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Mobile Stroke Unit Program

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Disclosure Information: David Fiorella, MD, PhD

- Medtronic – Consulting, Proctoring
- Cerenovous – Consulting
- Microvention – Consulting, Proctoring, Research Support
- Penumbra – Research Support
- Stryker – Consulting, Research Support
- Balt USA – Consulting, Research Support
- Siemens – Research Support
- MENTICE-Vascular Simulations – Stock Holder, Consultant
- Neurogami – Stock Holder, Consultant
- Marblehead – Consultant, Stock Holder
- RAPID.AI – Consultant
- RAPID Medical – Consultant
- Qapel Medical – Honorarium, Consultant
- Arsenal Medical – Consultant
- Phenox Medical – Consultant
  - **All the relevant financial relationships listed for this individual have been mitigated.**

Learning Objectives

- Describe how an innovative solution can improve the overall quality of life of patients affected by stroke.

- Explain a model to replicate the success observed in saving lives and improving the post-stroke quality of life of those served by the Mobile Stroke Unit program.

Mobile Stroke Unit Program
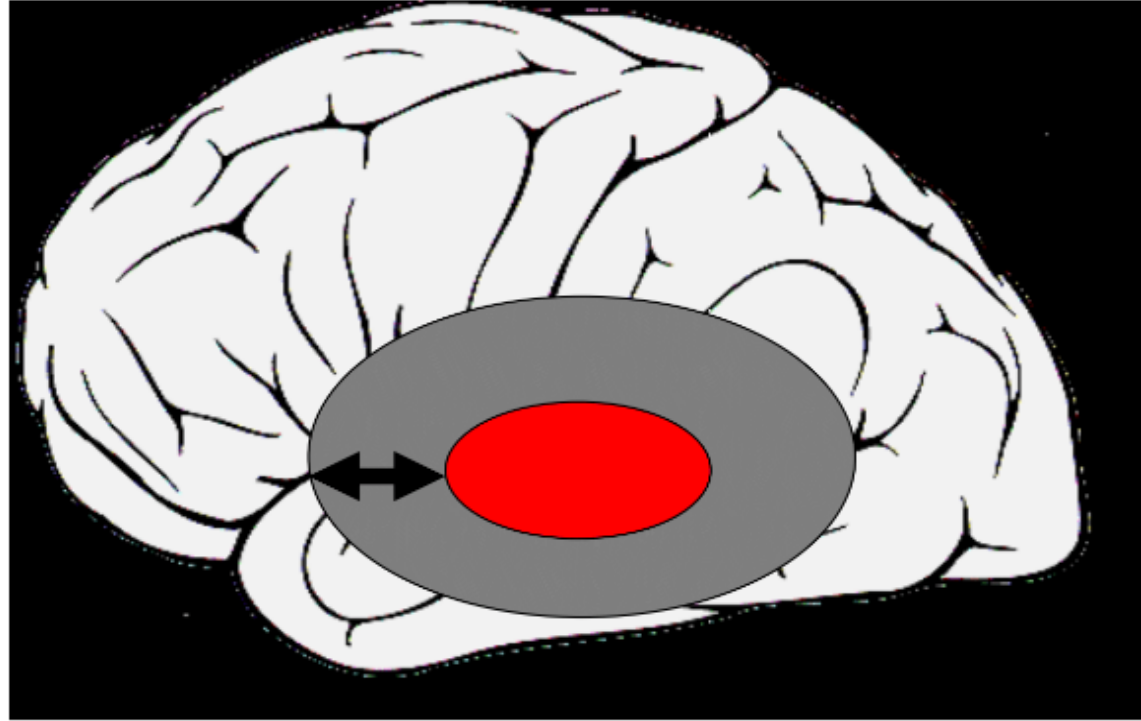
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Basic Premise Acute Stroke

Time=Brain

Penumbra

MRI/CT Abnormality: Bioenergetic Compromise = Core
Perfusion Abnormality: Hemodynamic Compromise = Ischemic

Diffusion/Perfusion Mismatch = Penumbra

Time=Brain: 1,900,000 neurons/minute

Time Is Brain—Quantified

Jeffrey L. Saver, MD

Background and Purpose—The phrase "time is brain" emphasizes that human nervous tissue is rapidly lost as stroke progresses and emergent evaluation and therapy are required. Recent advances in quantitative neurostereology and stroke neuroimaging permit calculation of just how much brain is lost per unit time in acute ischemic stroke.

Methods—Systematic literature-review identified consensus estimates of number of neurons, synapses, and myelinated fibers in the human forebrain; volume of large vessel, supratentorial ischemic stroke; and interval from onset to completion of large vessel, supratentorial ischemic stroke.

Results—The typical final volume of large vessel, supratentorial ischemic stroke is 54 mL (varied in sensitivity analysis from 19 to 100 mL). The average duration of nonlacunar stroke evolution is 10 hours (range 6 to 18 hours), and the average number of neurons in the human forebrain is 22 billion. In patients experiencing a typical large vessel acute ischemic stroke, 120 million neurons, 830 billion synapses, and 714 km (447 miles) of myelinated fibers are lost each hour. In each minute, 1.9 million neurons, 14 billion synapses, and 12 km (7.5 miles) of myelinated fibers are destroyed. Compared with the normal rate of neuron loss in brain aging, the ischemic brain ages 3.6 years each hour without treatment. Altering single input variables in sensitivity analyses modestly affected the estimated point values but not order of magnitude.

Conclusions—Quantitative estimates of the pace of neural circuitry loss in human ischemic stroke emphasize the time urgency of stroke care. The typical patient loses 1.9 million neurons each minute in which stroke is untreated. (*Stroke*. 2006;37:263-266.)

Basic Premise Acute Stroke

- Time = Brain
- **Faster delivery** of critical therapies to patients with stroke will result in
  - Better functional outcomes
  - Lower rates of disability and death

# HOW DOES THE MOBILE STROKE UNIT FIT INTO ALL OF THIS??

Mobile Stroke Unit (MSU)

- An ambulance equipped with:
  - Tele-neurology
  - Tele-radiology
  - CT Scanner with Contrast Injector (CT/CTA)
  - Key Medications: IV tPA; K-Centra
  - Staff
    - Critical Care Nurse, Paramedic, EMT, CT tech

MSU = Mobile Stroke Emergency Room

- Diagnose and initiate stroke treatment AT THE PATIENT'S DOOR (not ours)

- Identify patients for thrombectomy in the field and PREPARE EVERYTHING NECESSARY for intervention while the patient is in transit
  - Especially important after hours and weekends
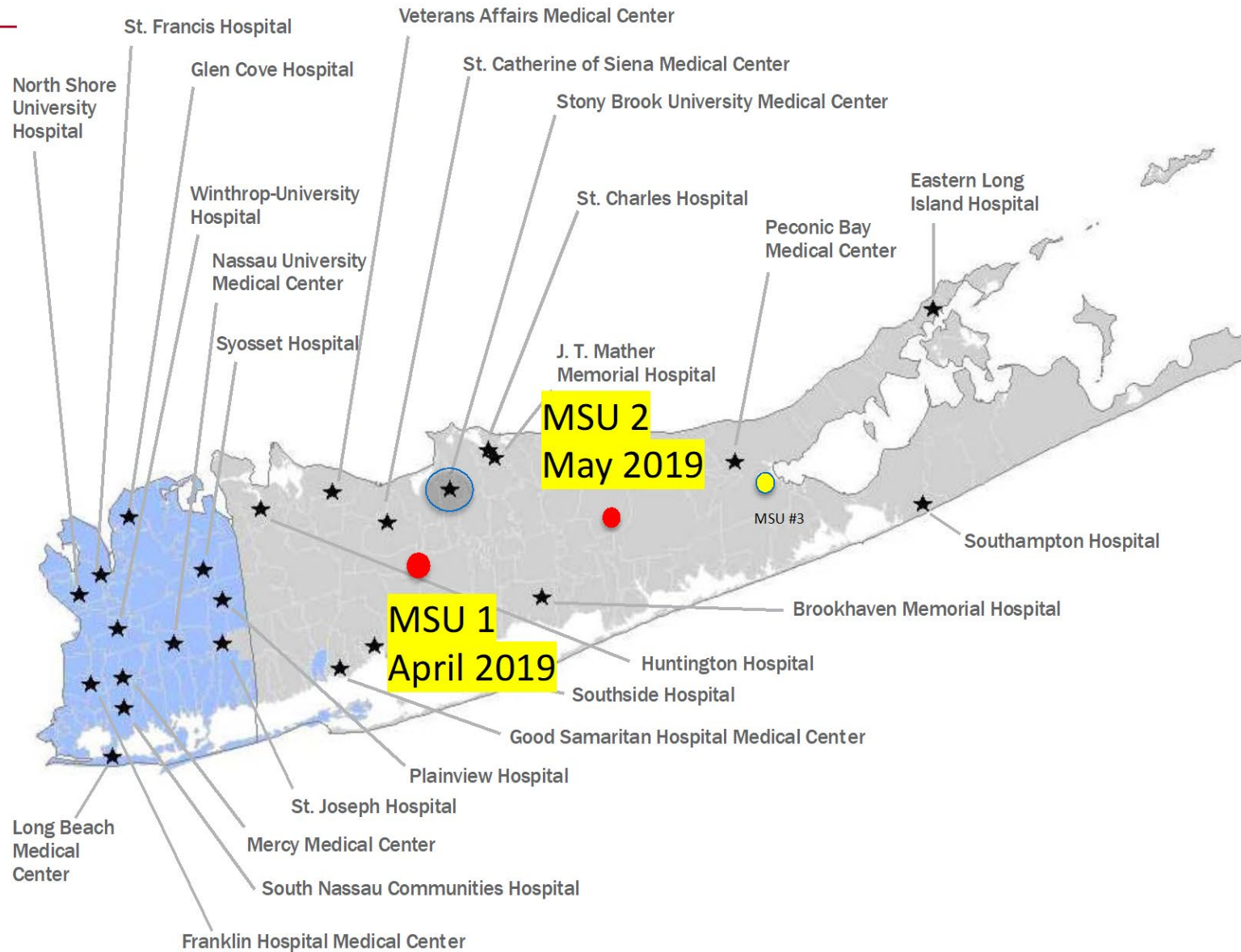
What Did We Want to Accomplish?

- Make a fast and accurate diagnosis of "stroke" vs. "no stroke" ON SITE

- Make a fast and accurate diagnosis of hemorrhagic vs. ischemic stroke

- Give eligible patients IV t-PA immediately
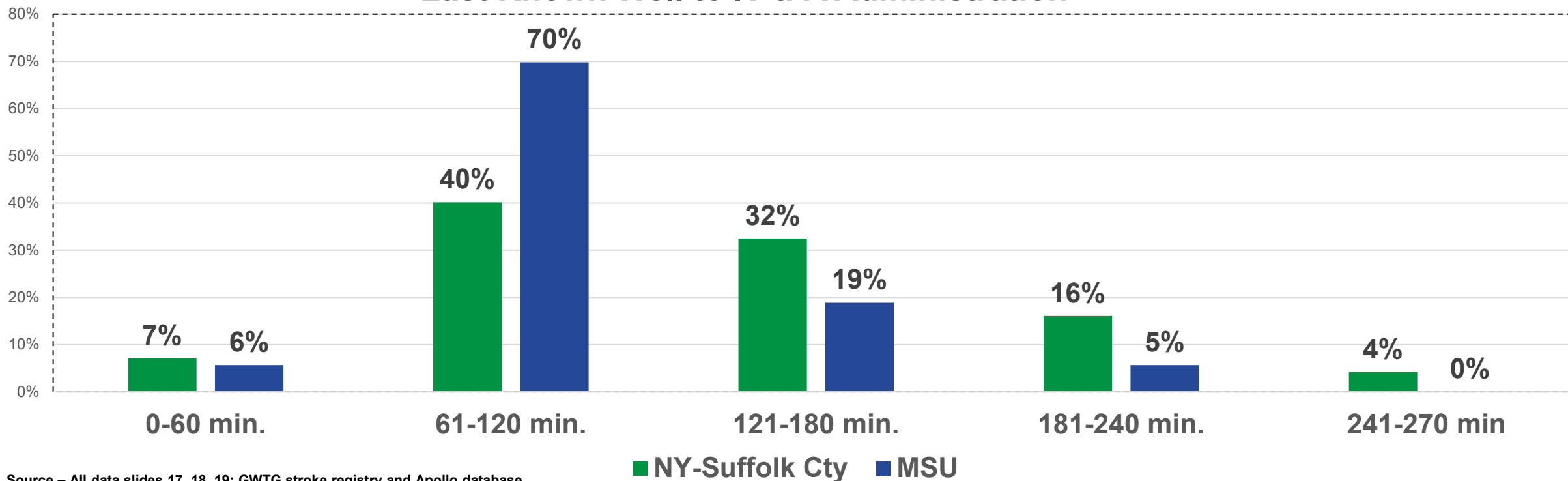
Mobile Stroke Unit Program Volume

- **Calls April 8, 2019 - December 31 2020: 2272 calls**
- ✓Transported Calls to Hospitals: 750 calls (33%)
- ✓Transport
  - ✓To SB: 533 (71%)
  - ✓To outside hospital: 217 calls (29%)
- ✓Age Range: 21-101, mean 72
- ✓Gender: 47% male; 53% female
- ✓ IV tPA administered = 53 calls
  - ✓ IV tPA administered 43 to SB; 10 to outside hospital
- ✓85 Thrombectomy/thrombolysis cases to SB; 3 to outside hospital
- ✓730 Feedback loop documents sent to 45 EMS agencies

76% MSU patients received IV tPA within 2 hours LKW **VS 47% Non-MSU patients**
95% MSU patients received IV tPA within 3 hours LKW **VS 79% Non-MSU patients**

Suffolk County Mean Last Known Well to IV tPA administered=**136 min**
MSU Mean Last Known Well to IV tPA administered= **104 min 32 min earlier!!**

## Last Known Well to IV tPA Administration

	0-60 min.	61-120 min.	121-180 min.	181-240 min.	241-270 min
NY-Suffolk Cty	7%	40%	32%	16%	4%
MSU	6%	70%	19%	5%	0%

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✓ MSU door to IV tPA mean 42 minutes

✓ ED Door to IV tPA in Suffolk County mean 46 minutes

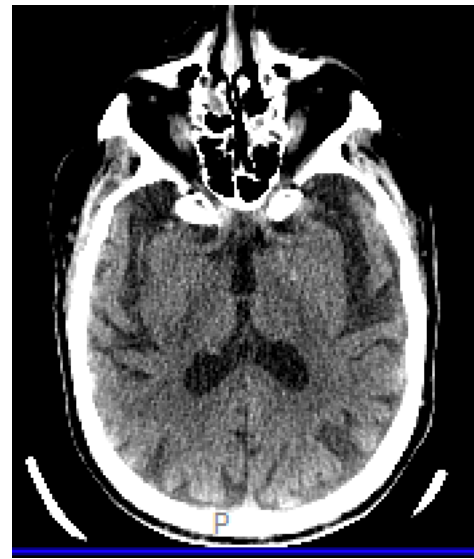✓ MSU door to IV tPA in 50 min=83% Non-MSU door to IV tPA in 50 min=68%

Door to IV tPA

Q2 2019- Q4 2020
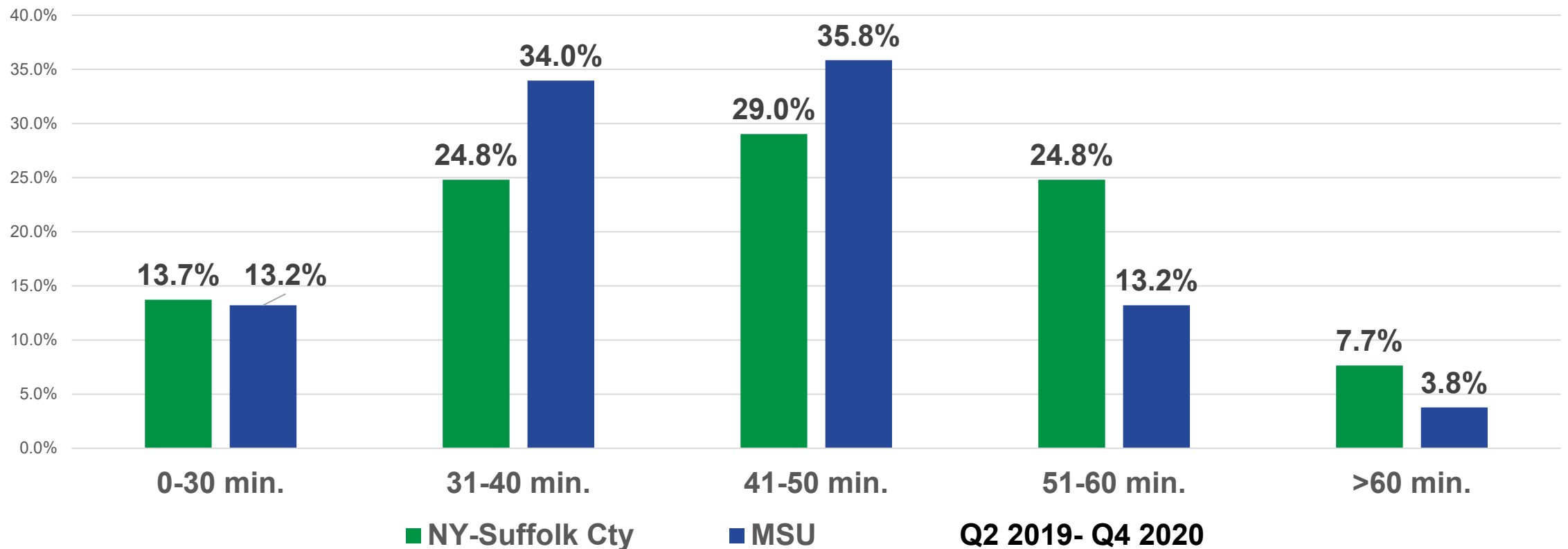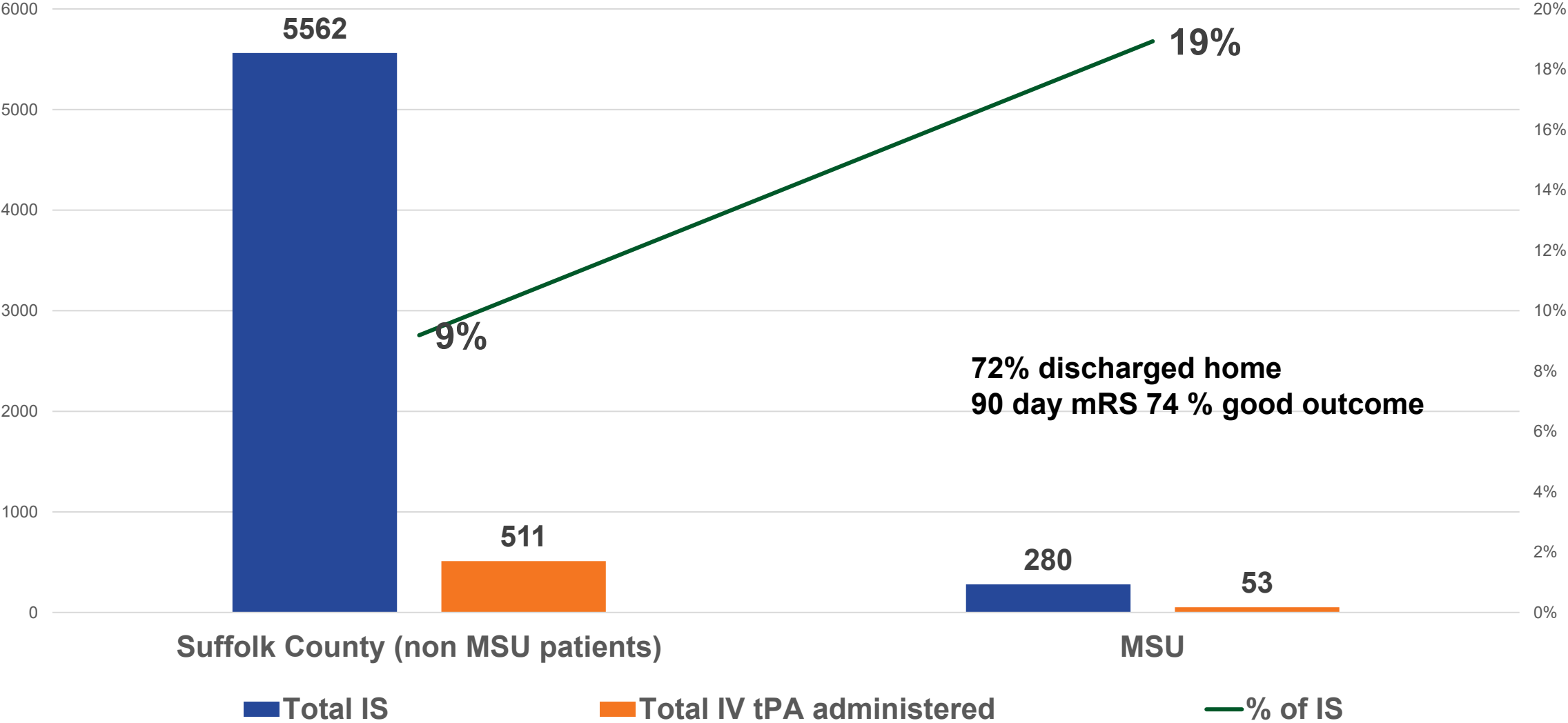
Patient Story

- Mr. MG 90 YOM
  - 1800: Acute onset of aphasia while talking on phone
  - 1833: MSU at patient
    - Exam done
    - Scans completed and interpreted
    - IV t-PA Started

  - OUTCOME: Discharged to home at Neurological Baseline
    - mRS = 0 at 90 Days

What Did We Want to Accomplish?

- Identify emergent large vessel occlusion quickly

- Get patients to the right hospital the first time

- Get eligible patients ON THE TABLE for thrombectomy quickly

- Get the VESSEL OPEN as quickly as possible

MSU patients Treated   VS   Non MSU patients Treated
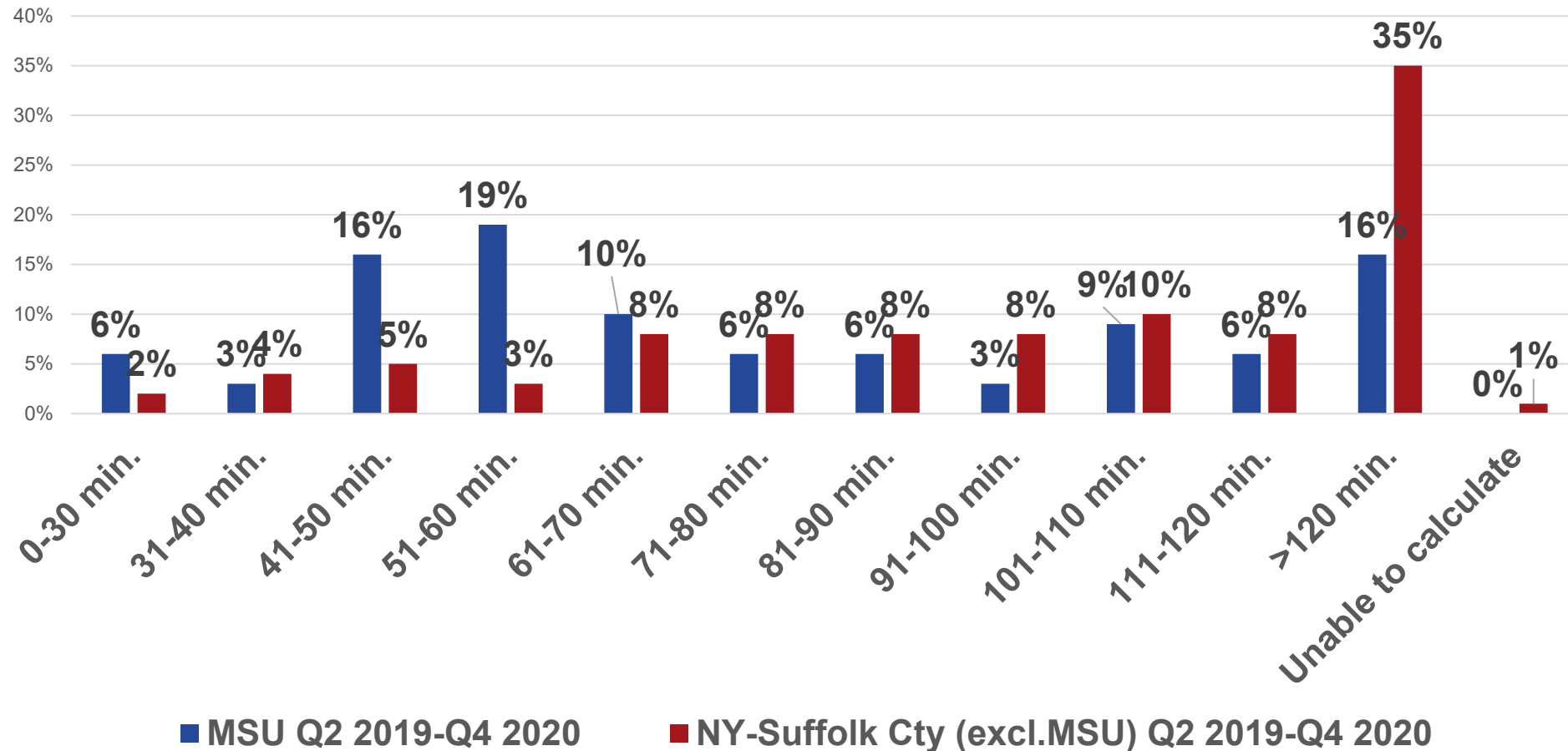**44%** within **60** minutes   **14%** within **60** minutes
66% within **90** minutes   **38%** within **90** minutes
84% within **120** minutes   **62%** within **120** minutes

Door to Recanalization/Reperfusion (DTRp) Times

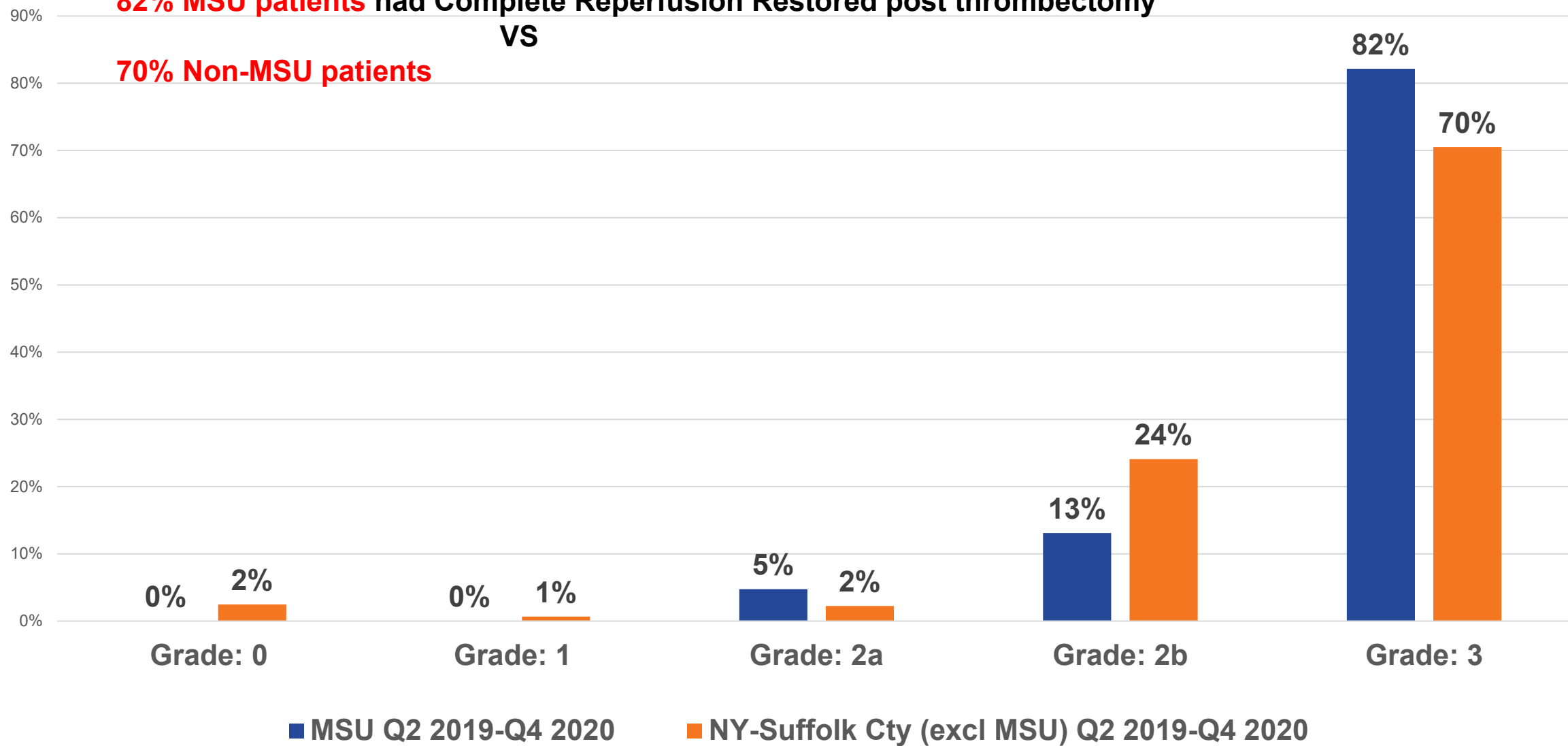Legend: ■ MSU Q2 2019-Q4 2020   ■ NY-Suffolk Cty (excl.MSU) Q2 2019-Q4 2020

TICI Score Post Treatment Reperfusion Grade

82% MSU patients had Complete Reperfusion Restored post thrombectomy
VS
70% Non-MSU patients

	Grade: 0	Grade: 1	Grade: 2a	Grade: 2b	Grade: 3
MSU Q2 2019-Q4 2020	0%	0%	5%	13%	82%
NY-Suffolk Cty (excl MSU) Q2 2019-Q4 2020	2%	1%	2%	24%	70%

■ MSU Q2 2019-Q4 2020   ■ NY-Suffolk Cty (excl MSU) Q2 2019-Q4 2020

Patient Story

- Ms. CR 68 YOF
  - Wake Up Stroke-Left Hemiplegia
  - 0915: Call received
  - 0929: MSU at patient
    - Exam done
    - Scans completed and interpreted= Right MCA Occlusion
  - 1013: arrival to ED
  - 1015: to Angio Suite
  - OUTCOME: Discharged to home at Neurological Baseline
    - mRS = 0 at 90 Days

In CVC Suite 1015
First Pass 1032
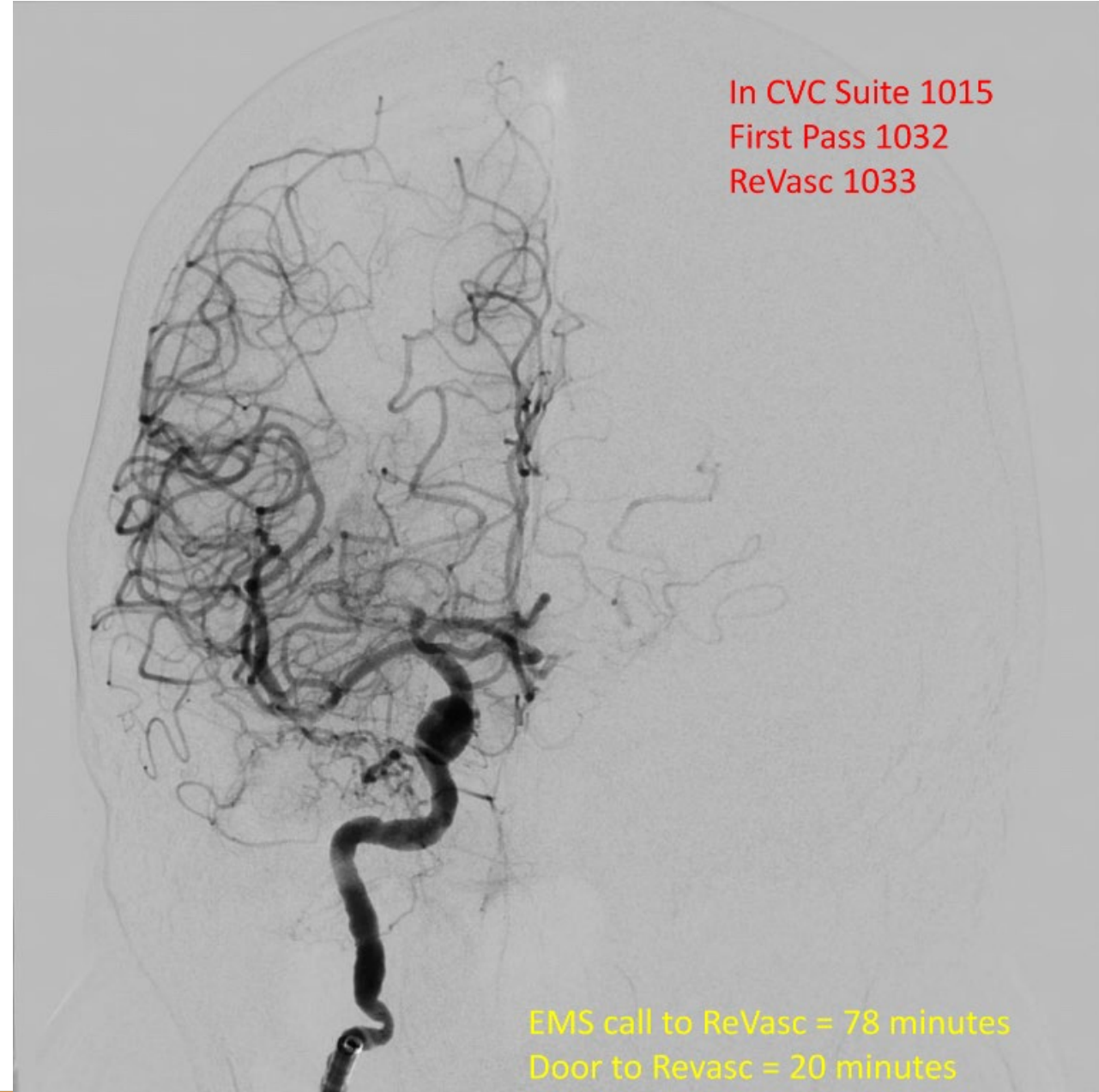
In CVC Suite 1015
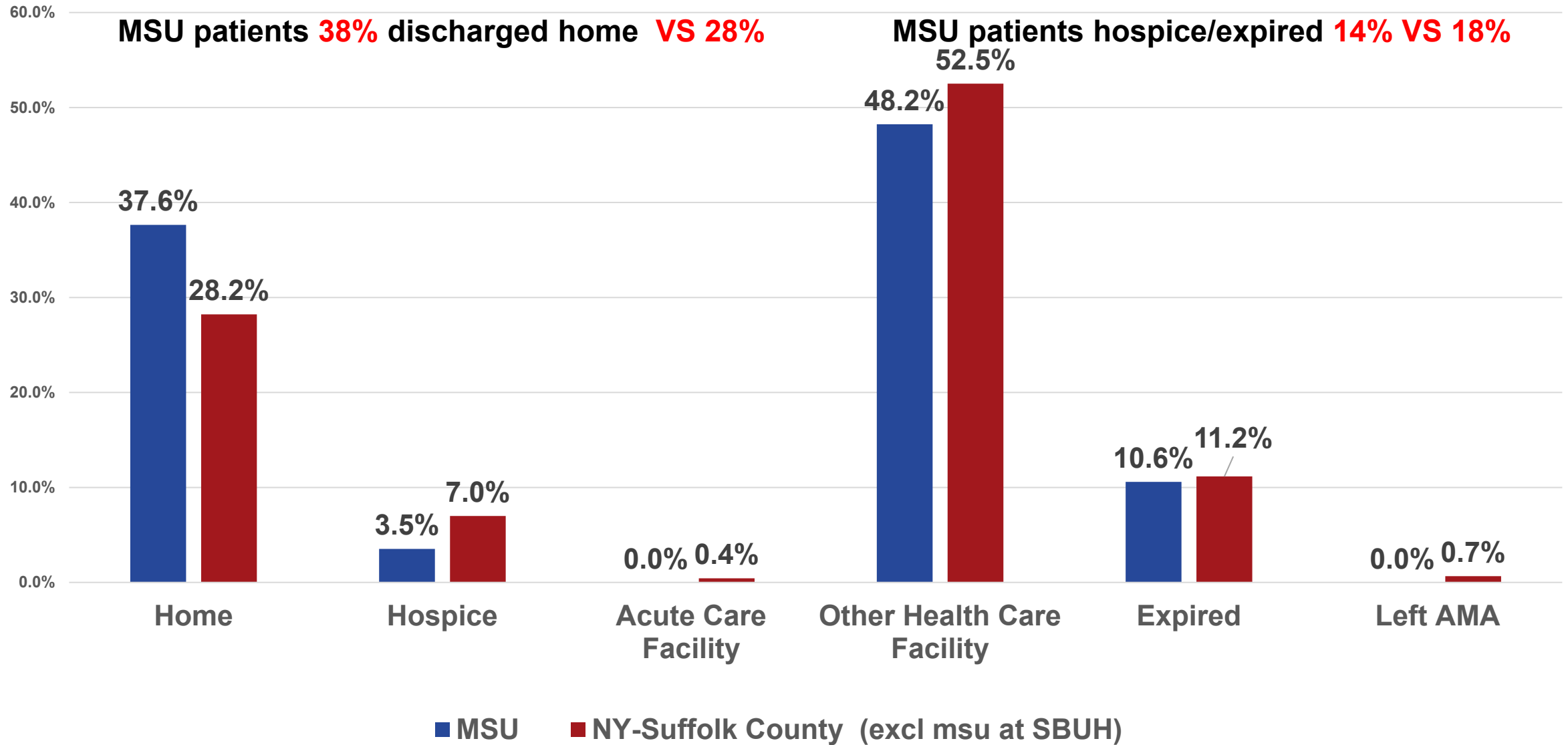First Pass 1032
ReVasc 1033

EMS call to ReVasc = 78 minutes
Door to Revasc = 20 minutes

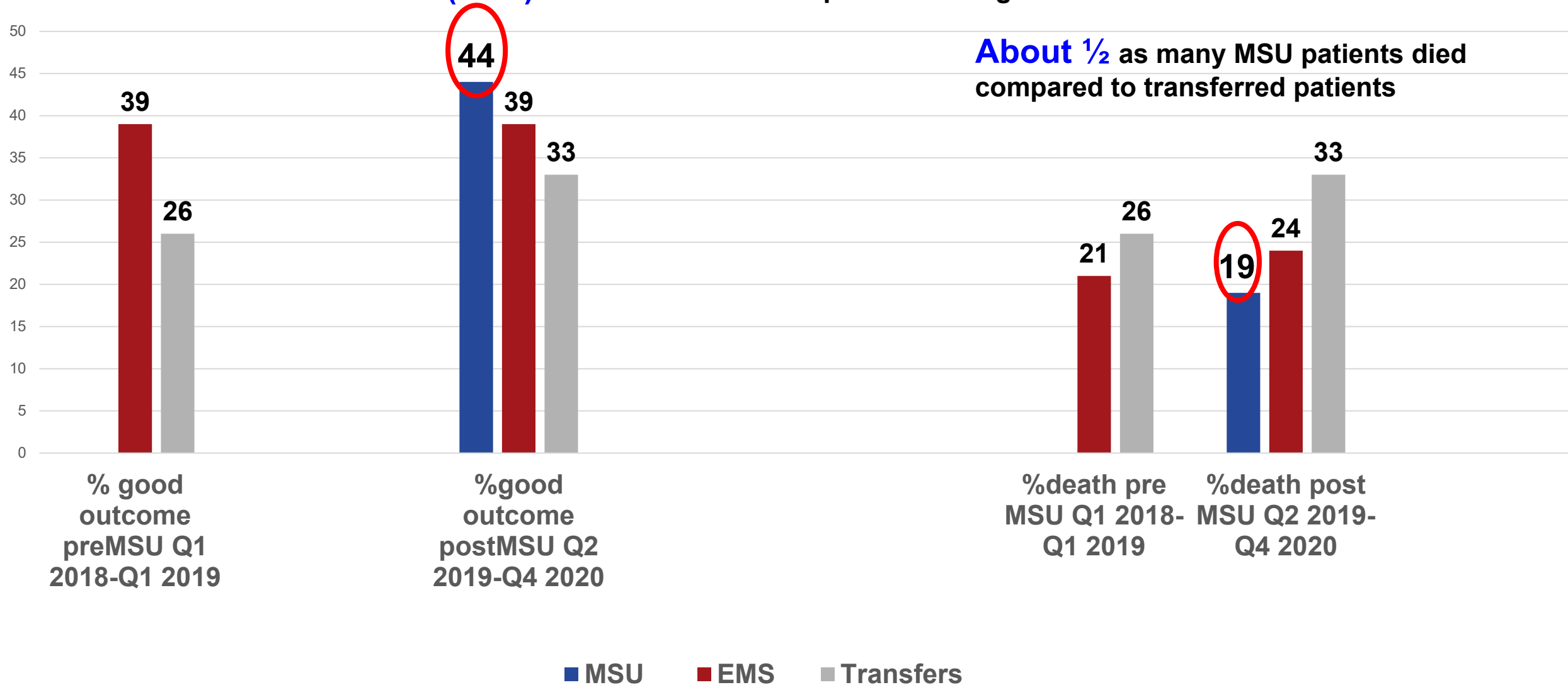# What Did We Want to Accomplish?

• Improve patient outcomes

# 90 Days mRS following Endovascular Reperfusion Therapy

Almost ½ (44%) of MSU endovascular patients with good outcome.

About ½ as many MSU patients died compared to transferred patients

Legend: ■ MSU ■ EMS ■ Transfers
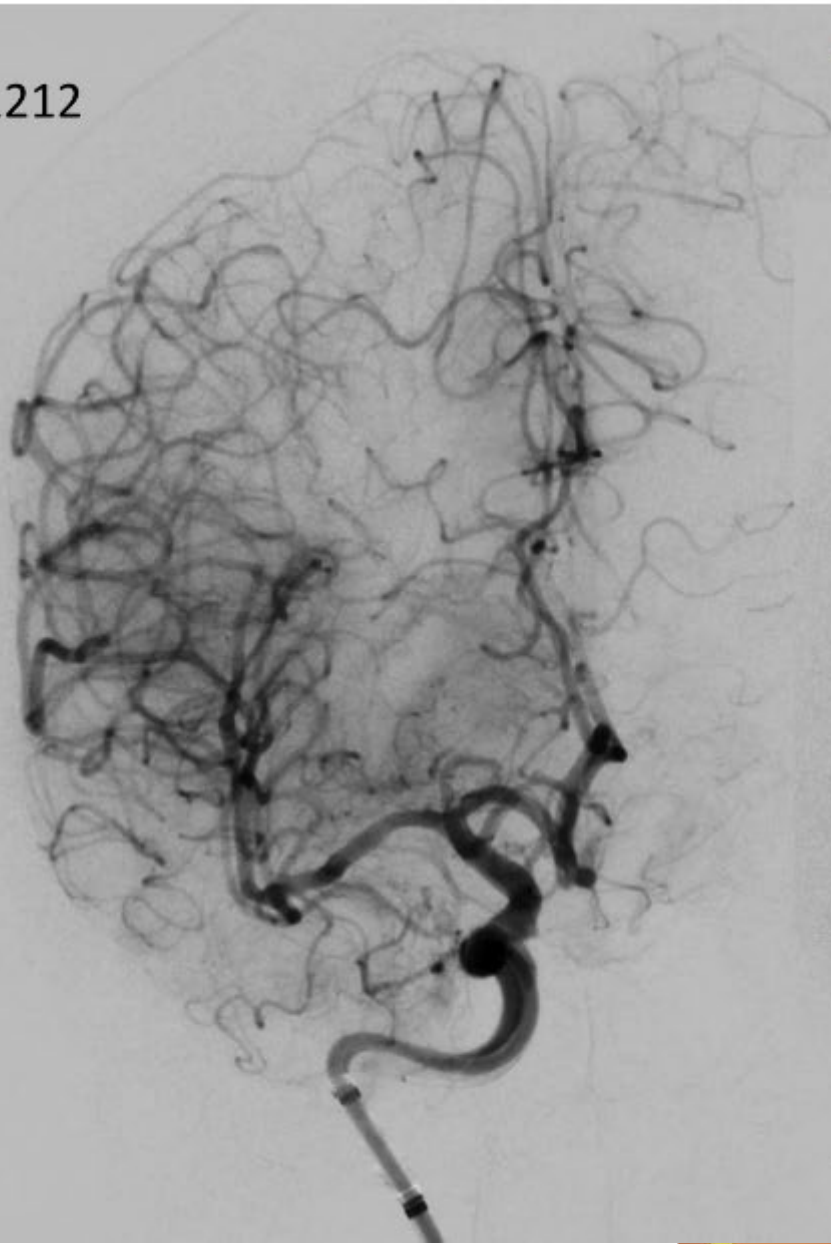
Patient Story

- Ms. VS 83 YOF
    - Wake Up Stroke-Left Hemiplegia, neglect, left gaze
    - 1037: MSU at patient
        - Exam done
        - Scans completed and interpreted= Right MCA Occlusion
    - 1144: arrival to ED
    - 1156: in Angio Suite
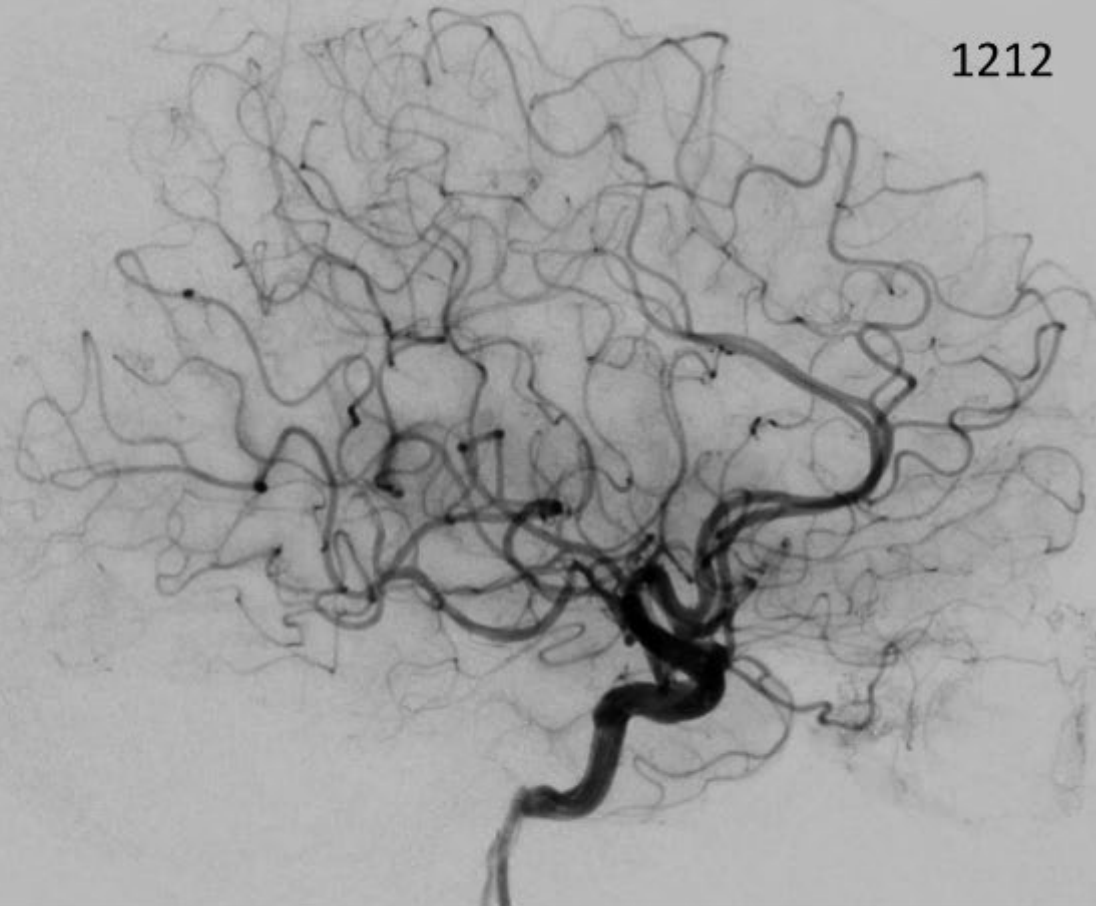   - OUTCOME: Discharged to home with mRS = 2
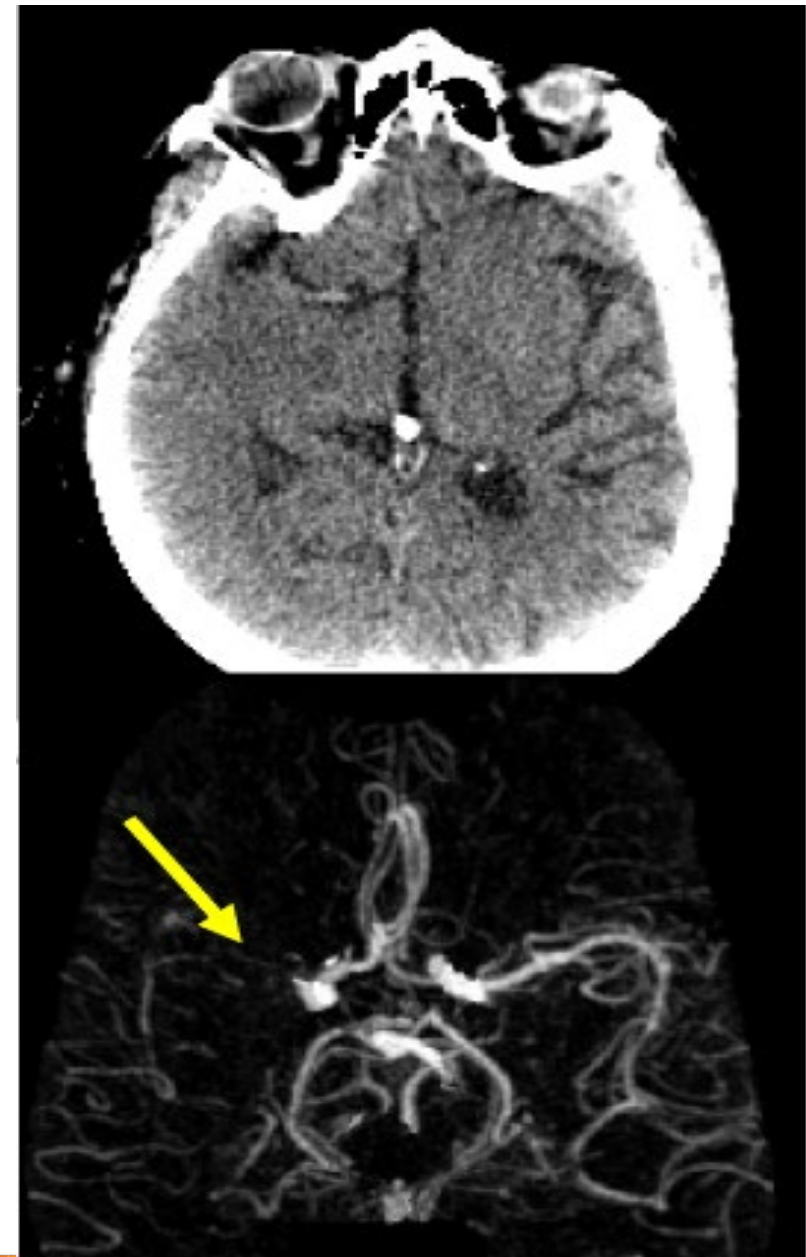
1212

1212

Lessons Learned

- Continuous stroke education of our Local EMS partners improves
  Stroke recognition
  - Appropriate use of the MSU's
  - Partnership for better patient outcomes

- Maximization of the Mobile Stroke Units is
  8am-8pm, 7 days a week, 365 days a year

- Improving communication between the MSU crew and in hospital personnel reduces door to revascularization times

Key Takeaways

Mobile Stroke Unit Program results in

Shorter Time to IV tPA

Shorter Time to Thrombectomy

Better Functional Outcomes

Reduced Death

Questions?

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