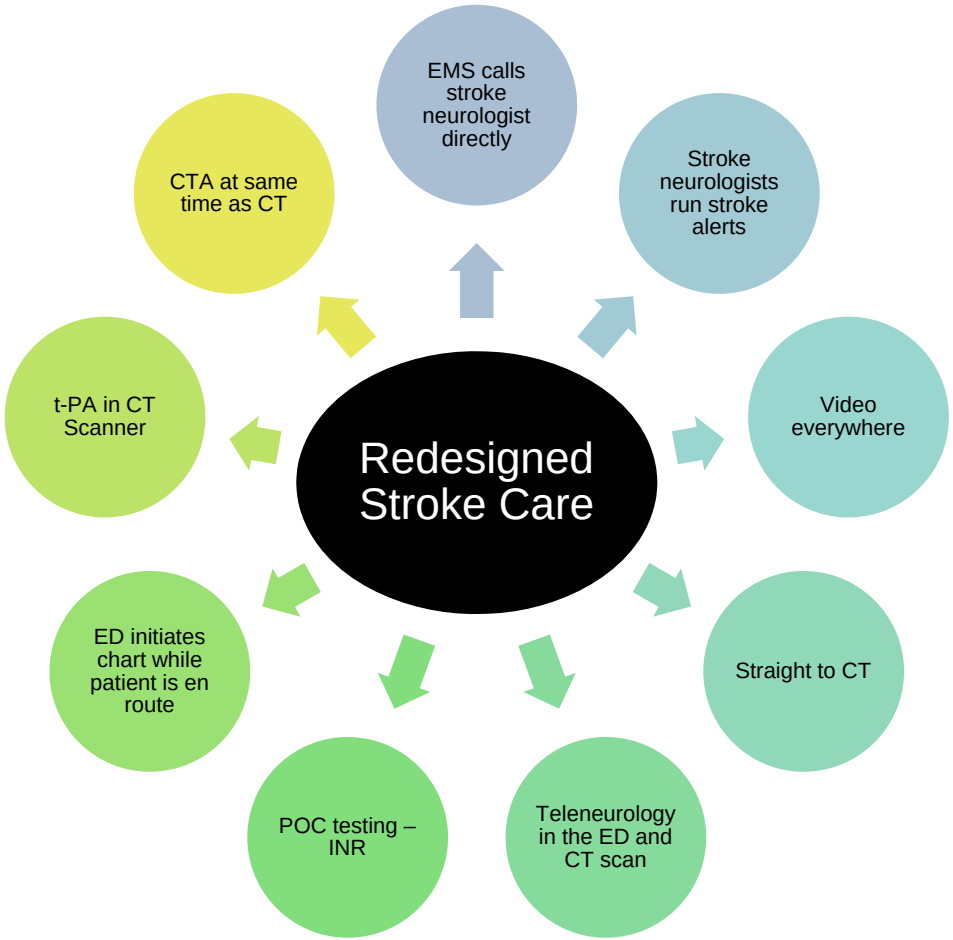
# What Will the Future Look Like?



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# KP Acute Stroke Redesign

- Senior leadership support
- Multidisciplinary team
  - ED physicians
  - Stroke neurologists
  - Neuroradiologists
  - ED nursing
  - Hospitalists
  - CT techs
  - Lab
  - Pharmacy
- Extensive project management support
- Extensive planning for new process
- Goal = full role out by the end of 2015



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# Stroke Redesign 2015 and Emergency Medicine

- Each role (EMS, ED RNs, ED techs, ED physicians, Neurology, Radiology, etc.) clearly defined
  - There are expectations outlined at key time intervals
  - Role will be more pronounced after-hours (e.g. 12a-7a), when teleneurology will be unavailable
- There are 2 distinct workflows, depending on patient arrival: EMS vs. walk-in
- The redesign will help provide better stroke care by:
  - expediting stroke evaluation and management in general
  - offloading much of the workload and decision-making to stroke neurology
  - improving door-to-needle times for IV t-PA and directing appropriate patients for EST

# Acute Stroke Alert Algorithm – Overview

The new stroke workflow can be summarized by the mnemonic "**ABCDE**":

## A – Assessment

- Determine last-known well-time (LKWT)
- Look for stroke mimics and signs of trauma (usual history/exam)
- The stroke alert will be activated within 5 hours of LKWT
- Screen for potential bleeding problems:
  - Does the patient take warfarin, TSOA, or low-molecular weight heparin?
  - Is the patient on hemodialysis?

## B – Brain

- Perform brief neurological exam (or NIHSS, time permitting)
- This should be done by the stroke neurologist (when available)

## Acute Stroke Alert Algorithm – Overview

There are then 3 KEY Decision Points:

**C – CT angio or not?**

- Stat CT will be ordered
- Barring known IV contrast allergy (anaphylaxis), the patient should be getting a stat CT scan from the arch of the aorta to the Circle of Willis ("arch to COW") right after the non-contrast CT head is done if there is no bleed or mass

**D – DRIP or not?**

- DRIP stands for "Drug Rapid IV Push"
- Idea is to get IV t-PA on-board as quickly as possible
- IV t-PA is still considered first-line treatment for most stroke patients
- May be given with the patient still in CT and before CT angio is done

## Acute Stroke Alert Algorithm – Overview

**E – Endovascular Stroke Therapy (EST)**

- If a large vessel occlusion (LVO) is identified on CT angio, then the patient may be a candidate for EST
- Decision will be made in conjunction with Neurology
- Most patients who receive IV t-PA and then have a LVO will get EST
- Some patients who do not receive IV t-PA may still be candidates for EST

Again, the point is to think of this algorithm as follows:

A – Assessment

B – Brain

C – CT imaging (almost always including CT angio)

D – DRIP or not

E – EST or not

# Acute Stroke Redesign: Key Components

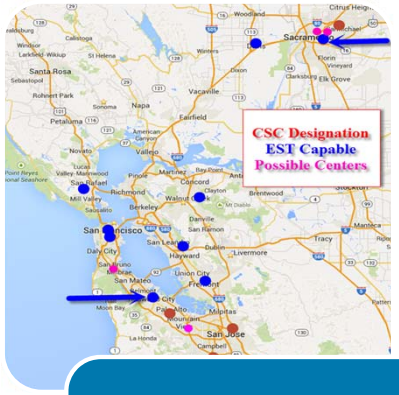
Stroke Neurologist Involved early in the workflow via Video

- Rapid assessment
- Early tPA ordering

Direct to CT & CTA

tPA administered in the CT suite

- Nearly all patients receive a CTA




Rapid Transfer when appropriate for Endovascular Treatment – ambulance called when t-PA ordered

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## Teleneurology “Hub”

- Small core group of neurologists who are involved in all stroke alerts
- Remote exam by teleneurologists with RN assistance
- Active 7am – midnight 7 days a week
- Neurologist orders the t-PA

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# Step One: Rapid Assessment on Arrival with Video


- Call to Neurologist via central 800 number - neurologist activates tele-presence unit
- Clinical assessment and exam by stroke neurologist by video
- Clinical assessment by ED physician
- IV access
- Lab
  - Blood sugar testing
  - INR if on warfarin or unknown
- Discussion of t-PA / CTA risks, benefits, alternatives
- IV t-PA ordered as soon as possible (allows time for mixing)
- Call on / off stroke alert based on clinical assessment
- Checklist / time out before leaving for CT

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# Step 2: Direct to CT/CTA after t-PA is Determined Appropriate

- **Direct to CT scanner –**
- **CTA completed directly after CT or t-PA**
- **t-PA in CT scanner if no CT contraindication**



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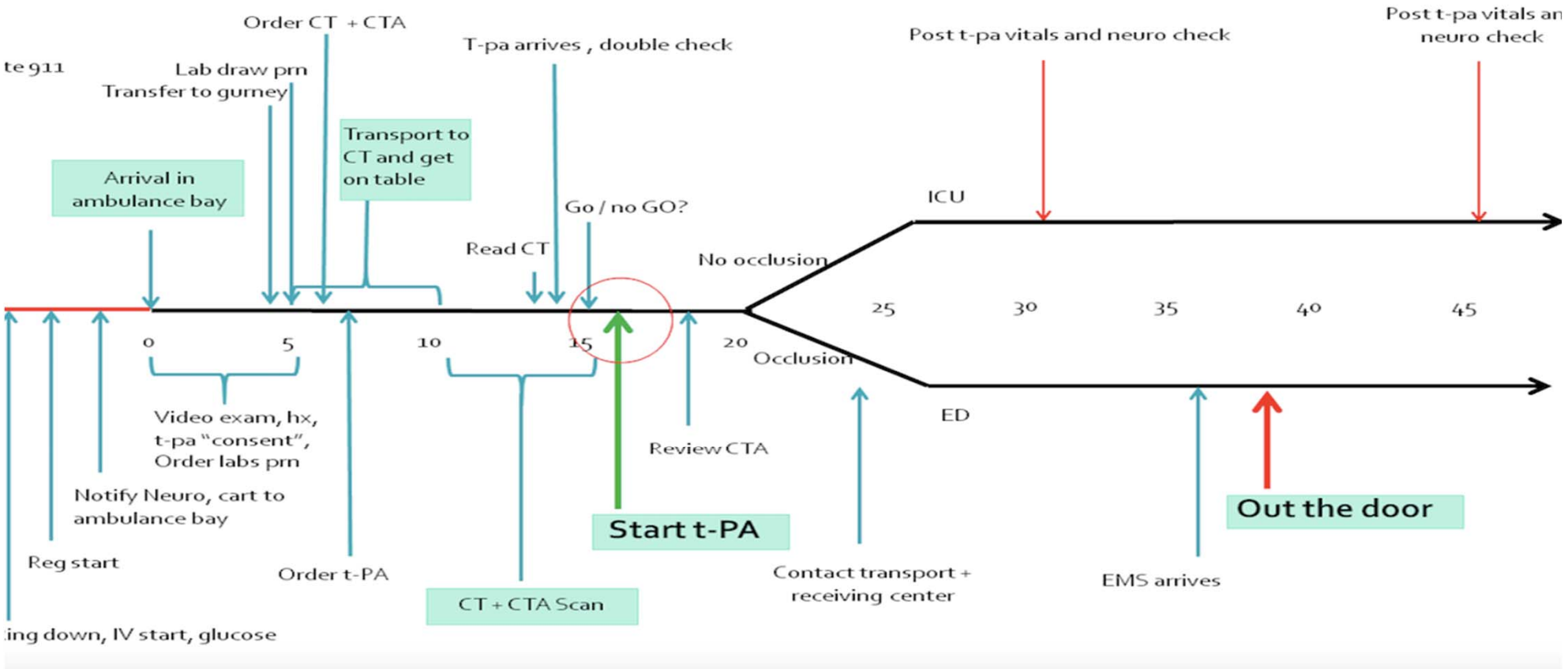
# Step 3: Rapid Transfer

- Identification of preferred endovascular centers and contacts
  - One call system
  - Imaging access
  - Direct to cath lab
- Ambulance transfer hub contacted upon ordering of t-PA
  - LVO identified : keep coming
  - LVO ruled out : never mind
- Ongoing time and outcome tracking

# Acute t-PA Treatment Timeline

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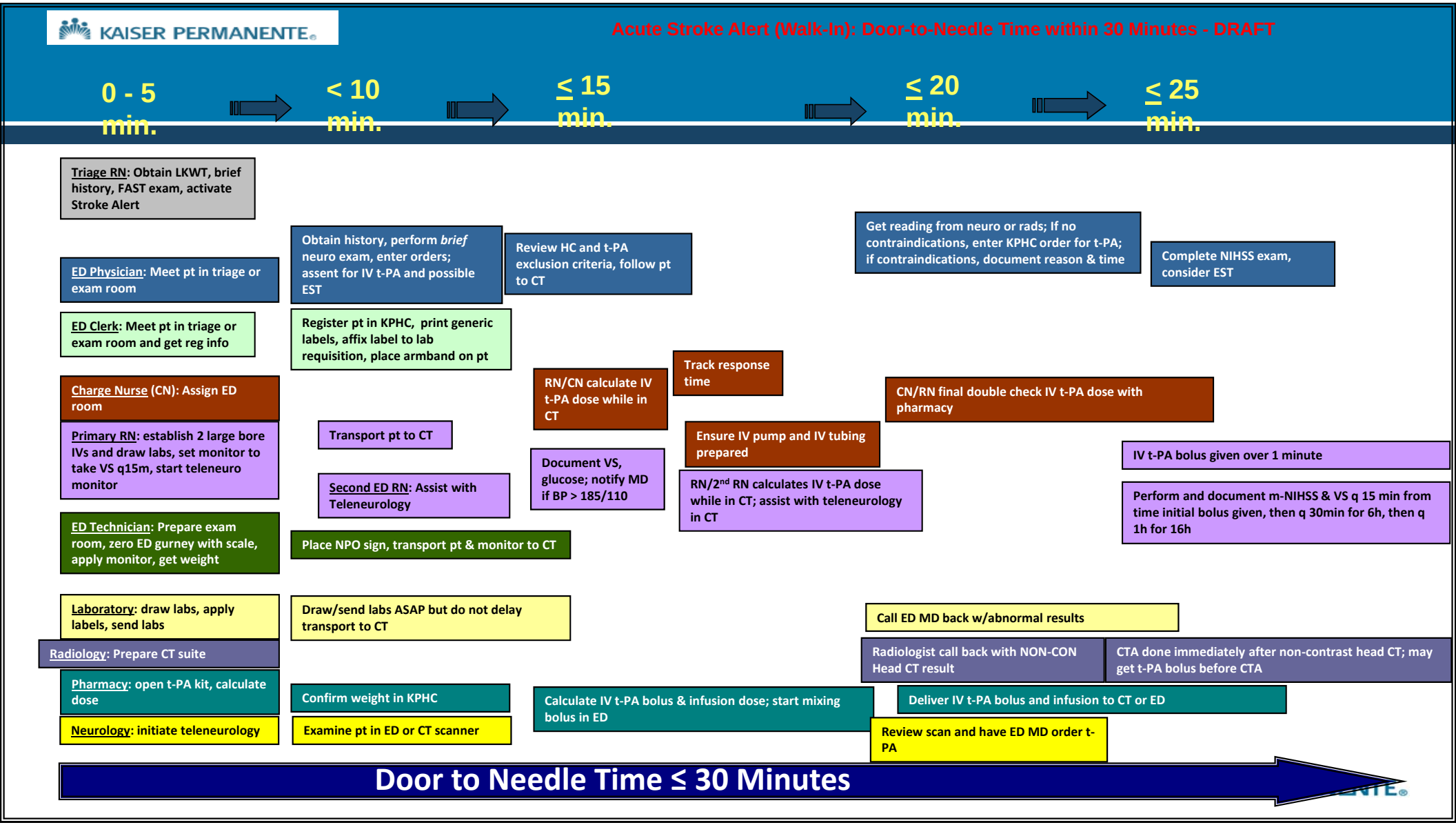
# Acute Stroke Alert (Walk-in): Door-to-Needle Time within 30 Minutes - DRAFT



# Sample Role Card (EMS)

## EMS

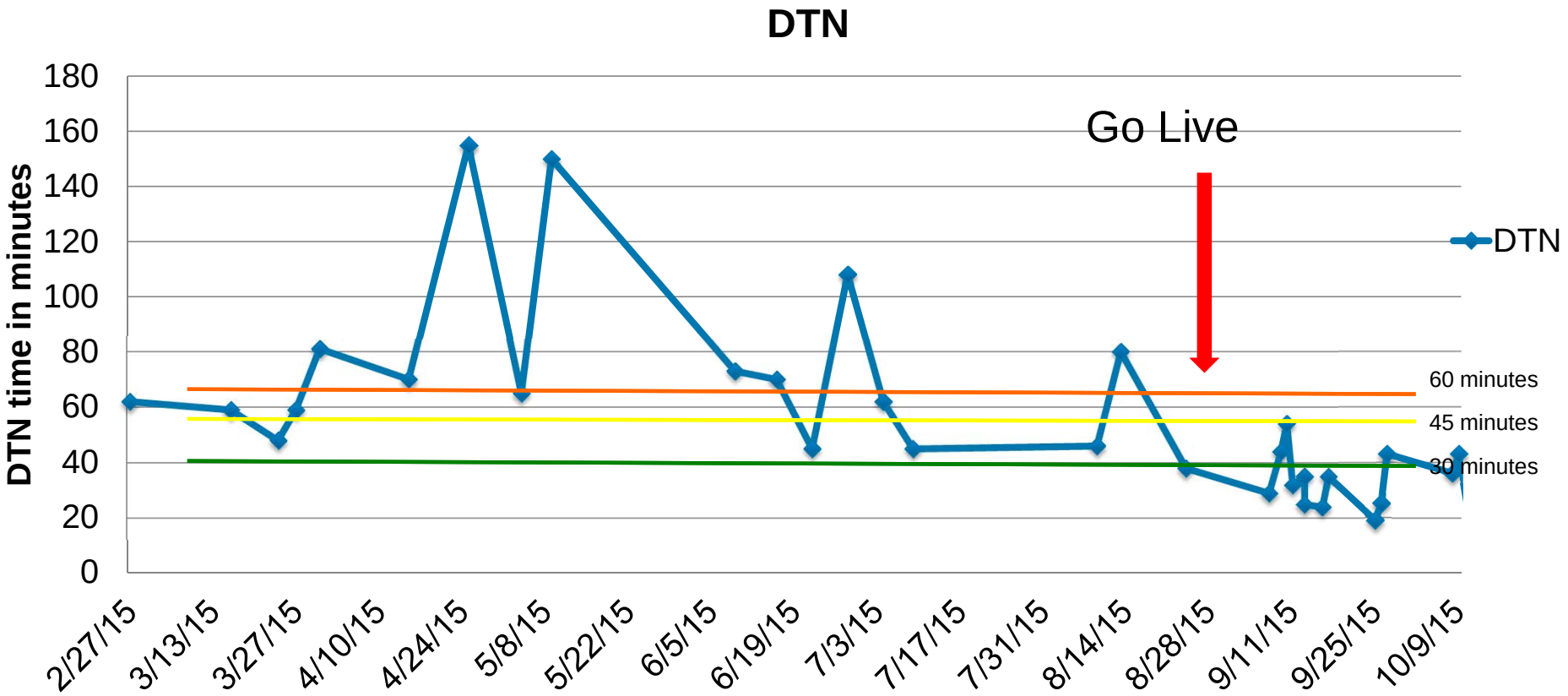
- ❑ Provide (or obtain):
  - ❑ Name
  - ❑ MRN
  - ❑ Last-known well time
  - ❑ Name of Family Contact with Best Contact Phone #
- ❑ Glucose (fingerstick)
- ❑ Medications – Evidence of *any* anticoagulant?

| | |
|---|---|
| Warfarin (Coumadin) | Dabigatran (Pradaxa) |
| Apixaban (Eliquis) | Rivaroxaban (Xarelto) |
| Aspirin/clopidogrel (Plavix) | Enoxaparin (Lovenox) |

# Testing and Design

- Simulations at alpha >> beta sites
- Refining process with simulation learnings
- Development of training materials and plans for rapid scaling

# Early Results (3 medical centers)

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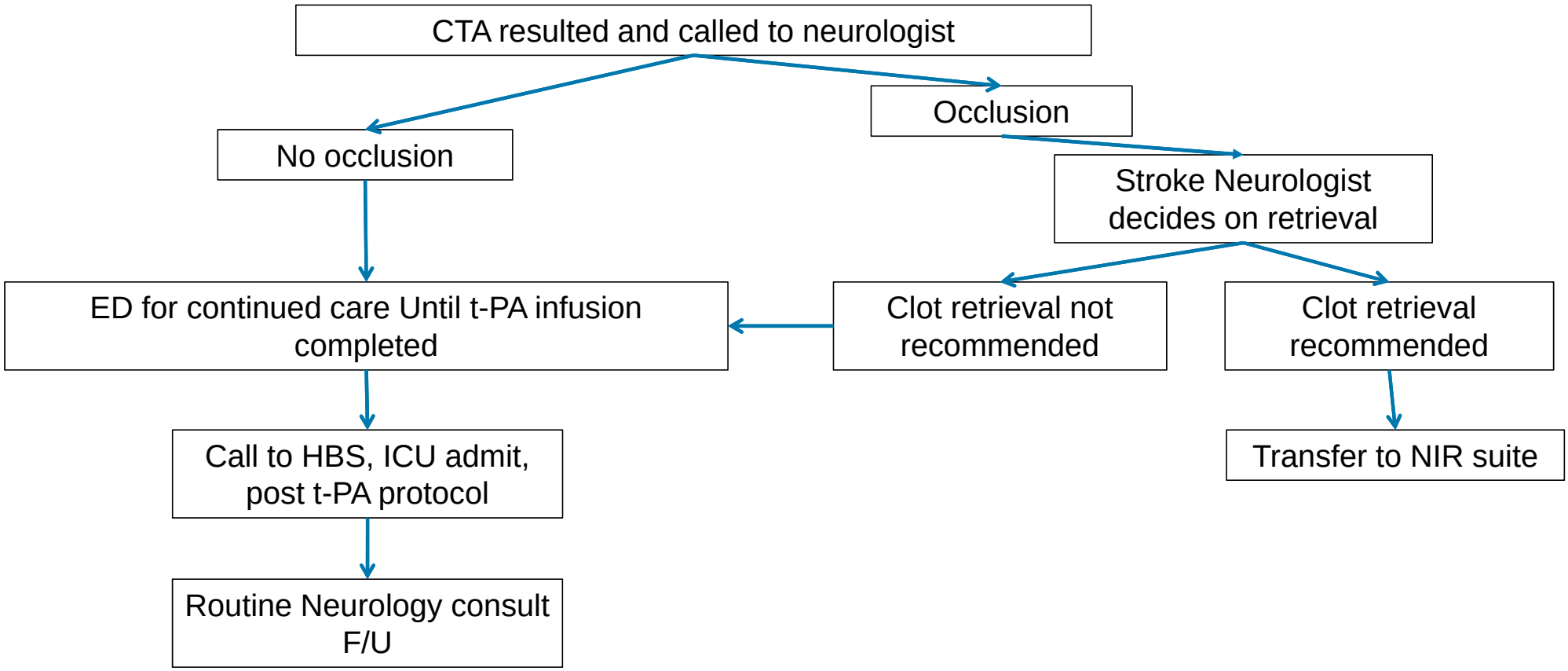
# After the IV Treatment and Occlusion is Found– Next Steps



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## Rollout to All 21 Medical Centers

- Teleneurologist training
- Teleneurologist credentialing at all facilities
- Development of role cards for each team member
- Training video
- Local implementation teams
- Webex kick off / training
- Local facility simulations
- Concurrent data collection and review
- Targeted completion by end of year

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## Planned Future Work

- Comparison of population outcomes pre and post process change
  - DTN
  - First door to endovascular treatment times
  - Transfer times
  - Rate of treatment
  - Discharge disposition
  - Mortality
  - Functional status

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# Frequently Asked Questions (FAQ) for Emergency Physicians (1/5)

- **When does a stroke alert get called, based on last-known well time (LKWT)?**
  - Regardless if the facility is EST-capable or not, stroke alert called for **5 hours of LKWT.**
  - If there is a large vessel occlusion (LVO) on CTA, then stroke neurology will arrange for transfer
  - What if the patient is clearly not an IV t-PA candidate (e.g. known recent INR > 1.7 or outside the window for IV t-PA)?
    - For stroke patients that may have a LVO, EST may be an effective treatment. Thus stroke-like patients should be treated with the same urgency as IV t-PA candidates until a LVO has been ruled out as the etiology.
    - To avoid ordering t-PA for those cases that clearly do not meet IV t-PA criteria, the ED physician should notify the charge RN, and Neurology should not launch the t-PA order set.

# Frequently Asked Questions (FAQ) for Emergency Physicians (2/5)

- **What if there are 2 or more concurrent stroke alerts at the same time, either at the same or different facilities?**
  - The stroke  neurologist will need to multitask
  - Local neurology will serve as backup. The ED physician will contact the local neurologist at the request of the telestroke neurologist.

- **How can we possibly capture all strokes and treat them within 30 minutes?**
  - We must focus on the obvious strokes and doing well on these first, so that we can be better prepared to handle the more atypical stroke
  - As we improve stroke recognition, we will strive to reduce door-to-needle times for these more atypical presentations
  - We will probably never get all strokes treated in under 30 minutes but can  try
  - We need to improve walk-in triage tools, e.g. FAST, ROSIER

# Frequently Asked Questions (FAQ) for Emergency Physicians (3/5)

- **With the rush to get the patient to the CT scanner, may we end up treating TIAs or stroke mimics?**
  - Yes, this is quite possible. However for this disease, time is of the essence. **Most** TIAs last 5-15 minutes.
  - Non-stroke patients who get IV t-PA tend to do well with fewer complications than stroke patients who receive IV t-PA.
- **What if teleneurology fails, the monitor is not working, etc?**
  - Facetime on iPhone/iPad
- **What if the patient is too obese for the CT scanner?**
  - Weight limits vary locally – this should be in your local workflow. However breaking the CT scanner table is a valid concern.
- **What if the CT scanner is occupied with a patient undergoing a procedure and cannot be moved?**
  - Locally driven decision – local facility must have contingency plan in place
  - Prenotification to CT techs and Radiologist as part of initial stroke alert necessary

# Frequently Asked Questions (FAQ) for Emergency Physicians (4/5)

- **What if the IV access is poor and we cannot obtain a CT angiogram?**
  - If no IV access at all, still send for non-contrast CT head and try to place peripheral IV ASAP and give t-PA if indicated, deferring CTA. If still unable to get IV access, you can give t-PA through a central line at a compressible site (IJ, femoral) but physician should have considerable skill (i.e. the line placement should be easy)
  - If IV access OK for t-PA but not sufficient for IV contrast for CTA, then get stat non-contrast CT head and give t-PA ASAP. If a peripheral line appropriate for CT angiography is placed, then get stat CT angio. If still unable to get an acceptable peripheral IV, then get stat time-of-flight MRA (no contrast needed)
  - Peripheral ultrasound-guided IV access may be useful AFTER the noncontrast head CT is performed and tPA is started. Central line may not be used for CTA unless specifically rated for power injection.

# Frequently Asked Questions (FAQ) for Emergency Physicians (5/5)

- **How do we cancel the initial stroke alert (e.g. patient is a probable stroke mimic)?**
  - Will use “Cancel stroke alert/all clear” if the initial stroke alert is cancelled
  - If the plan is to proceed with CT head/CT angiography, probable IV t-PA, possible EST, will say “yes/no CTA,” “yes/no DRIP,” “yes/no EST”
- **What about t-PA that is mixed but not used (based on CT findings or another contraindication)?**
  - Genentech will reimburse, even if blood is found on the CT scan
- **Who writes the order for t-PA? Can the stroke neurologist order the t-PA remotely?**
  - Stroke neurologist
- **What happens if the ED physician is opposed to giving IV t-PA when the stroke neurologist feels that IV t-PA is indicated for a particular patient?**
  - Both ED doctor and neurologist should agree on decision for t-PA. Stroke neurology WILL be the one actually ordering the medication.
  - These cases will be tracked.

Questions?

Contact Information:
Sunil Bhopale, MD
sunil.bhopale@kp.org
(650) 299-3683

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