Impact of Telemedicine on Delivery of Acute Stroke Care

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Nov 4th, 2022

Disclosures:

None

My background

- Involved in telemedicine since 2012
- Currently participate in coverage of 100+ cameras spanning 5 networks and 17 states
- Home network,

–CODOC (Colorado and surrounding states, est. 2006)

–>50 cameras

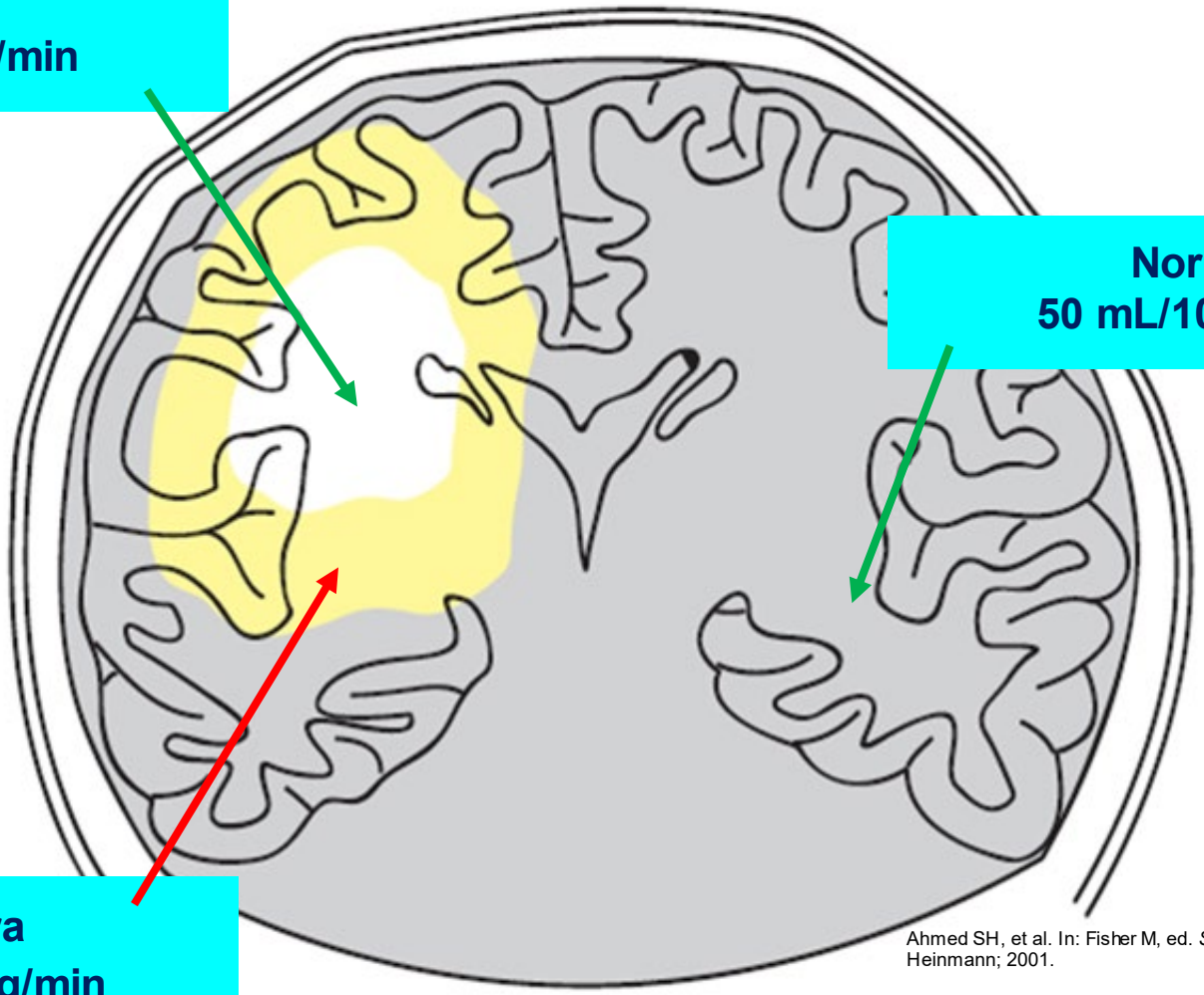
–>20,000 consults performed

- Blue Sky Telehealth

–Since March of 2021: 110,820 consults performed

–Currently doing 200-300 consults per day

Infarct
<8 mL/100 g/min



Normal
50 mL/100 g/min

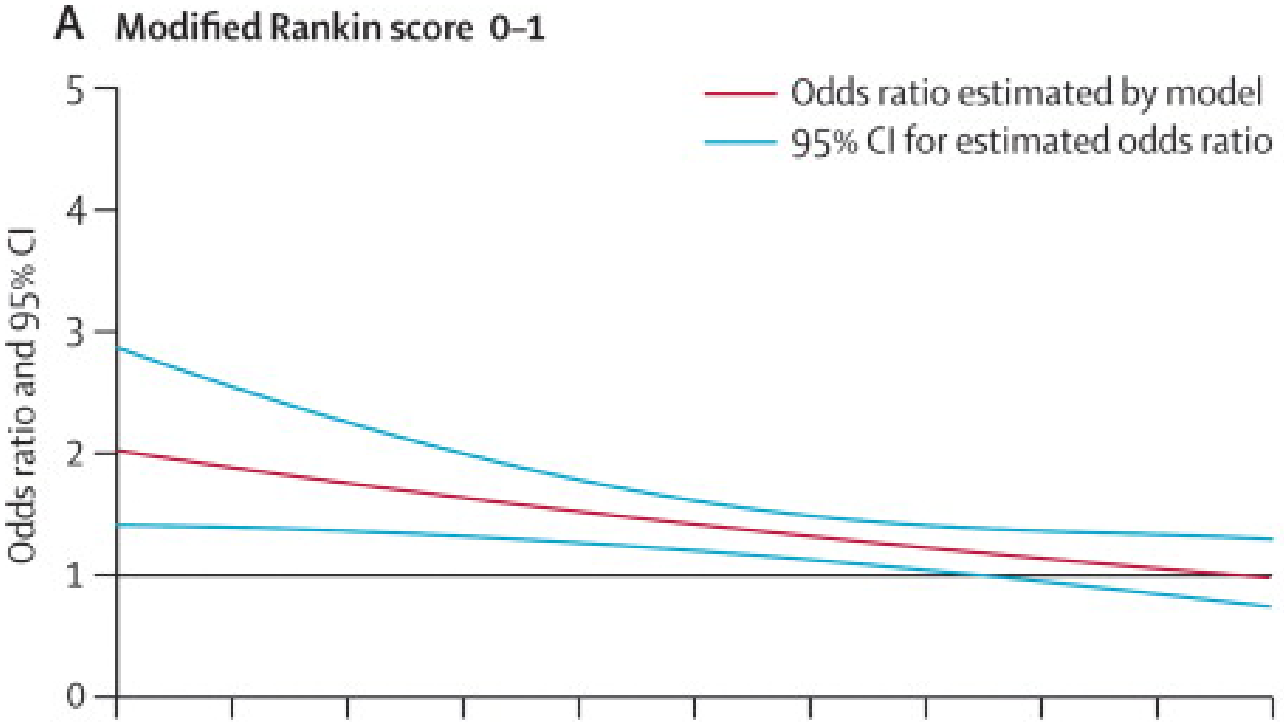
Penumbra
8-20 mL/100 g/min

Ahmed SH, et al. In: Fisher M, ed. *Stroke Therapy*. *2nd* ed. Butterworth Heinmann; 2001.

Benefit of tPA continually decreases over time

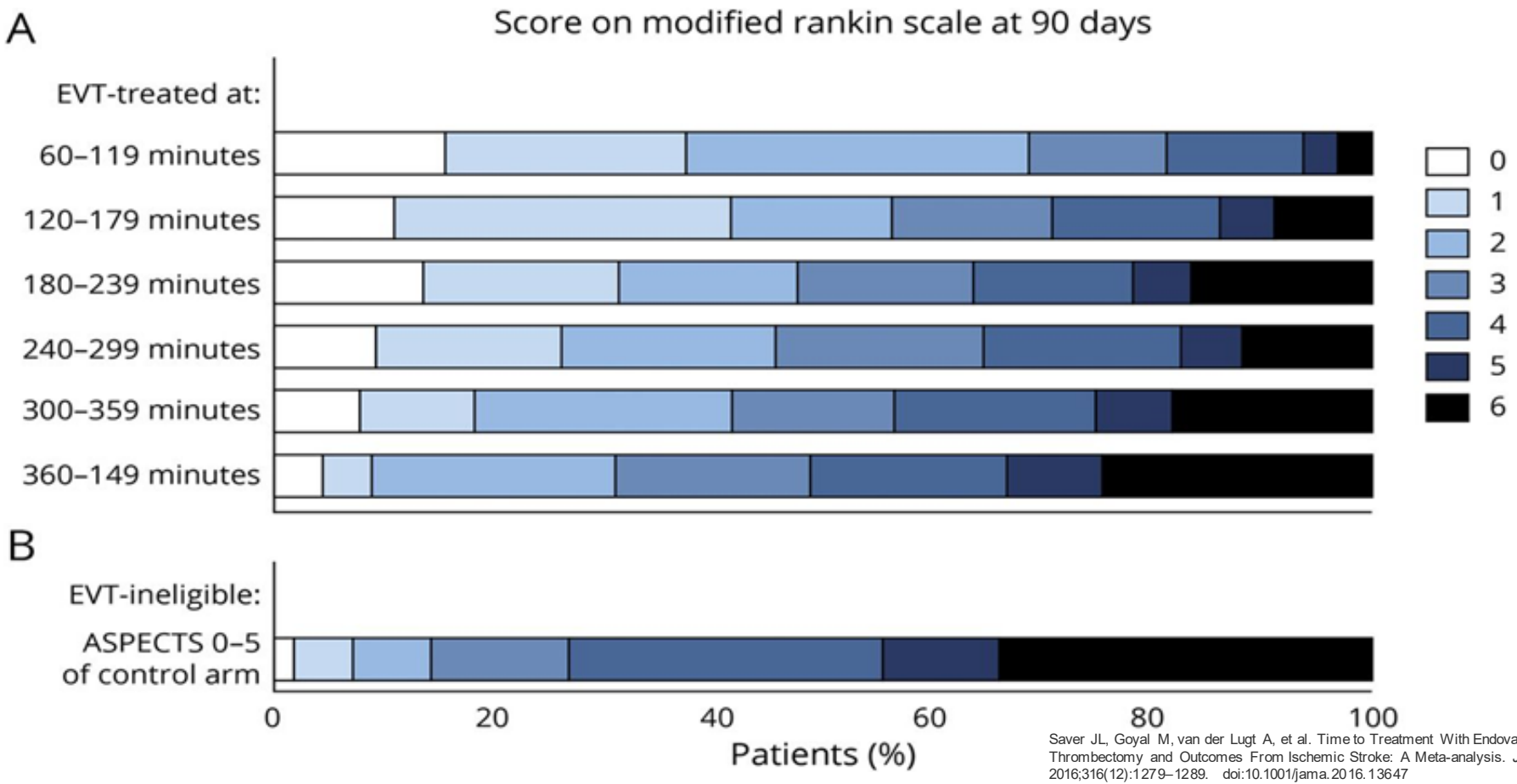
Pooled data from NINDS, ECASS, EPITHET and ATLANTIS TRIALS (n=3670)

NNT for mRS 0-1:
NNT 4.5 for 0-90 min
NNT 9.0 for 91-180 min
NNT 14.1 for 181-270 min
NNT 21.4 for 271-360 min



Lees, FRCP, Bluhmki, PhD, Von Kummer, MD, Brott, MD, Toni, MD, Grotta, MD. Time to treatment with intravenous alteplase and outcome in stroke: an updated pooled analysis of ECASS, ATLANTIS, NINDS, and EPITHET trials. The Lancet. VOLUME 375, ISSUE 9727, P1695-1703, MAY 15, 2010

Benefit of Mechanical Thrombectomy Continually decreases with Time



Saver JL, Goyal M, van der Lugt A, et al. Time to Treatment With Endovascular Thrombectomy and Outcomes From Ischemic Stroke: A Meta-analysis. *JAMA*. 2016;316(12):1279–1289. doi:10.1001/jama.2016.13647

Conclusions

“Any time delay to EVT reduces QALYs and decreases the economic value of care provided by this intervention. Health care policies to implement efficient prehospital triage and to accelerate in-hospital workflow are urgently needed”

Wolfgang G. Kunz, MD, Myriam G. Hunink, PhD, Mohammed A. Almekhlafi, MD, Bijoy K. Menon, MD, et al. Public health and cost consequences of time delays to thrombectomy for acute ischemic stroke. Neurology 2020;95:e2465-e2475

Neurologist involvement in the stroke alert process leads to higher tpa rates for ischemic stroke patients

Effect of SMC Stroke Center:
Treatment of Ischemic Strokes w/ Lytics*

*Includes all ischemic strokes in database, not just stroke alerts

- Salami S, Kolluru A, Al-Najafi S, Stover C, Mar A, Szpunar S, et al. Utilization and outcome of thrombolytic therapy for acute ischemic stroke: the St. John Hospital code stroke experience. *J Clin Outcomes Manag*. 2011;**18**(4):165–9.

- Hsieh CY, Chen CH, Chen YC, Kao Yang YH. National survey of thrombolytic therapy for acute ischemic stroke in Taiwan 2003–2010. *J Stroke Cerebrovasc Dis*. 2013;**22**(8):e620–7. doi: 10.1016/j.jstrokecerebrovasdis.2013.07.043

- Charipar R, Charipar E. Administration of tissue plasminogen activator for acute ischemic stroke in a rural Wisconsin hospital. *Wis Med J*. 2008;**107**(4):176–80

- Ahro Kim, Ji Sung Lee, Ji Eun Kim, Young Min Paek, Kyuyoon Chung, Ji-Hyeon Park, Yong-Jin Cho, Keun-Sik Hong. Trends in yield of a code stroke program for enhancing thrombolysis. Journal of Clinical Neuroscience, Volume 22, Issue 1, 2015, Pages 73-78

- Lakshminarayan, K., Peacock, J.M., Luepker, R.V. and Tsai, A.W., 2008. Thrombolytic treatment after acute ischemic stroke results from the Minnesota Stroke Registry and opportunities to improve care. Journal of vascular and interventional neurology. *1*(3), p.87.

Stroke Telemedicine seems like a natural progression to provide our limited resources of stroke specialists to rural and urban communities.

Similar treatment times compared to neurologist covered stroke centers

Denver primary stroke centers vs CSC (Swedish Medical Center)

Reach Trial: Rural Georgia

- Nearly one quarter of the tPA-treated patients were treated within 90 minutes of the onset of symptoms and more than half were treated within 2 hours.
  - Regional model urban system of stroke care in which only 28% of the tPA-treated patients were treated in <2 hours

David C. Hess, MD; Samuel Wang, MS; William Hamilton, MBA, MHA; Sung Lee, MD; Carol Pardue, RN, MSN; Jennifer L. Waller, PhD; Hartmut Gross, MD. REACH Clinical Feasibility of a Rural Telestroke Network. Stroke 2005;36:2018-2020.

Efficacy of site-independent telemedicine in the STRokE DOC trial: a randomised, blinded, prospective study. 2008

- 234 patients: half randomized to telephone consultation, half to telemedicine
- **Correct treatment decisions** were made more often in the telemedicine group than in the telephone group
  - (108 [98%] *vs* 91 [82%], odds ratio [OR] 10·9, 95% CI 2·7–44·6; p=0·0009)
- Slight increase rate of thrombolytics compared to phone but not statistically significant (p=0.34)
- No difference in symptomatic hemorrhage or mortality

Meyer MD , Raman PhD , Hemmen MD, Obler MD , Zivin PhD, Rao PhD, Thomas PhD. Efficacy of site-independent telemedicine in the STRokE DOC trial: a randomised, blinded, prospective study. The Lancet Neurology Volume 7, Issue 9, September 2008, Pages 787-795

Impact of Telemedicine Implementation in Thrombolytic Use for Acute Ischemic Stroke: The University of Pittsburgh Medical Center Telestroke Network Experience

- Retrospective Review of 2588 patients spanning from 2005-2008
  - 919 before telemed implementation
  - 1669 after telemed implementation
- Treatment rates increased
  - 2.8% prior to telemedicine
  - 6.8% following telemedicine implementation
- *Arrivals from EMS within 3 hours of symptom onset increased $p<0.002$*
  - 6% pre telemedicine
  - 9.5% post telemedicine
- Symptomatic hemorrhage rates decreased
  - 10.7% pre telemedicine
  - 1.8% post telemedicine

Amorim MD, Shih PhD, et al. Impact of Telemedicine Implementation in Thrombolytic Use for Acute Ischemic Stroke: The University of Pittsburgh Medical Center Telestroke Network Experience. Journal of Stroke and Cerebrovascular Diseases. Volume 22, Issue 4, May 2013, Pages 527-531

TeleStroke Units Serving as a Model of Care in Rural Areas: 10 year experience in Bavaria and Germany

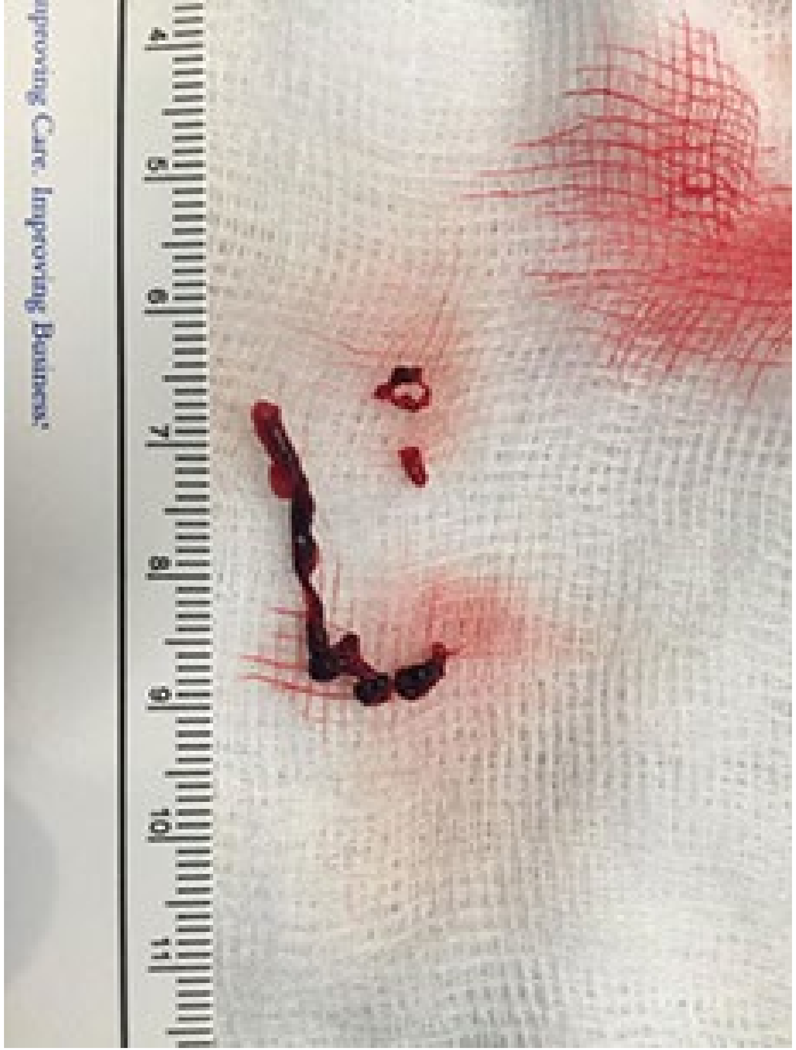
- 3331 patients treated with lytic therapy
  - 2.6% pre telemedicine
  - 15.5% post telemedicine
- Median onset to treatment times
  - 150->120 mins
- Median door to groin times
  - 80 mins->20 mins
- Increased the number of patients with stroke and transient ischemic attack treated in hospitals with (Tele-)Stroke Units substantially
  - 19% -> 78%

Müller-Barna, MD, Hubert, MD, Boy, MD, Bogdahn, MD, Wiedmann, PhD, Heuschmann, MD, MPH, Audebert, MD. TeleStroke Units Serving as a Model of Care in Rural Areas. 10-Year Experience of the TeleMedical Project for Integrative Stroke Care. Stroke Volume 45, Issue 9, September 2014; Pages 2739-2744

Improvements in Mechanical Thrombectomy Models

- Door-to-groin puncture: 47 min vs 69 min, p = 0.04
- 20 additional endovascular therapies

Pedradosa *Cerebrovasc* Dis 2012
Switzer *Circ Cardiovasc Qual Outcomes* 2013



Acute Stroke Model of Care

Door to Treatment Time ≤ 30 minutes

-10 min

Pre-Hospital Activation

0 min

Initial ED MD Eval

≤ 5 min

Telemedicine/Neurologist Evaluation

≤ 10 min

Telemedicine/Neurologist Evaluation

≤ 30 min

tPA Administration

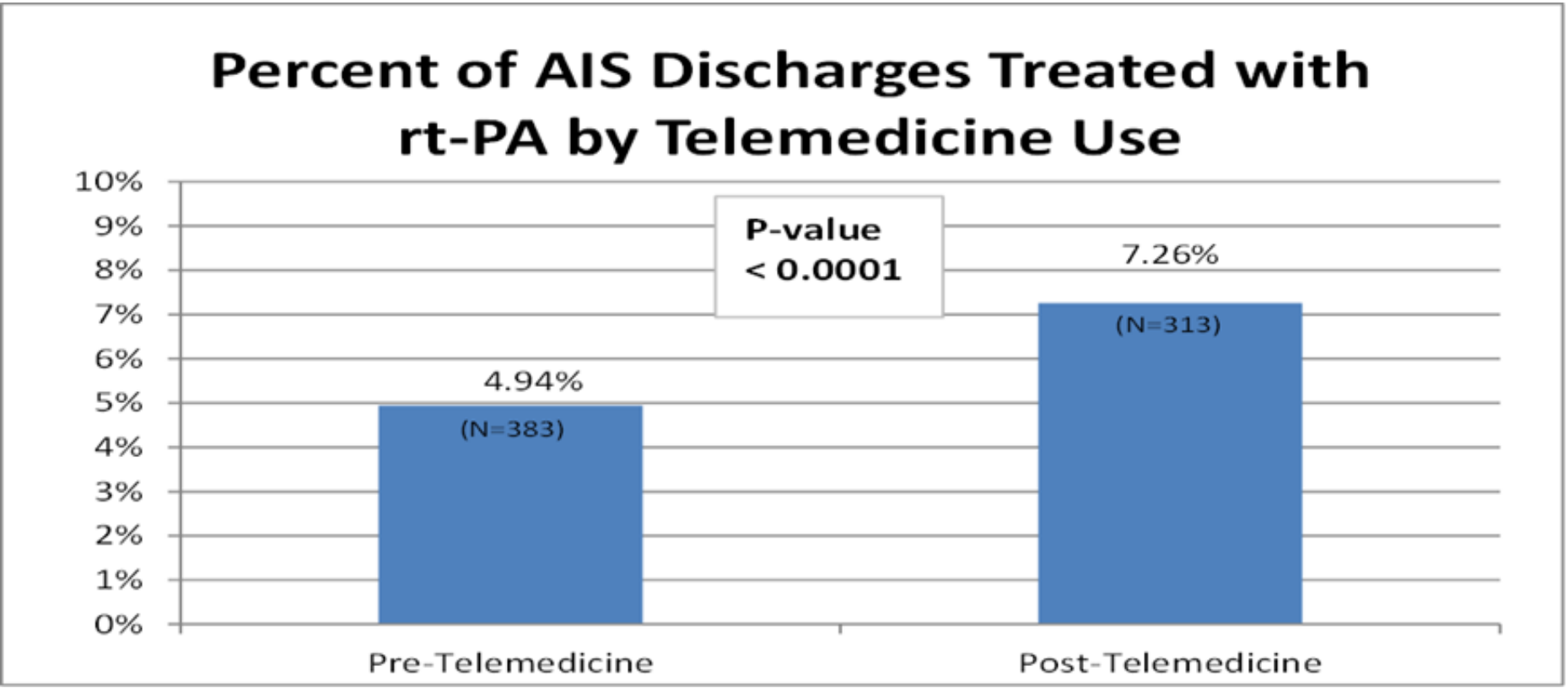
Transfer Consideration

INR Team Activation

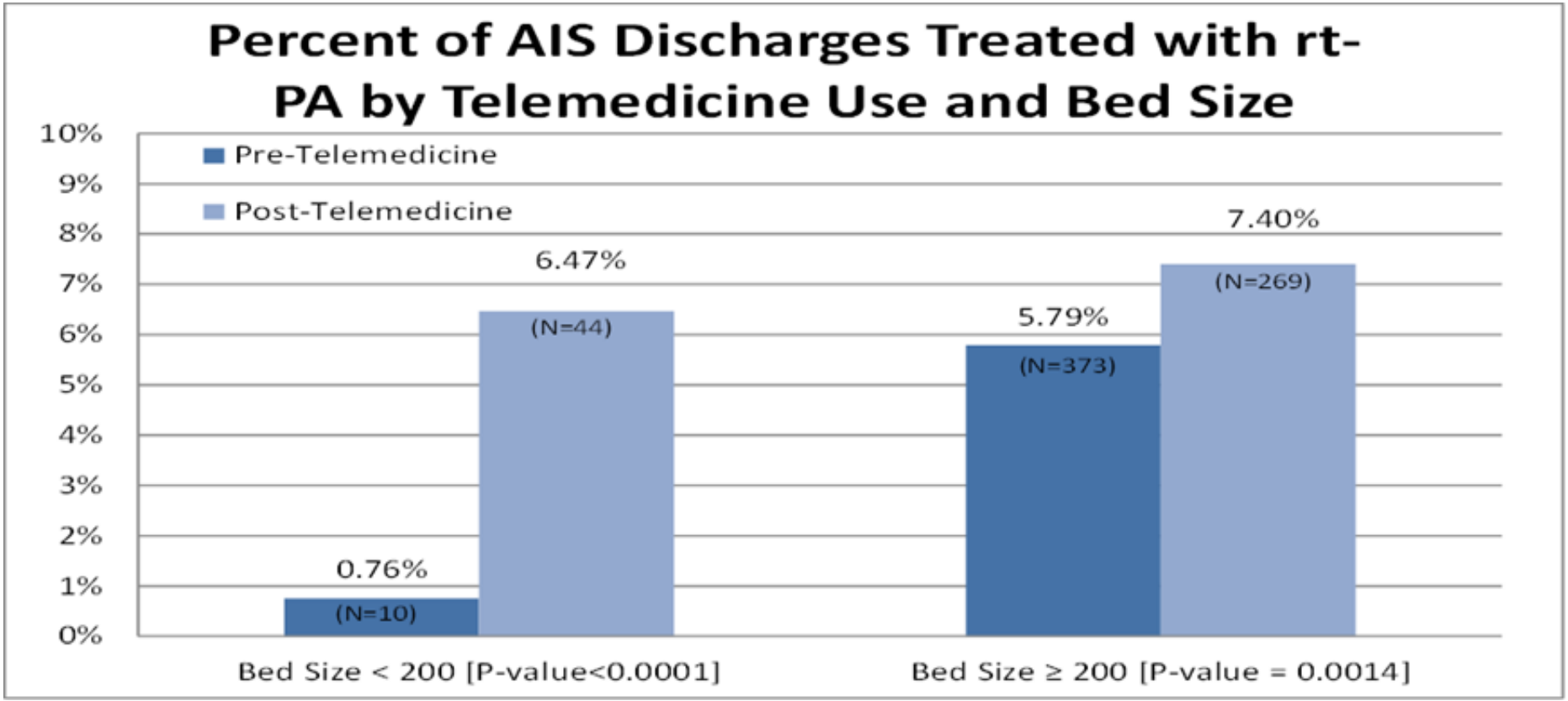
Reperfusion Treatment and Stroke Outcomes in Hospitals With Telestroke Capacity

- 153,272 patients
- 643 hospitals with telestroke capacity, there were 76 636 patients with stroke who were matched 1:1 to patients at similar hospitals without telestroke capacity
- Patients cared for at telestroke hospitals had higher rates of reperfusion treatment compared with those cared for at control hospitals (6.8% vs 6.0%; difference, 0.78 percentage points; 95% CI, 0.54-1.03; P < .001
- d lower 30-day mortality (13.1% vs 13.6%; difference, 0.50 percentage points; 95% CI, 0.17-0.83, P = .003)

Andrew D. Wilcock, PhD; Lee H. Schwamm, MD; Jose R. Zubizarreta, PhD, et al, JAMA 2021

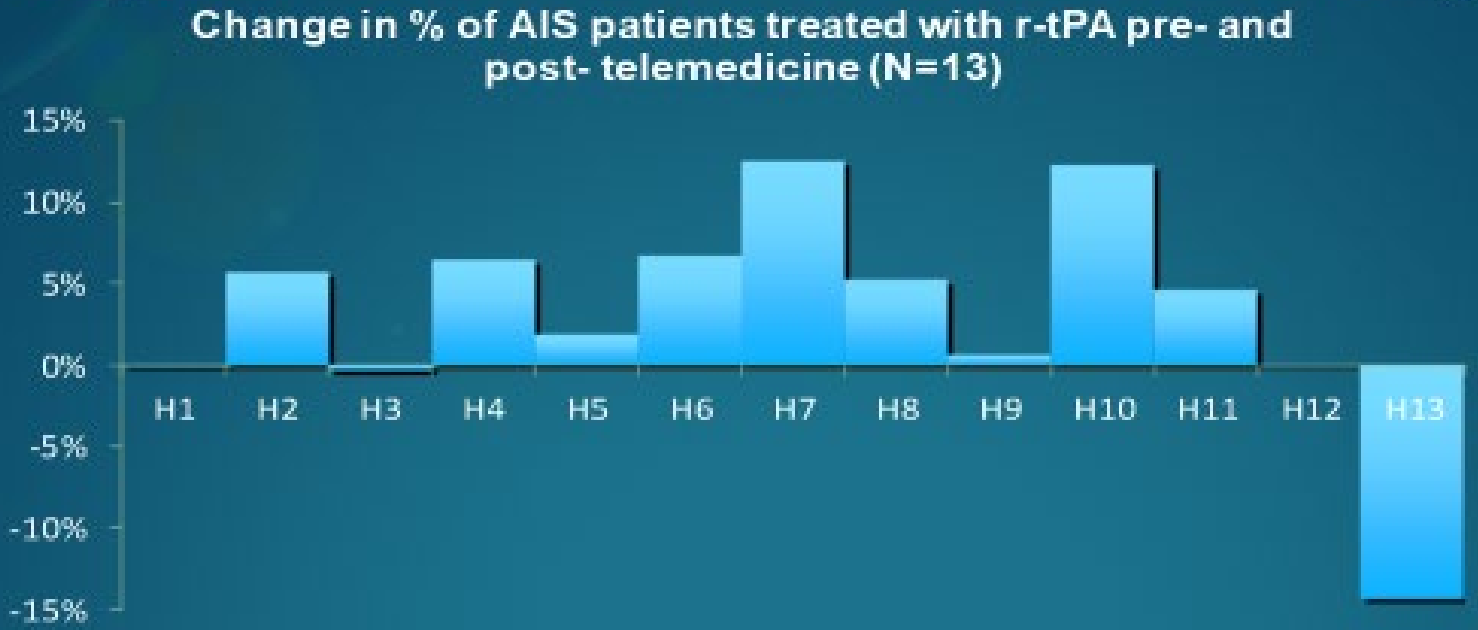


AAN Presentation by Dr. Jeff Wagner in 2014 using data from a network in Santa Barbara, CA



AAN Presentation by Dr. Jeff Wagner in 2014 using data from a network in Santa Barbara, CA

Hospital-Level rt-PA Treatment Changes



AAN Presentation by Dr. Jeff Wagner in 2014 using data from a network in Santa Barbara, CA

Why Such Disparity in Effect Among Hospitals?

Table 1 Twelve measures to reduce treatment delays

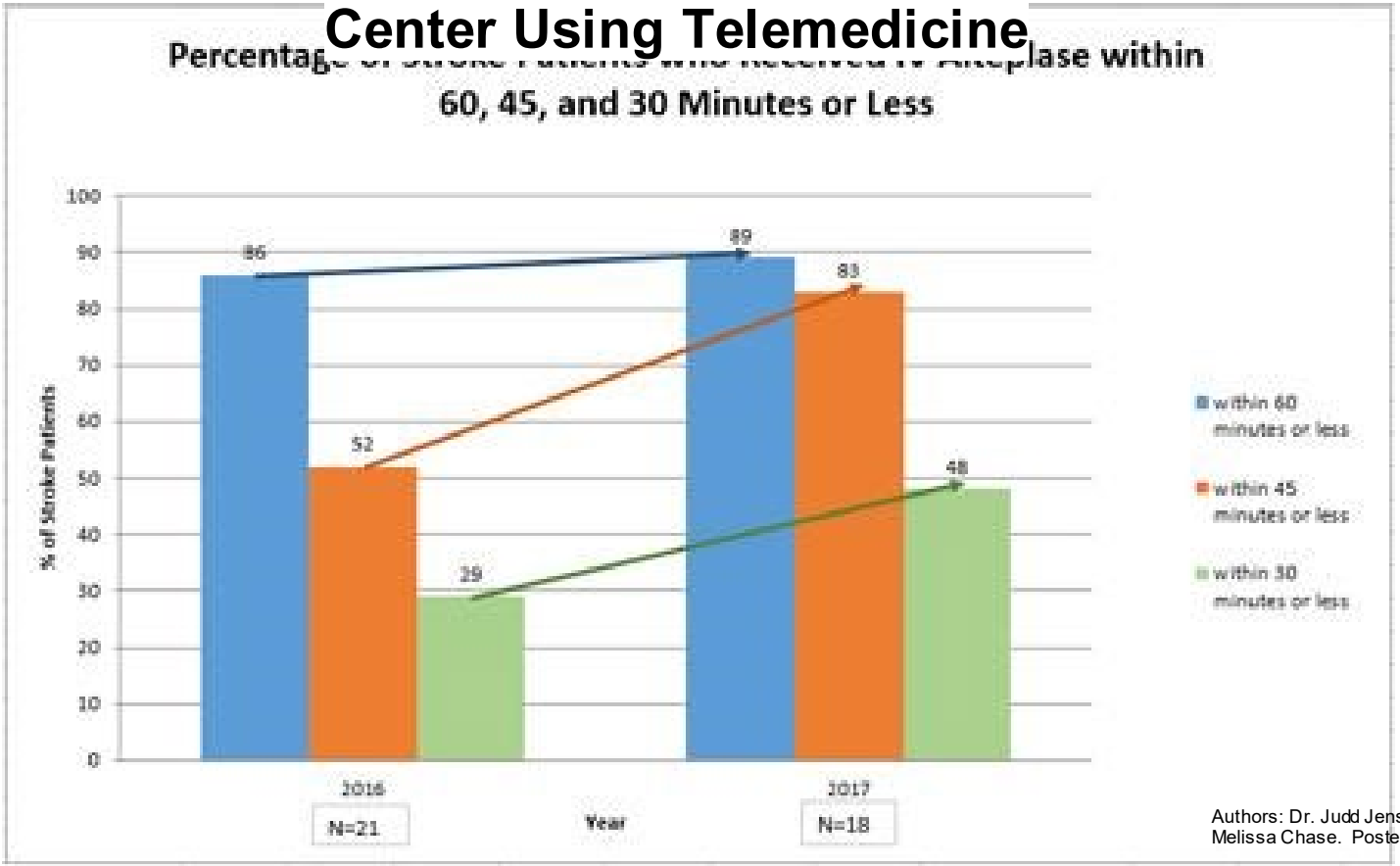
Measure	Description	Year
EMS involvement	Education of dispatchers and EMS personnel, stroke high-priority dispatch	1998
Hospital prenotification	EMS contacts stroke physician directly via mobile phone	2001
Alarm and preorder of tests	Laboratory and CT computer-ordered and alarmed at prenotification	2001
No-delay CT interpretation	Stroke physician interprets the CT scan, not waiting for formal radiology report	2001
Premixing of tPA	With highly suspect thrombolysis candidates, tPA premixed prior to patient arrival	2002
Delivery of tPA on CT table	Bolus administered on CT table	2002
CT relocated to ER	Patient transfers of several hundred meters, including elevators, were no longer needed	2003
CT priority and CT transfer	CT emptied prior to patient arrival, and patient transferred straight onto CT table, not ER bed	2004
Rapid neurologic evaluation	Patient is examined upon arrival, on CT table	2004
Preacquisition of history	Statewide electronic patient records and eyewitness interview before/during transportation	2005
Point-of-care INR	Laboratory personnel draw blood while patient on CT table, and perform instant POC INR	2005
Reduced imaging	While all patients have a CT, advanced imaging reserved for unclear cases only	2005

Team Sport:

- EMS
- Triage nurses and access center
- ED physicians
- Laboratory
- CT techs
- Pharmacy
- RNs: ED, ICU
- Radiology
- IT
- Neuroradiology
- IR technicians and RNs

Meretoja, Atte, et al. Reducing in-hospital delay to 20 minutes in stroke thrombolysis. *Neurology* 79.4 (2012): 306-313.

Achieving 30 Minute Median Door to Needle Time at an Urban Center Using Telemedicine



Authors: Dr. Judd Jenson, Dr Jeff Wagner, Melissa Chase. Poster presentation at AAN

- **Direct neurology beam into the Telemedicine camera (rather than phoning first)**
  - Coordination with triage, EMS, access center, RN, and ED physicians
- The Teleneurologist remains on the camera, which accompanies the patient to CAT Scan (CT).
- **The neurologist reads the head CT in real time**
  - Through the camera at the time of this publication requiring training and buy in from CT techs
  - Now through smart phone APPs like Rapid and Viz AI
    - CTH technician education and IT support
- **Pharmacy responds to stroke alerts in person**, and pre-mixes (if the neurologist deems appropriate) tPA at the bedside
  - Pharmacy also aids in blood pressure management
- **Radiology calls neurologist directly in less than 5 minutes.** If no hemorrhage is confirmed on the CT scan, a verbal order to administer **tPA is given while in the CT suite**
  - Radiology buy in, CT buy in, ED physician buy in
- Ensuring Patient safety
  - Checklist
  - Stroke kit with mixing guidelines, dosing charts, and blood pressure medications
- **Stroke committee to collaborate with all affected departments.**
  - RN and physician CMEs created
  - mock stroke alerts

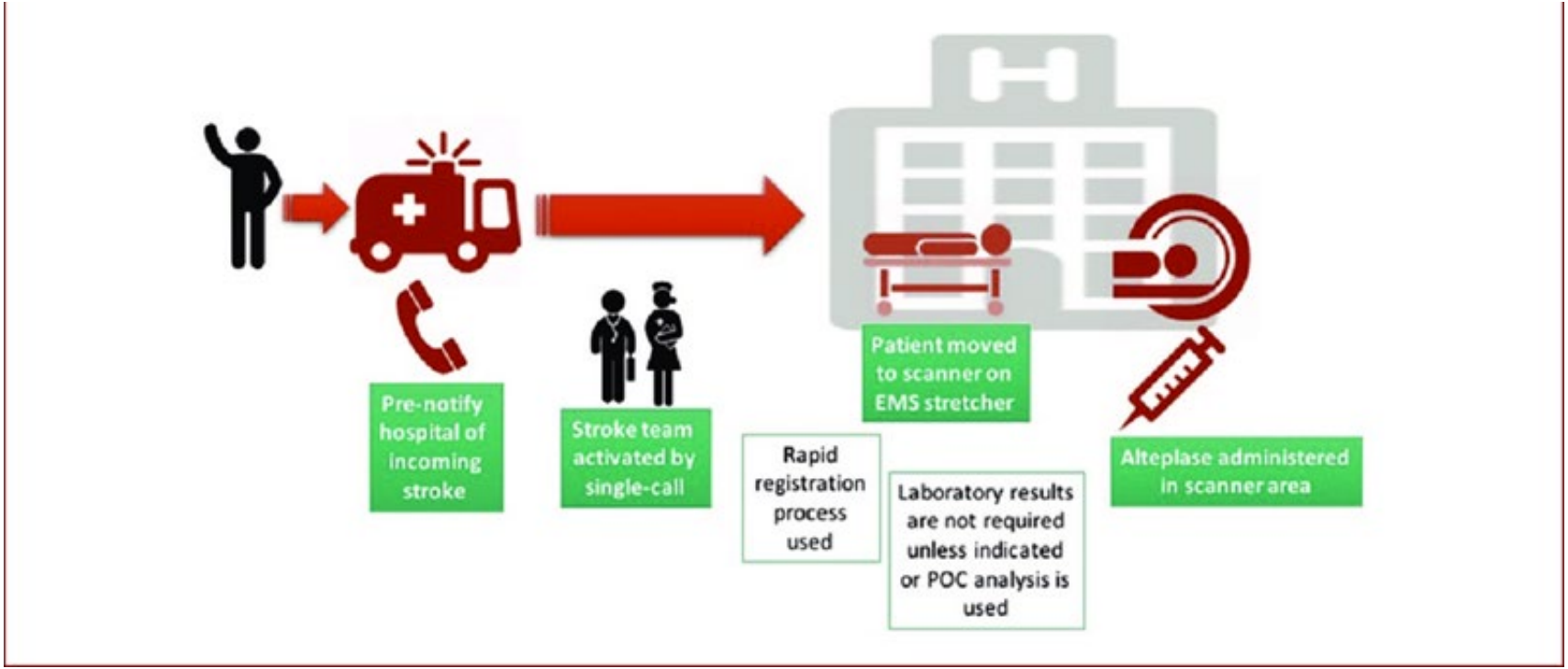
Authors: Dr. Judd Jenson, Dr Jeff Wagner, Melissa Chase. Poster presentation at AAN

A Successful Nurse-Driven Acute Stroke Code Algorithm to Reduce Door-to-Needle Time at a Telestroke Site

- DTN times at “spoke” telemedicine sites were 14 minutes longer
- the telestroke neurologist was seen as ineffective in running the stroke code remotely
- on-site stroke code leader was necessary to efficiently guide the team through the stroke code
- The code leader followed a simple Acute Stroke Code Checklist similar to that of the ACLS algorhythm
- The stroke code leader did not need to be an expert in stroke neurology, thus it was decided to have the primary nurse or charge nurse be the code leader

Jennifer L Moran, Lydia E Kim and Kazuma Nakagawa. A Successful Nurse-Driven Acute Stroke Code Algorithm to Reduce Door-to-Needle Time at a Telestroke Site. Stroke. 2020;51:ATP363

DTN time decreased from a median DTN: Pre vs. Post 42.5 to 33.0 min (p = 0.0012)



Jennifer L Moran, Lydia E Kim and Kazuma Nakagawa. A Successful Nurse-Driven Acute Stroke Code Algorithm to Reduce Door-to-Needle Time at a Telestroke Site. Stroke. 2020;51:ATP363

How can you be part of the team?

Stroke

An American Heart Association Journal

The improvement collaborative was the key factor in reducing door-to-needle times and improving outcomes for ischemic stroke patients across Alberta, Canada.

Kamal N, Jeerakathil T, Stang J, Liu M, Rogers E, Smith E, Demchuk A, Siddiqui M, Mann B, Bestard J, et al. Provincial Door-to-Needle Improvement Initiative Results in Improved Patient Outcomes Across an Entire Population. Stroke. 2020. DOI: 10.1161/STROKEAHA.120.029734

Question

Delivery of neurology consultation for acute stroke through the use of telemedicine improves access to time critical, quality care across healthcare settings.

- Paul CL, Ryan A, Rose S, Attia JR, Kerr E, Koller C, Levi CR. How can we improve stroke thrombolysis rates? A review of health system factors and approaches associated with thrombolysis administration rates in acute stroke care. Implement Sci. 2016 Apr 8;11:51. doi: 10.1186/s13012-016-0414-6. PMID: 27059183; PMCID: PMC4825073.

- Lawrence R. Wechsler, MD, FAHA, Chair, Bart M. Demaerschalk, MD, MSc, FRCPC, FAHA, Vice Chair, Lee H. Schwamm, MD, FAHA, Vice Chair, Opeolu M. Adeoye, MD, MS, FAHA, Heinrich J. Audebert, MD, Christopher V. Fanale, MD, David C. Hess, MD, Jennifer J. Majersik, MD, MS, FAHA, Karin V. Nystrom, APN, Mathew J. Reeves, BVSc, PhD, FAHA, Wayne D. Rosamond, PhD, MS, FAHA, Jeffrey A. Switzer, DO, MCTSTelemedicine Quality and Outcomes in Stroke: A Scientific Statement for Healthcare Professionals From the American Heart Association/American Stroke AssociationStrokeVolume 48, Issue 1, January 2017; Pages e3-e25

- Nicholas Richard Evans ,1,2 Lynda Sibson,3 Diana J Day,3 Smriti Agarwal,3 Raj Shekhar,4 Elizabeth A WarburtonHyperacute stroke thrombolysis via telemedicine: a multicentre study of performance, safety and clinical efficacyBMJ Open 2022;12:e057372. doi:10.1136/ bmjopen-2021-057372

- Andrew D. Wilcock, PhD; Lee H. Schwamm, MD; Jose R. Zubizarreta, PhD; Kori S. Zachrison, MD, MSc; Lori Uscher-Pines, PhD; Jessica V. Richard, BS; Ateev Mehrotra, MD, MPHReperfusion Treatment and Stroke Outcomes in Hospitals With Telestroke CapacityJAMA Neurol. doi:10.1001/jamaneurol.2021.0023 Published online March 1, 2021.

HCA MIDWEST HEALTH

RESEARCH MEDICAL CENTER

Special Thanks to

Jana Braklow
Mike Hoyt
Darcy Zeigler