# North Dakota 2021 Stroke & Cardiac Conference

**December 8, 2021 - Stroke Focus**
**December 9, 2021 - Cardiac Focus**

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**Plenary Presentation**
**8:00 AM-2:15 PM**

**Simulation Sessions**
**2:15 PM-3:15 PM**

**Conference Website**

American Heart Association.

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# Acute Coronary Syndrome Care:

## Speedy STEMI Research

## &

## Quick Case Study

**2021 North Dakota Stroke & Cardiac Conference**
**December 9th, 2021**
**10:30 am – 11:30 am**

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STEMI Program Manager – Essentia Health, Duluth, MN

Essentia Health

American Heart Association
Learn and Live

# Richard Mullvain Disclosures: None

- **No disclosures or relevant financial conflicts of interest to report**
- **I am the STEMI Program Manager for Essentia Health**
  - St. Mary's Medical Center in Duluth, MN

# Learning Objectives:

Review and apply new understanding to the evolution of STEMI Protocols and Programs in the Midwest

Learn about regional heart attack research, and apply new understanding to your practice and care of potential heart attack patients

Examine a STEMI case study, and consider process and practice improvements to help better care for STEMI patients

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Audience Polling Question

# What does STEMI stand for?

A. Single T-wave Elevated Myocardium Infarct
B. ST-Segment Elevation Myocardial Infarction
C. Sustained Timing Evolving Myocardium infarct
D. Spaced Timing Exit Mode Internal

*Subliminal Hint…*

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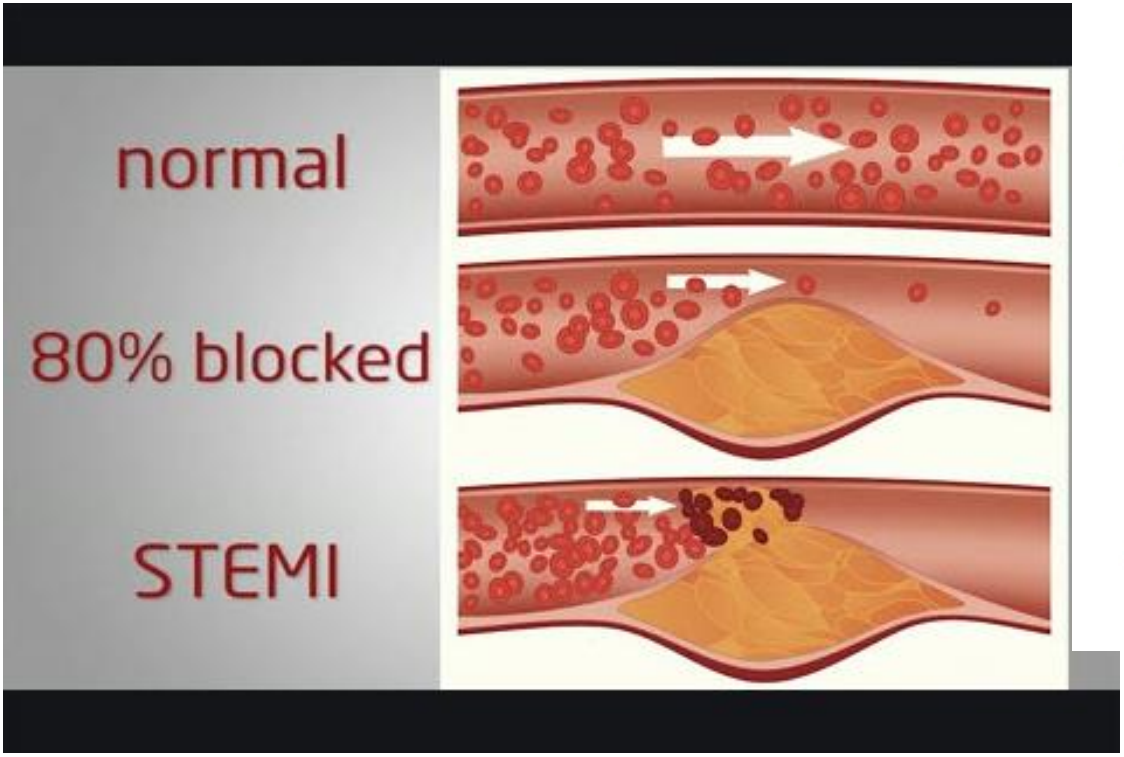
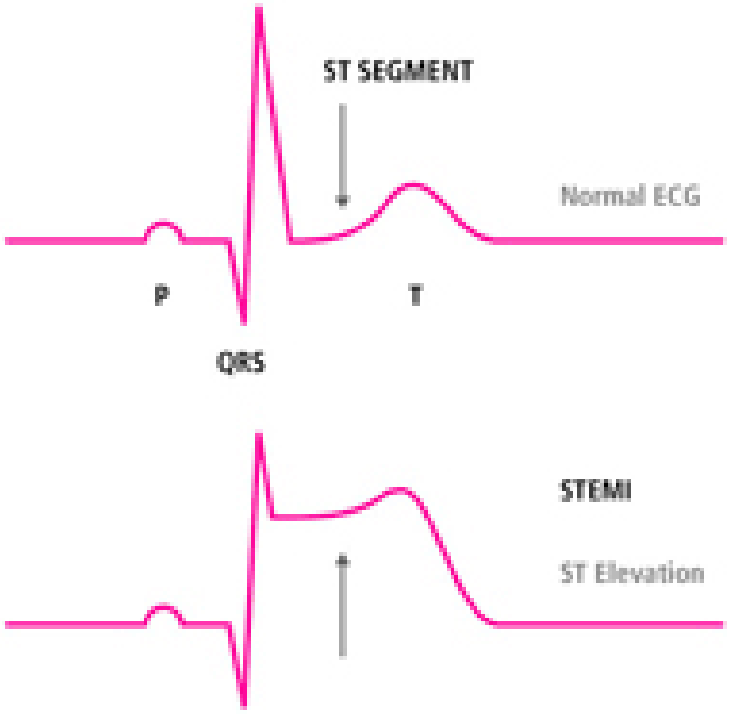
# ST-Segment Elevation Myocardial Infarction

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# STEMI

## ST segment Elevation Myocardial Infarction
## Definition / Diagnosis…

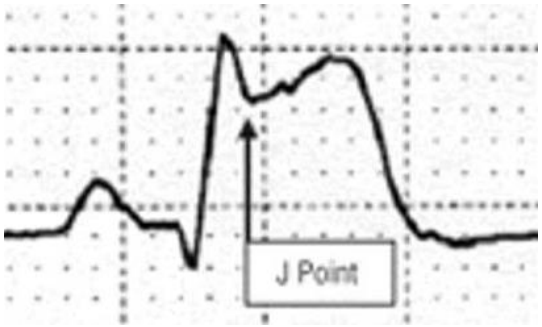
ST elevation at the J point in at least 2 contiguous leads (*of a 12-Lead ECG*)

For V2-V3:

≥ 2 mm in men

≥ 1.5 mm in women

And/or ≥ 1 mm in other contiguous chest leads, or the limb leads




Signs & symptoms of discomfort suspect for AMI (Acute Myocardial Infarction) or STEMI with a duration > 15 minutes, but < 12 hours

Although new, or presumably new, Left Bundle Branch Block (LBBB) at presentation occurs infrequently and may interfere with ST-elevation analysis

Care should be exercised in not considering this an AMI in isolation

If in doubt, immediate consultation with PCI receiving center is recommended

ECG demonstrates evidence of ST depression suspect of a Posterior MI

Consult with PCI receiving center

If initial ECG is not diagnostic but suspicion is high for STEMI

Obtain serial 12-Lead ECG's at 5-10 minute intervals

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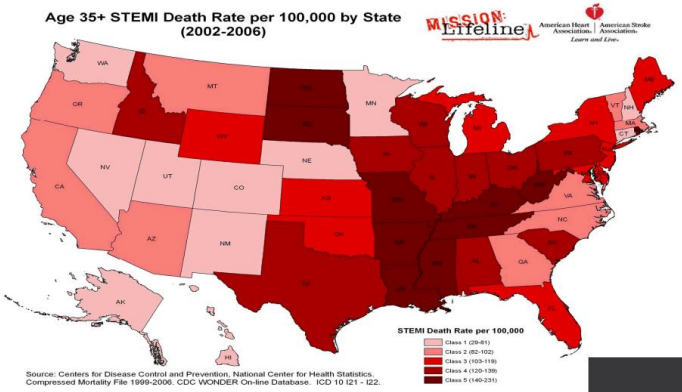
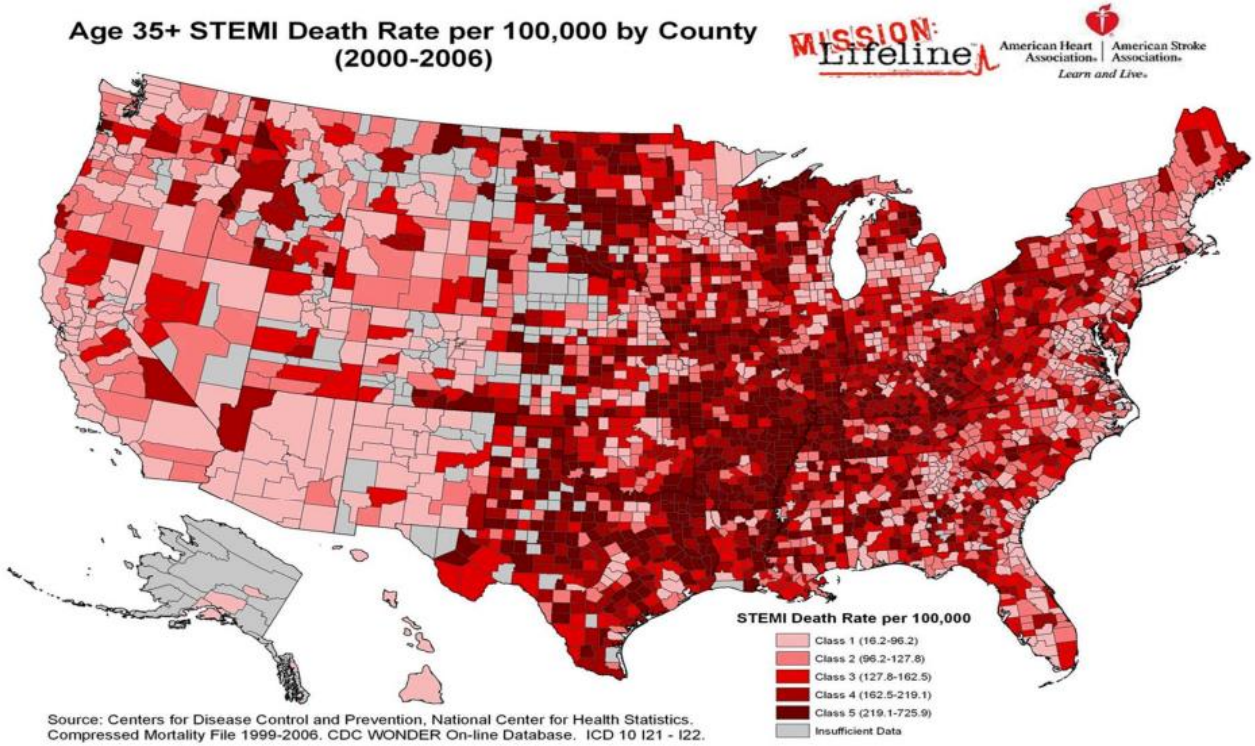
# MISSION: Lifeline™

## Improving the System of Care for STEMI Patients

http://www.americanheart.org/presenter.jhtml?identifier=3050213


Age 35+ STEMI Death Rate per 100,000 by State
(2002-2006)
STEMI Death Rate per 100,000
Class 1 (39-81)
Class 2 (82-102)
Class 3 (103-119)
Class 4 (120-139)
Class 5 (140-231)
Source: Centers for Disease Control and Prevention, National Center for Health Statistics.
Compressed Mortality File 1999-2006. CDC WONDER On-line Database. ICD 10 I21 - I22.


Age 35+ STEMI Death Rate per 100,000 by County
(2000-2006)
STEMI Death Rate per 100,000
Class 1 (16.2-96.2)
Class 2 (96.2-127.8)
Class 3 (127.8-162.5)
Class 4 (162.5-219.1)
Class 5 (219.1-725.9)
Insufficient Data
Source: Centers for Disease Control and Prevention, National Center for Health Statistics.
Compressed Mortality File 1999-2006. CDC WONDER On-line Database. ICD 10 I21 - I22.

## Launched in 2011, the North Dakota Mission: Lifeline project is an unprecedented collaborative effort that received funding from several key partners, including Helmsley, the State of North Dakota, and AHA

With nearly 740,000 residents spread over 69,000 square miles in 53 counties, North Dakota faces unique challenges to identify and transport heart attack patients to one of only six hospitals capable of performing PCI procedures. Mission: Lifeline sought to unify the state and establish standards of care to ensure that ***where*** a heart attack patient lives does not determine ***IF*** they survive

"Time is muscle," said Thomas Haldis, D.O., an interventional cardiologist with Sanford Health in Fargo and the current chair of the North Dakota Cardiac Taskforce. "The outcome of STEMI events depends greatly on the care patients receive and the timeframe in which they receive it."

"North Dakota has become a model system for rural states across the nation," said Jeffrey Sather, M.D., an emergency physician at Trinity Health in Minot and the former co-chair of the North Dakota Mission: Lifeline Task Force.
"…in a very short time North Dakota has gone from leading the country in heart attack death rates to leading the way in heart attack care."

https://helmsleytrust.org/north-dakota-exceeding-expectations-cardiac-care-44-million-grant/

# 2007-2010 Acute Myocardial Infarction (ICD10 I21 & I22)
# 35+ Age-Adjusted Mortality per 100,000
# STEMI Recieving Center Drive Time

American Heart Association.

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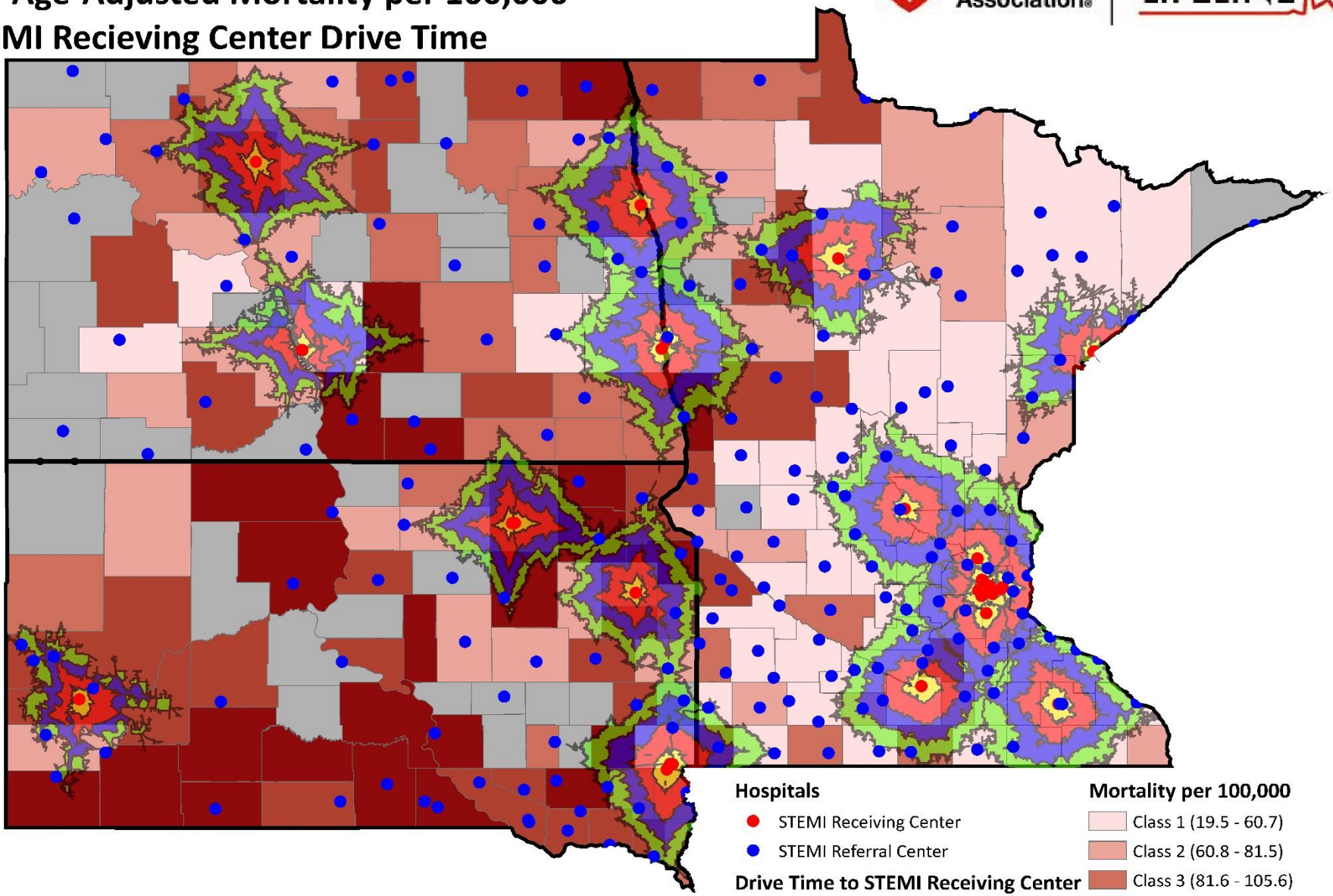


Source: CDC/NCHS Compressed Mortaltiy File 2007-2010.

N

0 25 50 100 150 200 Miles

Created: 4/1/14

NORTH DAKOTA DEPARTMENT of HEALTH

North Dakota Cardiac System of Care

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# ND STEMI
# Inter-Hospital Transfer Guideline
**(ST-Segment Elevation Myocardial Infarction)**

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**Altru Health System – Grand Forks**
**Phone: 701-780-5206 or 1-855-425-8781**
**Fax: 701-780-1097**

**CHI St. Alexius Health - Bismarck**
**Phone: 701-530-7699 or 1-877-735-7699**
**Fax: 701-530-7005**

**Essentia Health System - Fargo**
**Phone: 701-364-CALL (2255) or**
**844-865-CALL (2255)**
**Fax: 701-364-8405**

**Sanford Health System- Bismarck**
**Phone: 1-855-550-1225**
**Fax: 701-323-5751**

**Sanford Health System- Fargo**
**Phone: 701-234-6304 or 1-877-647-1225**
**Fax: 701-234-7203**

**Trinity Health System - Minot**
**Phone: 701-857-3000 or 1-800-223-1596**
**Fax: 701-857-3260**

***Ideal STEMI Treatment Goals:***

- **First Medical Contact-to-First ECG** time ≤10 minutes unless pre-hospital ECG obtained
- All eligible patients receiving any **Reperfusion** (PCI or fibrinolysis) therapy
- Fibrinolytic–eligible patients with **Door-to-Needle** time ≤ 30 minutes
- Reperfusion – eligible patients transferred to a PCI receiving center with referring center **Door in- Door out** time *(Length of Stay)* ≤ 45 minutes
- Referring Center ED **Door-to-PCI device time** ≤ 100 minutes *(includes transport time)*
- All STEMI patients without a contraindication receiving **aspirin** before ED discharge

***Patients with a contraindication to transfer or PCI:***

- Aspirin within 24 hours of hospital arrival, and aspirin at discharge
- Beta blocker at discharge
- LDL >100 who receive statins or lipid lowering drugs
- STEMI patients with left ventricular systolic dysfunction on ACEI/ARB at discharge
- STEMI patients whom smoke receive smoking cessation counseling at discharge

**Upon Transfer Fax the following documents to the accepting facility:** 12 L ECG, ED Record, Lab Results, Current Medication Record, ND STEMI documentation

# ND STEMI Guideline
# (ST-Segment Elevation Myocardial Infarction)

Updated 07/2016

North Dakota Cardiac System of Care | American Heart Association. life is why | MISSION: LIFELINE

## Diagnostic Criteria for STEMI

- ST elevation at the J point in at least 2 contiguous leads of ≥2 mm (0.2 mV) in men or ≥1.5 mm (0.15 mV) in women in leads V2–V3 and/or of ≥ 1 mm (0.1mV) in other contiguous chest leads or the limb leads.
- New or presumably new LBBB at presentation occurs infrequently, may interfere with ST-elevation analysis, and should not be considered diagnostic of acute myocardial infarction (MI) in isolation. If doubt persists, immediate referral for invasive angiography may be necessary. Consult with Cardiology.
- ECG demonstrates evidence of ST depression suspect of a Posterior MI consult with PCI receiving center
- If initial ECG is not diagnostic but suspicion is high for STEMI obtain serial ECG at 5-10 minute intervals

**ACTIVATE EMS TRANSFER TEAM**

**ACTIVATE STEMI ALERT at Receiving PCI Hospital**

### STANDARD ORDERS & LABS

□ Apply Continuous Cardiac Monitor

□ Insert (2) peripheral IV large bore Saline lock

□ CK, CK-MB □ Glucose

□ (Standard) Panel □ Magnesium

□ CBC □ Troponin

□ INR □ aPTT

*Do not delay transfer awaiting results

**CONSIDER:**
Estimated transfer time in minutes to PCI facility take into account arrival to your facility time:
Air: _____ and/or Ground: _____

**ASSESS**: Symptom Onset Date: _____ Time: _____
Code Status □ Full Code □ DNR
*If DNR Status consult receiving facility MD prior to initiation of transfer*

**REVIEW**: Thrombolytic Contraindications Page 2

### OPTIONAL MEDICATION

☐ **Nitroglycerin IV** or 0.4 mg SL
Evaluate if Erectile Dysfunction or Pulmonary hypertension medications taken in the past 24 hours including: Sildenafil (Viagra, Revatio), Vardenafil (Levitra, Staxyn), or Avanafil (Stendra), Tadalafil (Cialis, Adcirca). Hold nitrates for 48 hours following the last dose

☐ **Analgesia as needed**

☐ **Ondansetron** (Zofran) 4 mg oral or IV

☐ **Metoprolol** ☐ 25 mg oral
*CONTRAINDICATION FOR METOPROLOL*
*Do not give if any of the following: Signs of heart failure or shock, heart rate less than 60 or more than110, systolic blood pressure less than 100, second or third degree heart block, severe asthma or reactive airway disease*

## Choose One Reperfusion Pathway

### Time of First Medical Contact to PCI arrival Expected to be LESS THAN < 100 minutes

**PRIMARY PCI**
**Direct to CATH LAB for Emergent PCI**

□ **Aspirin** 324 mg chewed

□ **Ticagrelor (Brilinta) 180 mg PO *preferred*** **OR**

□ **Clopidogrel (Plavix) 600 mg PO**
**do not give both Plavix & Brilinta*

□ **Heparin IV Bolus** (60 Units/kg, max 4,000 Units)

□ **Transport** patient directly to Cath Lab for PCI (Percutaneous Coronary Intervention)
*Goal Arrival to Departure < 30 minutes unless awaiting air transport*

□ **Oxygen as needed** to keep SpO2 90-94%

**Do not give Thrombolytics **TNKase, rPA, or TPA***

### Time of First Medical Contact to PCI arrival anticipated to be GREATER THAN > 100 min

**THROMBOLYTIC Therapy**

□ **Aspirin** 324 mg chewed

□ **Tenecteplase IV (TNKase)** per attached protocol
*Facility Arrival to lytic administration goal LESS THAN < 30 minutes*

□ **Plavix 300 mg** PO
**If patient > 75 yrs. consult with cardiologist and consider reducing dosage to 75 mg PO*

□ **Heparin IV Bolus** (60 Units/kg, max 4,000 Units)

□ **Heparin IV Drip** (12 Units/kg/hr, max 1,000 Units/hr)

□ **Transport** patient urgently directly to PCI capable hospital
Goal Arrival to Departure < 45 minutes unless awaiting air transport

□ **Oxygen as needed** to keep SpO2 90%-94%

# ND STEMI Guideline
## (ST-Segment Elevation Myocardial Infarction)
Updated 07/2016

North Dakota Cardiac System of Care | American Heart Association. life is why | MISSION: LIFELINE

**Tenecteplase (TNKase) Dosing**

| Patient weight (kg) | TNK (mg) | TNK (mL) |
|---|---|---|
| Less than 60 kg | 30 mg | 6 mL |
| 60 or more but less than 70 | 35 mg | 7 mL |
| 70 or more but less than 80 | 40 mg | 8 mL |
| 80 or more but less than 90 | 45 mg | 9 mL |
| 90 or more kg | 50 mg | 10 mL |

☐ Call Report when patient leaves your hospital and confirm update departure time and ETA

☐ Fax All paperwork to Receiving Hospital (ECG, Labs, Orders, Physician Order, Notes, Medication administration record)

☐ Emergency Contact Name:

_____

Phone: _____

Disposition:

_____

**ABSOLUTE CONTRAINDICATIONS FOR FIBRINOLYSIS (TNK) IN STEMI**

1. Any prior intracranial hemorrhage
2. Known structural cerebral vascular lesion (e.g., arteriovenous malformation)
3. Known malignant intracranial neoplasm (primary or metastatic)
4. Ischemic stroke within 3 months except acute ischemic stroke within 3 hours
5. Suspected aortic dissection
6. Active bleeding or bleeding diathesis (excluding menses)
7. Significant closed-head or facial trauma within 3 months
8. Chest Pain/Symptom Onset > 12 hours

**RELATIVE CONTRAINDICATIONS FOR FIBRINOLYSIS: (TNK) IN STEMI**

1. History of chronic, severe, poorly controlled hypertension
2. Severe uncontrolled hypertension on presentation (SBP more than 180 or DBP more than 90 mmHg)
3. History of prior ischemic stroke more than 3 months, dementia, or known intracranial pathology not covered in contraindications
4. Traumatic or prolonged CPR (over 10 minutes)
5. Major surgery (within last 3 weeks)
6. Recent internal bleeding (within last 2-4 weeks)
7. Noncompressible vascular punctures
8. Streptokinase/anistreplase: prior exposure (more than 5 days ago) or prior allergic reaction to these agents
9. Pregnancy
10. Active peptic ulcer
11. Current use of anticoagulants: the higher the INR ___
12. Symptom Onset > 6 hrs. Prior to presentation consult Cardiology

**Data Elements Collected and Reported in the ND State STEMI Registry**

1. Date: _____ Time: _____ Initial Symptom Onset Time
2. Date: _____ Time: _____ If Ambulance or Air Pre-Hospital EMS First Medical Contact Time
3. Date: _____ Time: _____ If Ambulance or Air, EMS Dispatch
4. Date: _____ Time: _____ If Ambulance or Air, EMS Leaving Scene
   a. If Ambulance or Air, EMS Agency Name: _____ Agency Number _____ Run Number _____
5. Date: _____ Time: _____ Pre-Hospital STEMI ECG
6. Date: _____ Time: _____ Referring Hospital Arrival
7. Date: _____ Time: _____ Referring Hospital 1st STEMI ECG
8. Date: _____ Time: _____ EMS Transfer Initiated
9. If Ambulance or Air, EMS Agency Name: _____ Agency Number _____ Run Number_____
10. Date: _____ Time: _____ PCI Center Transfer Initiated
11. Date: _____ Time: _____ Referring Hospital Departure

**Contact Information**

**Transferring Facility Name:** _____ **Transferring Physician Name:** _____

**Receiving Facility Physician Name:** _____ **Primary RN Name:** _____

**Transferring Facility Contact Information for STEMI Feedback: Name:** _____

**Phone:** _____ **Email:** _____

**EMS Agency:** _____ **Contact Name:** _____

**Phone:** _____ **Email:** _____

# ND STEMI (ST-Segment Elevation Myocardial Infarction) Guideline

| Tenecteplase (TNKase) Dosing | | |
|---|---|---|
| Patient weight (kg) | TNK (mg) | TNK (mL) |
| Less than 60 kg | 30 mg | 6 mL |
| 60 or more but less than 70 | 35 mg | 7 mL |
| 70 or more but less than 80 | 40 mg | 8 mL |
| 80 or more but less than 90 | 45 mg | 9 mL |
| 90 or more kg | 50 mg | 10 mL |

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8. Streptokinase/anistreplase: prior exposure (more than 5 days ago) or prior allergic reaction to these agents
9. Pregnancy
10. Active peptic ulcer
11. Current use of anticoagulants: the higher the INR ____
12. Symptom Onset > 6 hrs. prior to presentation consult Cardiology

Weight: lb. kg | Height: in. | Age: yrs

| Medication | Dose | Time Start | Time Stop | RN (Initials) |
|---|---|---|---|---|
| Aspirin (81 mg chew x 4) | 324 mg | | | |
| Ticegrelor *(Brilinta) Oral (PPCI therapy arm only) * Do not give Brilinta and Plavix together | 180 mg | | | |
| Clopidogrel (Plavix) Oral PPCI therapy dose | 600 mg | | | |
| Clopidogrel (Plavix) Oral Lytic therapy dose | 300 mg | | | |
| Heparin IV Bolus PCI Dose 60 U/kg, max 4000 Units Lytic Dose 60 U/kg, max 4000 Units | Units | | | |
| Heparin IV Infusion Lytic Dose 12 U/kg/hr max 1000 U/hr | Units/hr | | | |
| Tenecteplase (TNKase) IV * Do not give Ticegrelor with Lytic (TNK) | mg (= mL) | | | |
| Nitroglycerin Sublingual *Erectile Dysfunction Medication within past 24 hrs. □Yes □ No | 0.4mg<br>0.4mg<br>0.4mg | _____<br>_____<br>_____ | _____<br>_____<br>_____ | _____<br>_____<br>_____ |
| Nitroglycerin IV Infusion | mcg/min | | | |
| Morphine Sulfate IV | mg | | | |
| Ondansetron (Zofran) Oral | 4 mg | | | |
| Ondansetron (Zofran) IV | 4 mg | | | |
| Metoprolol 25 mg or 50 mg Oral | mg | | | |
| Eptifibatide (Integrilin) IV Bolus 180 mcg/kg (2 mg/mL vial) | mL | | | |
| Eptifibatide (Integrilin) IV Infusion 2 mcg/kg/min (0.75 mg/mL bottle) | mL/hr | | | |

Notes:_____

☐ _____ **Hospital**

☐ **Call:** _____-_____-_____

Request Activation of **STEMI** Protocol

☐ Call Report, when patient leaves your hospital and confirm update ETA

☐ **Fax** records to _____-_____-_____

☐ **Copy ECG, ED physician and Nurses documentation and send with patient – Do not delay transport**

☐ **Fax** All paperwork to referring Hospital (ECG, Labs, Orders, Physician Order, Notes, Medication administration record)

RN Name (Print):_____
RN Signature: _____
RN Initials: _____ Date: _____ Time:_____

**Allergies:**

_____
_____
_____

Emergency Contact Name: _____
Phone: _____-_____-_____

**Please Document Times:**

1. _____ Initial Chest Pain Onset Pain Scale 0-10 (10 being severe)
2. _____ Pre-Hospital ECG time (if available)
3. _____ Referring Hospital Arrival (Door – In)
4. _____ Referring Hospital 1st ECG Time _____ 2nd ECG Time
5. _____ Time Transport Activated
6. _____ STEMI Alert Activation (STEMI Receiving Hospital contacted)
7. _____ EMS Transport Arrival Time
8. _____ Referring Hospital Departure (Door-Out)

## NURSE DOCUMENTATION

Hospital: _____

City: _____

Revised 7-2016

Patient Name:

# North Dakota Mission: Lifeline EMS STEMI Transport Guideline

**Obtain 12 L ECG with Initial Vital Signs:** Goal: First Medical contact to ECG ≤ 10 min, Scene time: ≤ 15 minutes
**to provide early identification and pre-hospital arrival notification for suspected myocardial infarction or STEMI.*

- Chest pain, pressure, tightness or persistent discomfort above the waist age in pts. ≥ 35 yrs. of age
- "Heartburn" or epigastric pain
- Complaints of "heart racing" (HR >150 or irregular and >120) or "heart too slow" (HR < 50 and symptomatic)
- A syncopal episode, severe weakness, or unexplained fatigue
- New onset stroke symptoms (< 24 hours old)
- Difficulty breathing or shortness of breath (with no obvious non-cardiac cause)
- ROSC (return of spontaneous circulation) post cardiac arrest
- Recent Cocaine or Illicit drug use

**PH (Pre- Hospital) STEMI ALERT Activation Criteria:**
***Goal: Identify STEMI, Alert receiving facility- do not delay transport*

Activate STEMI Alert when any one of the criteria met & signs & symptoms suspect of (AMI) acute myocardial infarction including chest discomfort as described with a duration of >15 minutes <24 hours

- 12 L trained ALS EMS recognize ST segment elevation of ≥ 1 mm in 2 contiguous leads with
- Confirmed Interpretation of STEMI by a Practitioner (Physician, NP, PA) by transmission
- ECG Monitor interpretative statement reads: "Acute Myocardial Infarction" & signs & symptoms suspect of AMI including chest discomfort
  ***Reminder: For persistent symptoms obtain serial 12 L ECG's every 10 minutes during transport*

**Determine Transport Destination**

- **Transport time ≤ 75 minutes** and total time from first medical contact (EMS at patient's side) to PCI (Percutaneous Coronary Intervention) **FMC to PCI ≤ 120 minutes**. Notify medical control and consider transport directly to **PCI Capable Receiving Hospital for Primary PCI.**
- **Activate STEMI Alert**, transmit 12 L ECG as able, provide report to receiving hospital

- **Transport time ≥ 75 minutes** and estimated time from first medical contact (EMS at patient's side) **FMC to PCI ≥120 minutes**. Notify medical control and consider transport to the **closest appropriate non-PCI capable referring hospital** for possible fibrinolytic therapy and urgent transfer to a PCI Capable Receiving Facility for reperfusion.
- **Initiate fibrinolytic checklist** per protocol
- **Activate STEMI Alert**, transmit 12 L ECG as able, provide report to receiving hospital
- Consider Air Transport.

**Diversion Criteria:** If patient demonstrates Instability and/or has any one of the following Diversion Criteria requiring ED evaluation proceed to **closest appropriate hospital:**

- Possible need of head CT or neurological intervention / Confusion
- Emergent intubation Immediate circulatory stabilization
- Chest trauma or MVC victims
- DNR Status
- Left Bundle Branch Block

(revised 3/2014)

## BLS & ALS

- Administer **O2 starting at 2 L/Min per nasal cannula**, titrate as needed to maintain SpO2 > 92%
- Obtain Systolic/Diastolic blood pressure (BP) in both arms
- Administer **Chewable Aspirin 324 mg** by mouth
- Administer **Nitroglycerin Sublingual 0.4 mg** every 5 minutes up to 3 doses if chest discomfort present and SBP > 100. Check BP prior to each administering dose. Hold if SBP < 100 mm HG. Hold All Nitrates if Erectile Dysfunction medication taken within 36 hours.
- BLS only: Request ALS Intercept per local protocol

## ALS Only

- Establish large bore **IV access - Normal Saline 500ml KVO**, Establish a second IV Line as time allows.
- **Clopidogrel (Plavix) 600 mg** by mouth if transferring for PPCI at PCI Capable Receiving Facility
- **Heparin IV Bolus 70 Units/kg IV, max 5,000 Units** if transferring for PPCI at PCI Capable Receiving Facility
- Establish a **Nitroglycerine IV Drip** if chest discomfort is unrelieved. Initiate @ 5 mcg/min & titrate in increments of 5mcg/min to maintain a systolic BP of 100 mm/Hg or greater. Hold Nitrates if Erectile Dysfunction medication taken within 36 hours.
- Administer **analgesia** as needed for discomfort per protocol

## Documentation Reminders:

- ✓ Provide Copy of EMS Run Sheet with Report to RN or MD
- ✓ If STEMI/AMI alert is provided to the hospital, document the time.
- ✓ Provide a Printed Copy of Pre-Hospital 12 L ECG with Report to RN or MD

## Patient Care Goals:

- Provide early identification of patients and early notification of the hospital for suspected AMI or STEMI.
- Utilize an assessment tool that may reduce the time from onset of symptoms to receiving definitive cardiac interventions at the receiving hospital.
- Prepare patient for immediate transport with indicated medications administered en route to hospital. Attempt to limit the scene time to the shortest time possible.

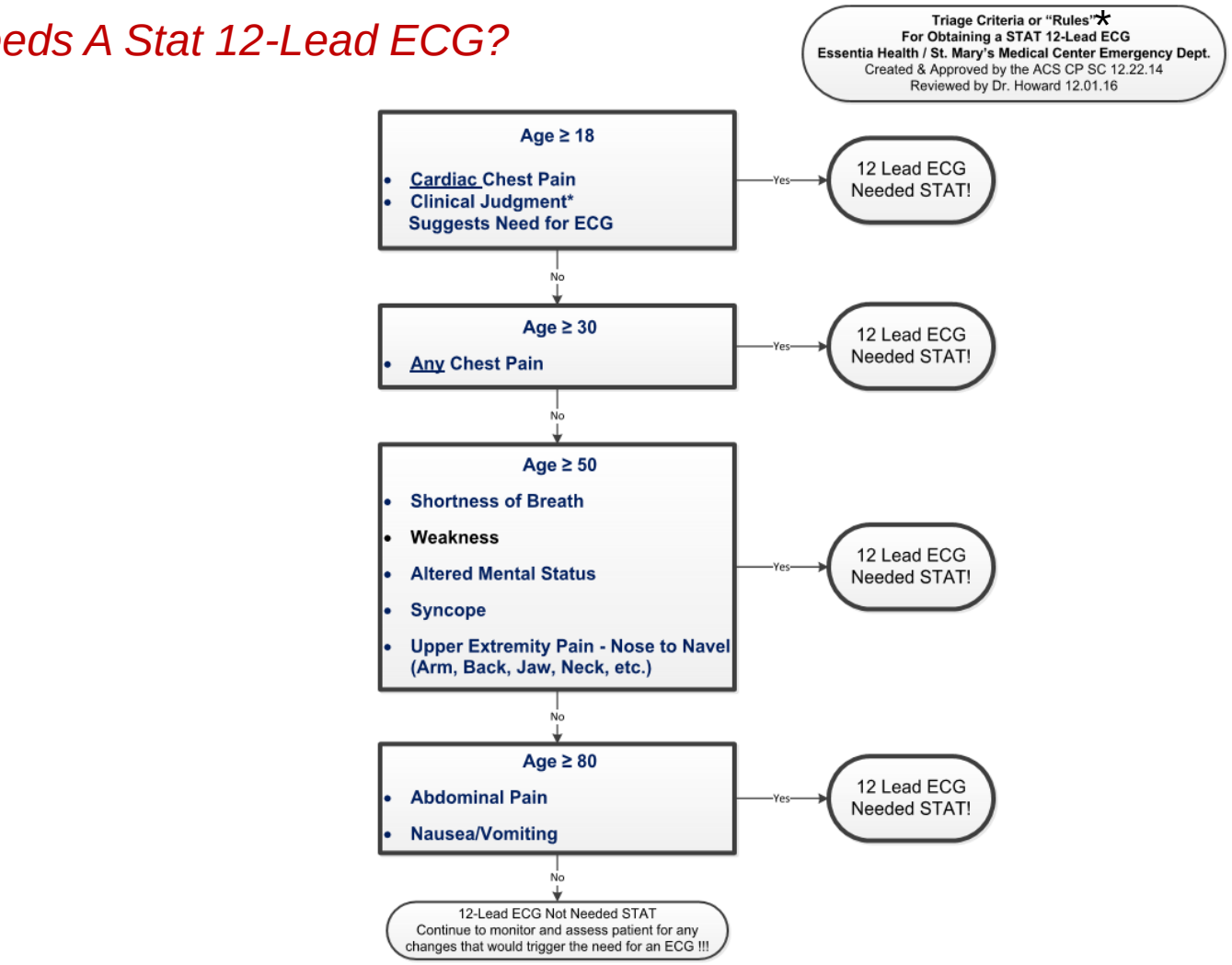
## AHA Mission: Lifeline EMS Best Practice Goals

1. All patients with non-traumatic chest pain, ≥ 35 years, treated and transported by EMS who get a pre-hospital 12-lead electrocardiogram
2. All STEMI patients transported directly to a STEMI receiving center, with first (pre-hospital) medical contact to PCI time ≤ 90 minutes directly or ≤120 minutes for transfers
3. All lytic eligible STEMI patients treated and transported to a referring hospital for fibrinolytic therapy with a door to needle time ≤ 30 minutes

## AHA Mission: Lifeline EMS Reporting Measures:

1. Time from symptom onset to EMS dispatch
2. Time from EMS dispatch to vehicle arrival at hospital door
3. All STEMI patients treated and transported to a referring hospital for fibrinolytics therapy should have a Fibrinolytic Checklist completed to identify contraindications to lytic therapy.
4. All suspected AMI/STEMI patients treated and transported by EMS should receive a 12-lead ECG
5. All STEMI patients with a pre-hospital identified STEMI call for field activation of a STEMI Alert at receiving hospital

# *Who Needs A Stat 12-Lead ECG?*




*Clinical Judgment requires assessment beyond the chief complaint. This list of rules is simply a guide. Clinical history, and evaluation of multiple symptoms beyond chest pain, may be present that should trigger concern for potential Acute Coronary Syndrome. Some of these include things like: Pressure, Discomfort, Tightness, Radiating Pain, Pounding, Racing, Beating Fast, Sweating, etc. Be suspicious of patients with cardiac risk factors, like high blood pressure, high cholesterol, diabetes, smoking history, and patient's with a known cardiac history or with recent cardiac surgery or intervention.

If in doubt, always err on the side of caution, and obtain a STAT 12-Lead ECG!

*Based on over 3.5 million ED visits

Adapted from: Development and Validation of a Prioritization Rule for Obtaining an Immediate 12-lead Electrocardiogram in the Emergency Department to Identify ST-elevation Myocardial Infarction Seth W. Glickman, MD, MBA, Frances S. Shofer, PhD, Michael C. Wu, PhD, Matthew J. Scholer, MD, PhD, Adanma Ndubuizu, MD, MPH, Eric D. Peterson, MD, MPH, Christopher B. Granger, MD, Charles B. Cairns, MD, Lawrence T. Glickman, VMD, DrPH, Chapel Hill, Durham, NC. Am Heart J. 2012;163(3):372-382.

*Hot off the Press – On-Line October 13th, 2021…In Print November 16th, 2021*

Circulation

**AHA POLICY STATEMENT**

# Systems of Care for ST-Segment–Elevation Myocardial Infarction

## A Policy Statement From the American Heart Association

Alice K. Jacobs, MD, FAHA, Chair; Murtuza J. Ali, MD; Patricia J. Best, MD; Mark C. Bieniarz, MD; Vincent J. Bufalino, MD, FAHA; William J. French, MD; Timothy D. Henry, MD; Lori Hollowell, MHIT, BSN, RN; Edward C. Jauch, MD, MS, FAHA; Michael C. Kurz, MD, MS, FAHA; Michael Levy, MD; Puja Patel, MS, MBA; Travis Spier, RN, MSN, NR-Paramedic, FP-C; R. Harper Stone, MD; Katie L. Tataris, MD, MPH; Randal J. Thomas, MD; Jessica K. Zègre-Hemsey, PhD, RN; on behalf of the American Heart Association Advocacy Coordinating Committee

Jacobs et al; Systems of Care for STEMI; Circulation. November 16, 2021. Vol 144, Issue 20;144:00–00.
DOI: 10.1161/CIR.0000000000001025

## Policy Recommendations: Entry Into the Health Care System

1. Health care professionals should advocate for patients with signs and symptoms of a heart attack to call 9-1-1 for EMS transport to decrease symptom onset to arrival time and time to definitive care through well-coordinated and culturally diverse public awareness campaigns.
2. All advanced life support EMS should provide 12-lead ECGs as a standard.
3. Basic EMS providers should be trained and granted permission through certification and state protocols to acquire 12-lead ECGs on patients experiencing chest pain or other suspected ischemic symptoms, especially those with suspected STEMI, with the findings communicated in accordance with local, regional, or state protocol.
4. EMS destination protocols should be designed to meet EMS FMC-to-PCI guideline recommendations.
5. EMS prehospital STEMI activation protocols should be developed and implemented.
6. EMS agencies should be supported appropriately with talented/trained staff, funding for acquisition, and the potential for transmission of prehospital ECGs, research funding, and backing of other groups, including cardiologists and professional societies.
7. EMS agencies should have an internal quality improvement program in place to review 100% of identified STEMIs and to provide hospital feedback on transported patients later identified as having STEMI but not identified in the field.
8. EMS should be represented at institutional and regional multidisciplinary quality improvement meetings.

Jacobs et al; Systems of Care for STEMI; Circulation. November 16, 2021. Vol 144, Issue 20;144:00–00.
DOI: 10.1161/CIR.0000000000001025

## Policy Recommendations: STEMI Referring Hospitals, Interhospital Transport, and STEMI Receiving Hospitals

1. STEMI referring hospitals should have a planned reperfusion strategy in place (either fibrinolytic administration or transfer for PCI).
2. A 9-1-1 call system should be used for requesting interhospital transfer (in the absence of immediately available hospital-based transport services).
3. Interhospital request time to arrival time should be within 15 minutes.
4. STEMI referring hospitals and STEMI receiving centers should have preplanned agreements in place.
   a. One-call transfer process
   b. Automatic acceptance
   c. Treatment algorithms
   d. Transfer processes (primary and backup)
5. STEMI receiving centers should have protocols in place to be able to quickly treat the patient with STEMI arriving by interhospital transfer.
6. STEMI receiving centers should strive to meet overall arrival-to-PCI (device time) within 90 minutes but strive for within 60 minutes and within 30 minutes for transferred patients with STEMI.
7. STEMI receiving centers should take the lead on coordinating multidisciplinary care and engaging STEMI referring hospitals, interhospital transport agencies, and EMS.
8. All hospitals and EMS agencies should be active participants in a regional system of care.

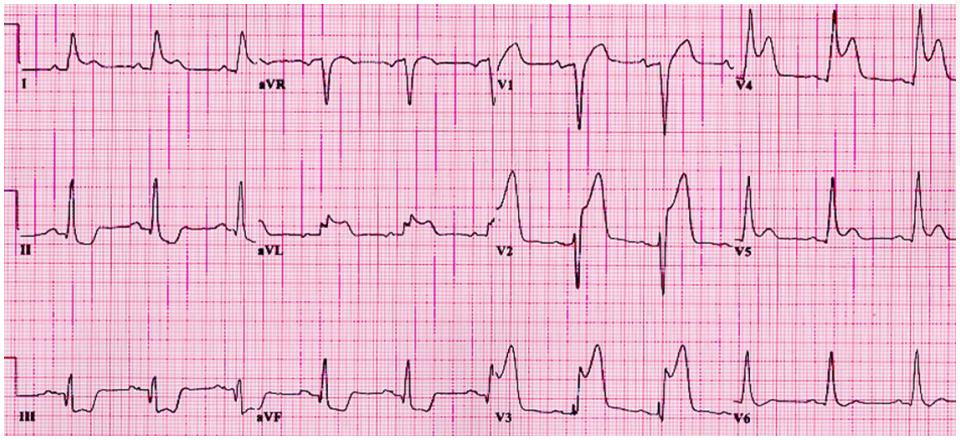
Jacobs et al; Systems of Care for STEMI; Circulation. November 16, 2021. Vol 144, Issue 20;144:00–00.
DOI: 10.1161/CIR.0000000000001025

## Policy Recommendations: Transitions in Care

1. The CCL should be activated as early as possible before arrival of the patient with STEMI at the hospital in order to provide definitive revascularization with the greatest efficiency, especially for high-risk patients.
2. Time in the ED should be minimized and not delayed by nonessential tests.
3. If the CCL is ready to receive the patient with STEMI, the ED should be bypassed, and direct transport to the CCL should occur for most patients.
4. After PCI, in-hospital care in the appropriate setting should include GDMT and transitional care management at discharge.
5. Patients with STEMI should receive a referral for cardiac rehabilitation from an inpatient setting.

Jacobs et al; Systems of Care for STEMI; Circulation. November 16, 2021. Vol 144, Issue 20;144:00–00.
DOI: 10.1161/CIR.0000000000001025

# STEMI Research…

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# Improving Rural STEMI Care through Multi-State Sharing and Collaboration

Jeffrey Sather, MD Trinity Health, Tomasz Stys, MD Sanford Health, Richard Mullvain, RPH, BCPS Essentia Health, Gary Myers, MS, NREMT, Mindy Cook, RN, BSN, Pam Moe, RN, CPHQ, Michelle Gardner, MBA, American Heart Association, Midwest Affiliate

American Heart Association. | MISSION: LIFELINE

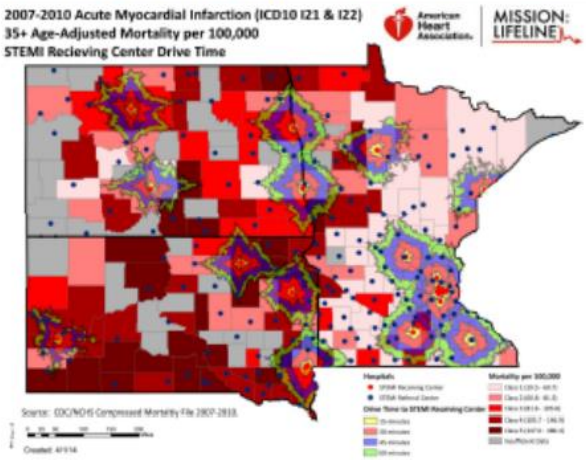
## Background

Several factors can impede the timely delivery of optimal care to STEMI patients, particularly in rural states such as South Dakota, North Dakota and Minnesota. South Dakota has 66 counties covering nearly 76,000 square miles. Five of the seven percutaneous coronary intervention (PCI)-capable facilities are located in two communities and travel distances between hospitals can exceed 200 miles. North Dakota consists of 53 counties over 69,001 square miles. Thirty-four entire counties are designated medically underserved areas and 13 counties have some part of them designated medically underserved. Similar distances issues between referring hospitals and PCI-capable facilities are also seen in the majority of the state of Minnesota. These rural areas are heavily dependent upon volunteer ambulance services and the capabilities of the small referring (non-PCI or CAH) hospitals to receive the STEMI patient and transfer in a timely manner. Excluding the Twin Cities and Rochester, there are a total of 18 PCI-capable hospitals throughout rural Minnesota, South Dakota and North Dakota. Only two of these hospitals are Chest Pain Accredited, with one having Mission: Lifeline® Accreditation. There are 153 Critical Access Hospitals in this region, making them crucial to a STEMI system of care.

ACTION Registry®–GWTG™

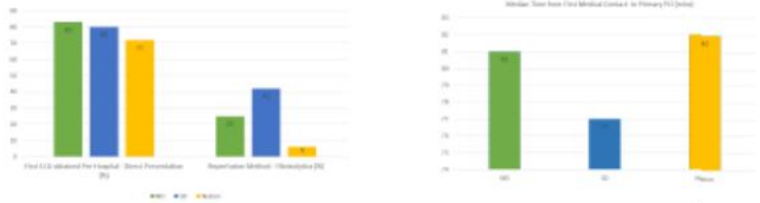
## Methods

Mission: Lifeline® is a strategic initiative to save lives and reduce disability by improving emergency readiness and response to heart attack patients. With funding support, the American Heart Association, hospital, EMS and state stakeholders have worked together to improve each component of STEMI systems, including across state borders. The South Dakota project started in 2010 followed by North Dakota in 2011. Minnesota was launched in 2013. In each state, STEMI task forces and provider specific sub-committees were formed. Each PCI-capable hospital was asked to participate in data collection through ACTION Registry®-GWTG™. EMS agencies in North Dakota and South Dakota were granted funds to purchase 12-lead monitor/defibrillators. Minnesota is currently in the process of allocating these devices, based on funding availability. Critical Access Hospitals and other non-PCI-capable facilities participated in STEMI education which included ways to improve time critical processes and transfer protocols. An education plan was delivered to EMS agencies South Dakota and North Dakota as well, and this same plan is being adjusted to meet the needs in Minnesota.




## Results

A statewide STEMI protocol was adopted in 2012 in North Dakota. South Dakota used this to create their own guideline which was adopted in 2013. Both protocols will be shared with the Minnesota task force in 2014 by the South Dakota and North Dakota physician champions. The number of 12-lead ECG transmissions have more than tripled in South Dakota since the start of the project. In addition the time from First Medical Contact (FMC) to PCI was 77 minutes in South Dakota from Q4 2012-Q3 2013 beating the national average of 82 minutes. North Dakota is also beating the national average with a FMC to PCI time of 81 minutes during that same timeframe.



## Conclusions

Although each state is very different, rural areas often have many of the same barriers for an effective state STEMI system. As the projects have moved forward, each state has approached each component a little differently and adjusted based on needs. The learning experience across state borders has been effective way to make progress. The hospital data and 12-lead ECG transmission increase has proven that there is better STEMI system awareness and competence throughout the states resulting in a faster time from first medical contact to device. The collaboration of EMS and hospitals around state borders will also help with the sustainability of the projects and most importantly, the ability for better outcomes for STEMI patients, regardless of their location.

## Limitations

Data was collected from ACTION Registry®-GWTG™, which is the registry used by all PCI capable hospitals in SD, MN and ND. The first medical contact results captures patients that have presented directly to a PCI hospital via EMS or by walk-in. Transfers from other acute facilities are not included in this data. The ECG Transmissions were provided by LifeNet and includes the majority of transmissions.

DISCLOSURE INFORMATION
The following relationships exist related to this presentation: no disclosure

Abstract & Poster - 17th Congress Society of Cardiovascular Patient Care, San Diego, CA. Sather J, Stys T, Mullvain R, Myers G, Cook M, Moe P, Gardner M; Improving Rural STEMI Care through Multi-State Sharing and Collaboration.
Critical Pathways in Cardiology Sept. 2014 Vol 13 – Issue 3.

# Results

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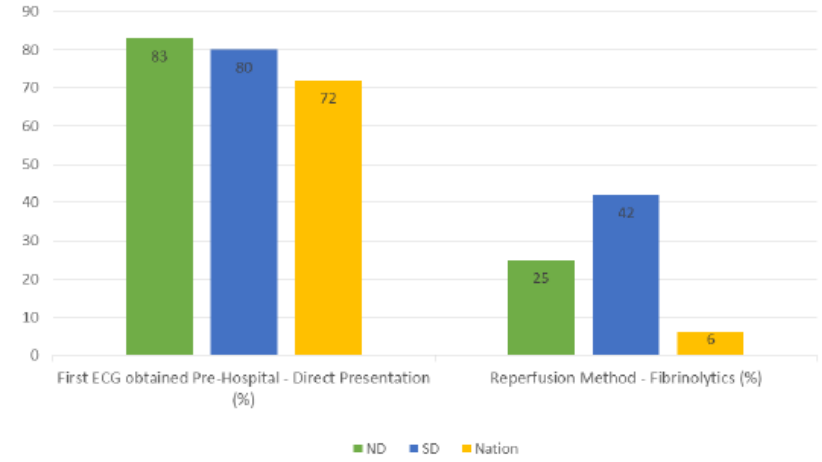


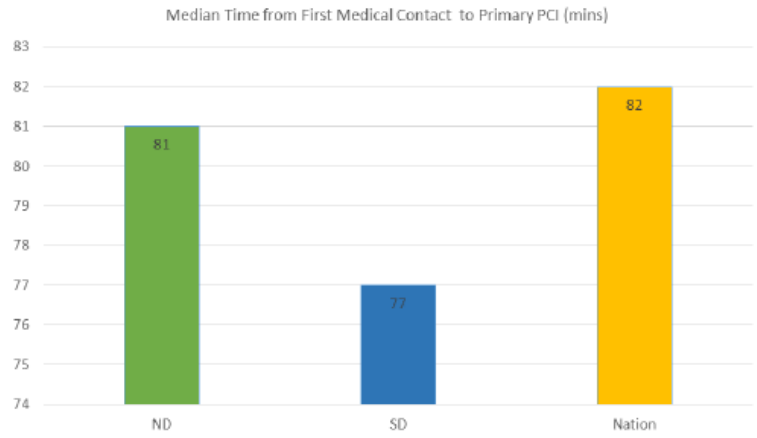


Abstract & Poster - 17th Congress Society of Cardiovascular Patient Care, San Diego, CA. Sather J, Stys T, Mullvain R, Myers G, Cook M, Moe P, Gardner M; Improving Rural STEMI Care through Multi-State Sharing and Collaboration.
Critical Pathways in Cardiology Sept. 2014 Vol 13 – Issue 3.

# Rural Systems of Care: Real World Observations and Trends in STEMI Patient Characteristics, and correlations of arrival mode to outcomes

- Background: Minnesota, North Dakota and South Dakota have been enhancing statewide systems through infrastructure and clinical education regarding ST-elevation myocardial infarction (STEMI) since 2010 in an attempt to equalize access to timely reperfusion in rural areas
- A trend in faster times has been noted to Primary Percutaneous Coronary Intervention (PPCI) for STEMI patients who transfer directly to Percutaneous Coronary Intervention (PCI) capable facilities via Emergency Medical Services (EMS) and receive a pre-hospital 12-lead ECG in comparison to those who first present to a non PCI capable facility

March 2017
Abstract & Poster – AHA QCOR – Arlington, VA
Rural Systems of Care: Real World Observations and Trends in STEMI Patient Characteristics, and correlations of arrival mode to outcomes
Authors: Dr. Scott Mikesell, Dr. Jeffrey Sather, Dr. John Gallagher, Richard Mullvain, Dr. Tomasz Stys, Gary Myers, Michelle Scharnott, Mindy Cook.
Circulation: Cardiovascular Quality and Outcomes. March 2017; Vol 10, Issue suppl_ 3

# Rural Systems of Care: Real World Observations and Trends in STEMI Patient Characteristics, and correlations of arrival mode to outcomes

- Methods: Data was collected via ACTION Registry-GWTG from 2012-2015. The cohort was defined as STEMI patients who received PPCI with interfacility transfer and without and who receive a pre-hospital 12-lead ECG and do not
- The association between mode of transport, time to PPCI, and outcomes including LV function, in hospital clinical events, and in-hospital mortality was analyzed by unadjusted association
- Adjusted risk of mortality including age, sex, mortality risk, first contact variables and risk factors were applied (defined by Risk adjusted mortality model: McNamara) in order to **determine if arrival mode correlates to better outcomes**

March 2017
Abstract & Poster – AHA QCOR – Arlington, VA
Rural Systems of Care: Real World Observations and Trends in STEMI Patient Characteristics, and correlations of arrival mode to outcomes
Authors: Dr. Scott Mikesell, Dr. Jeffrey Sather, Dr. John Gallagher, Richard Mullvain, Dr. Tomasz Stys, Gary Myers, Michelle Scharnott, Mindy Cook.
Circulation: Cardiovascular Quality and Outcomes. March 2017; Vol 10, Issue suppl_ 3

# Rural Systems of Care: Real World Observations and Trends in STEMI Patient Characteristics, and correlations of arrival mode to outcomes

- Results: The direct transfer group demonstrated shorter cumulative times (79 vs. 145 min., p=<0.001) to coronary reperfusion as compared to the interfacility transfer group
- The pre-hospital ECG group experienced a shorter time to transfer (40 vs. 55 min., p=<0.001) to a PPCI center consistent with earlier system recognition and activation for a STEMI patient
- The **direct transfer and pre-hospital ECG groups had a statistically significant less risk of in-hospital cardiogenic shock, congestive heart failure, cardiac arrest and death** as a composite end-point, p=0.011 & <0.001 respectively
- During the years of 2012 to 2015, the performance of pre-hospital ECGs has increased

March 2017
Abstract & Poster – AHA QCOR – Arlington, VA
Rural Systems of Care: Real World Observations and Trends in STEMI Patient Characteristics, and correlations of arrival mode to outcomes
Authors: Dr. Scott Mikesell, Dr. Jeffrey Sather, Dr. John Gallagher, Richard Mullvain, Dr. Tomasz Stys, Gary Myers, Michelle Scharnott, Mindy Cook.
Circulation: Cardiovascular Quality and Outcomes. March 2017; Vol 10, Issue suppl_ 3

# Rural Systems of Care: Real World Observations and Trends in STEMI Patient Characteristics, and correlations of arrival mode to outcomes

- Conclusion: Mission Lifeline programming in rural statewide systems of care is positively impacting STEMI patients by reducing the risk of in-hospital shock, congestive heart failure, cardiac arrest and death in STEMI patients **presenting via EMS** through broad application of pre-hospital ECG, education, and hospital triage and procedural PPCI streamlining

March 2017
Abstract & Poster – AHA QCOR – Arlington, VA
Rural Systems of Care: Real World Observations and Trends in STEMI Patient Characteristics, and correlations of arrival mode to outcomes
Authors: Dr. Scott Mikesell, Dr. Jeffrey Sather, Dr. John Gallagher, Richard Mullvain, Dr. Tomasz Stys, Gary Myers, Michelle Scharnott, Mindy Cook.
Circulation: Cardiovascular Quality and Outcomes. March 2017; Vol 10, Issue suppl_ 3

# COVID-19 Era and STEMI

- The rates of ST-segment elevation myocardial infarction (STEMI) admissions worldwide have decreased during the COVID-19 pandemic
- Disruption to emergency services may result in delays to the primary percutaneous coronary intervention (PPCI) pathway including time from pain onset to first medical contact and in-hospital delivery of revascularization
- The systemic inflammatory response, induced by COVID-19, appears to disrupt antithrombotic mechanisms contributing to a higher incidence of thrombotic complications
  - The implications for acute coronary syndromes remain unclear.

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Little, et al.; COVID-19 pandemic and STEMI: pathway activation and outcomes from the pan-London heart attack group; Open Heart 2020; 7(2): e001432. doi: 10.1136/openhrt-2020-001432

# COVID-19 Era and STEMI

- STEMI Admissions reduced 21%
- Ambulance response times increased by 12 minutes

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Little, et al.; COVID-19 pandemic and STEMI: pathway activation and outcomes from the pan-London heart attack group; Open Heart 2020; 7(2): e001432. doi: 10.1136/openhrt-2020-001432

# Patients With Active COVID-19 and STEMI

- Higher thrombotic burdon
- More likely to have intensive care unit admissions
  - 32.6% vs 9.3%
- Increased length of stay
  - 4 days vs 3 days
- Higher mortality
  - 21.7% vs 9.3%

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Little, et al.; COVID-19 pandemic and STEMI: pathway activation and outcomes from the pan-London heart attack group; Open Heart 2020; 7(2): e001432. doi: 10.1136/openhrt-2020-001432

# Still Try for PPCI if Possible…

- Systemic thrombolysis has been suggested as an alternative strategy to managing patients with STEMI during the pandemic…
- However, our data suggest that even at the peak of COVID-19 related admissions to hospital, it has been possible to maintain effective PPCI services

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Little, et al.; COVID-19 pandemic and STEMI: pathway activation and outcomes from the pan-London heart attack group; Open Heart 2020; 7(2): e001432. doi: 10.1136/openhrt-2020-001432

Catheterization & Cardiovascular Interventions

SCAI Society for Cardiovascular Angiography & Interventions

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# Impact of COVID-19 pandemic on STEMI care: An expanded analysis from the United States

Santiago Garcia MD, Larissa Stanberry PhD, Christian Schmidt MS, Scott Sharkey MD, Michael Megaly MD, Mazen S. Albaghdadi MD, Perwaiz M. Meraj MD, Ross Garberich MS, MBA, Farouc A. Jaffer MD, PhD, Ada C. Stefanescu Schmidt MD MSc, Simon R. Dixon MBChB, Jeffrey J. Rade MD, Timothy Smith MD, Mark Tannenbaum MD, Jenny Chambers MBA, Frank Aguirre MD, Paul P. Huang MD, MSc, Dharam J. Kumbhani MD, SM, MRCP, Thomas Koshy MD, Dmitriy N. Feldman MD, Jay Giri MD, MPH, Prashant Kaul MD, Craig Thompson MD, Houman Khalili MD, Brij Maini MD, Keshav R. Nayak MD, Mauricio G. Cohen MD, Sripal Bangalore MD, MHA, Binita Shah MD, MS, Timothy D. Henry MD, ... See fewer authors

From North Dakota

First published: 07 August 2020 | https://doi.org/10.1002/ccd.29154 | Citations: 22

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# STEMI After COVID-19 Era

## Jan 2019–Feb 2020 compared to Mar–Apr 2020

- 29% Reduction in STEMI activations
- 34% Reduction in activations leading to angiography
- 20% Reduction in activations leading to Primary PCI
- 20% Increase in Door to Balloon times

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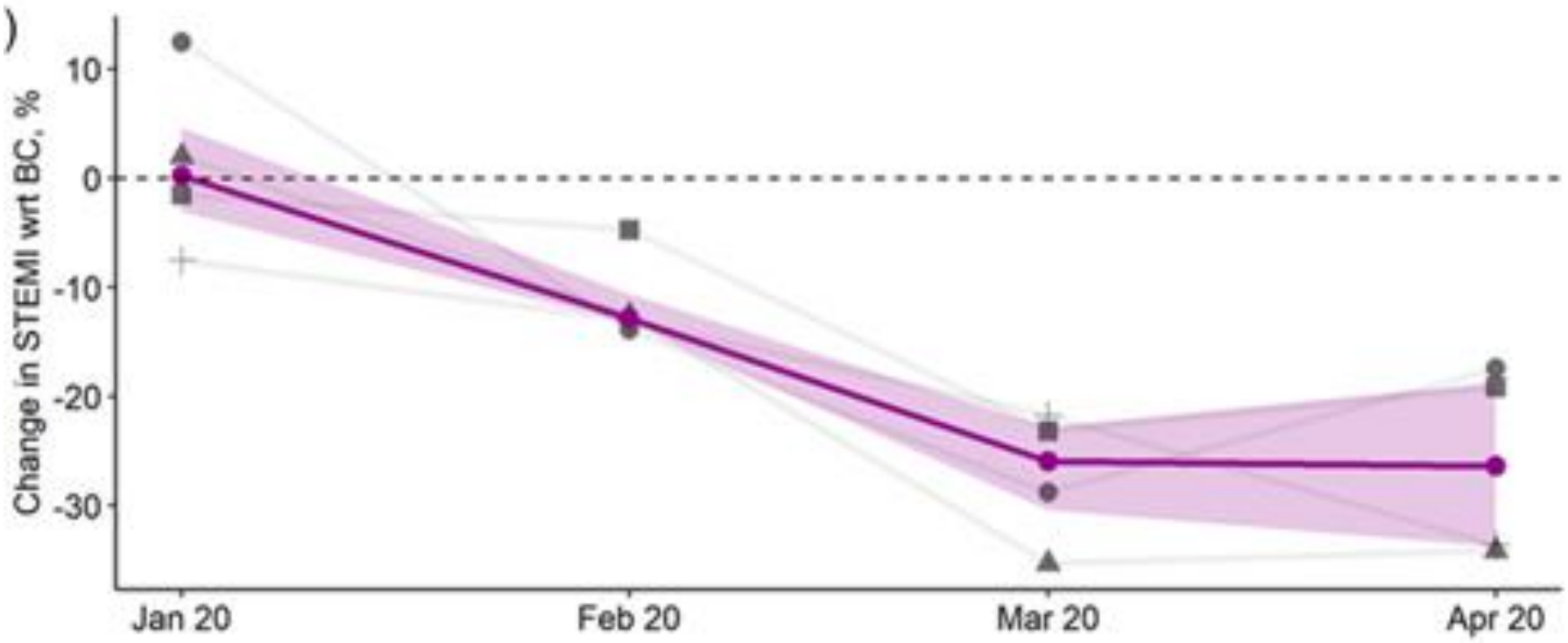
Garcia, et al; Impact of COVID-19 pandemic on STEMI care: An expanded analysis from the United States; Aug. 2020, Catheterization & Cardiovascular Interventions. Doi.org/10.1002/ccd.29154

# % Change in STEMI Activations with respect to time Before COVID-19

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Catheterization and Cardiovascular Interventions, Volume: 98, Issue: 2, Pages: 217-222, First published: 07 August 2020, DOI: (10.1002/ccd.29154)

# *This Just In!!!*
# Revascularization in Late-Presenting STEMI Patients

- Revascularization of STEMI patients presenting between 12–48 hours of symptom onset (latecomers) is associated with significant short- and long-term mortality benefit

Percutaneous Myocardial Revascularization in Late-Presenting Patients With STEMI. J Am Coll Cardiol Sept. 20, 2021;78:1291-1305.

# Methods:

- Data from three nationwide observational studies from the FAST-MI (French Registry of Acute ST-elevation and non-ST-elevation Myocardial Infarction) program over a 1-month period in 2005, 2010, and 2015 were analyzed

- Patients presenting between 12–48 hours after symptom onset were classified as latecomers

Percutaneous Myocardial Revascularization in Late-Presenting Patients With STEMI. J Am Coll Cardiol Sept. 20, 2021;78:1291-1305.

# Results

- A total of 6,273 STEMI patients were included in the three cohorts
  - 1,169 (18.6%) were latecomers
  - Patients treated with fibrinolysis and patients deceased within 2 days after admission were excluded.
  - A total of 1,077 patients were analyzed, of whom 729 (67.7%) were revascularized within 48 hours after hospital admission.
- At 30-day follow-up, the all-cause death rate was significantly lower among revascularized latecomers (2.1% vs. 7.2%; $p < 0.001$)
- After a median follow-up of 58 months, the rate of all-cause death was 30.4 (95% confidence interval [CI], 25.7-35.9) per 1,000 patient-years in the revascularized latecomers group versus 78.7 (95% CI, 67.2-92.3) per 1,000 patient-years in the nonrevascularized latecomers group ($p < 0.001$)
- In multivariate analysis, revascularization of latecomer STEMI patients was independently associated with a significant reduction of mortality occurrence during follow-up (hazard ratio, 0.65; 95% CI, 0.50-0.84; $p = 0.001$).

Percutaneous Myocardial Revascularization in Late-Presenting Patients With STEMI. J Am Coll Cardiol Sept. 20, 2021;78:1291-1305.

**CENTRAL ILLUSTRATION: Mortality Comparison in the Latecomer Population According to Revascularization Status**

**Latecomers STEMI patients (12-48 hours)**
65 years old
31% female
21% diabetics
22% atypical chest pain
69% admission via emergency medical service

| Revascularization | No revascularization |
|---|---|
| 63 years old | 70 years old |
| 28% female | 38% female |
| 4% Killip score >2 | 8% Killip score >2 |
| GRACE risk score 142 | GRACE risk score 155 |

| | | | |
|---|---|---|---|
| 30-day mortality (%) | 2.1% | 7.2% | $P < 0.001$ |
| Long-term mortality (for 1,000 patient-years) | 30.4 | 78.7 | $P < 0.001$ |


Bouisset, F. et al. J Am Coll Cardiol. 2021;78(13):1291-1305.

# Conclusion

- Coronary revascularization of latecomer* STEMI patients is associated with better short- and long-term clinical outcomes

- *Presenting between 12-48 hours of symptom onset

Percutaneous Myocardial Revascularization in Late-Presenting Patients With STEMI. J Am Coll Cardiol Sept. 20, 2021;78:1291-1305.

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I'd Rather Be Working
and Doing STEM Research!

# Local STEMI Research

- Richard Mullvain, RPH, BCCP, BCPS (AQC), CCCC

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## LESS LYTICS, LESS CRITICS: IMPACT OF REDUCING FIBRINOLYTIC USE ON OUTCOMES IN A LARGE RURAL ST-ELEVATION MYOCARDIAL INFARCTION PROGRAM

Ischemic Heart Disease

Catherine P. Benziger, David Supinski, Richard Mullvain, and Ronald Regal

J Am Coll Cardiol. 2021 May, 77 (18_Supplement_1) 188

Essentia Health

# Less Lytics, Less Critics: Impact of Reducing Fibrinolytic Use on Outcomes in a Large Rural ST-Elevation Myocardial Infarction Program

**David Supinski[1], Richard Mullvain[2], Ron Regal[2], Catherine Benziger[2]**
[1]University of Minnesota Medical School, Duluth, MN;
[2]Essentia Health Heart and Vascular Center, Duluth, MN

## BACKGROUND

The ST-elevation myocardial infarction (STEMI) guidelines recommend a mixed treatment strategy - primary percutaneous coronary intervention (PPCI) within 90-120 minutes or fibrinolytic therapy if patients are eligible and unable to receive PPCI within 120 minutes from first medical contact (FMC). We aimed to evaluate reperfusion strategy and outcomes after implementation of a comprehensive, large inter-facility transfer STEMI program.

## METHODS

- Prospective observational cohort study
- All STEMI patients between 5/03/2009-6/24/2019.
- Data analysis using standard STEMI metrics and cox regression method Kaplan-Meier survival curves for survival analysis, logistic regression for mortality and readmission
- Results were adjusted for age and sex.

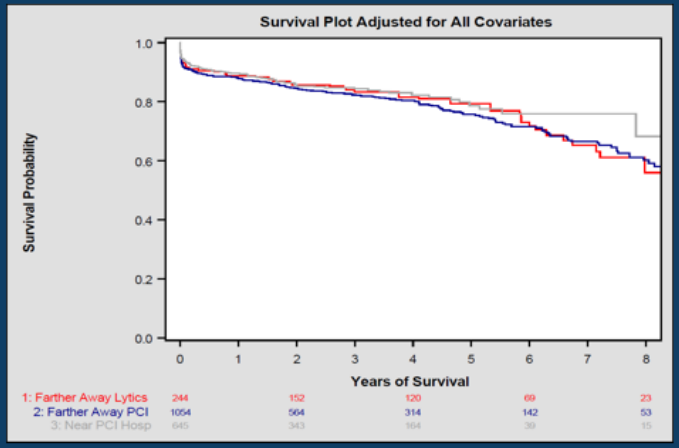
## RESULTS

- 2011 (28.4% female, mean age 62.3 years.) STEMI activations.
- 1765 treated by the PPCI pathway, 246 times for the fibrinolytic pathway.
- Annual fibrinolytic use from 2009 to 2018 decreased from 23.92% to 6.13%.
- Rural patients receiving fibrinolytics had a hazard ratio of 1.06 (95% CI: 0.77-1.47) compared to Rural patient receiving PCI treatment, 1-year survival rates were 0.87, (95% CI 0.84-0.90) and 0.88 (95% CI 0.87-0.90) respectively.
- The 30-day readmission for rural patients in the PPCI protocol was 8.7% compared to 11.2% in the fibrinolytic pathway.

## CONCLUSION

Noninferior outcomes were demonstrated in patients with extended time to PCI. Readmission rates were significantly lower among PPCI patients compared to those treated with fibrinolytics. There was also no significant change in overall outcomes as treatment strategy shifted towards increased PCI use.

**Noninferior survival** and **decreased readmission rates** supports our protocol to deliver PPCI to more patients in a large rural health system despite extended times to treatment.




ACC.21

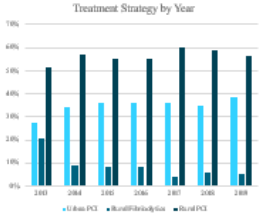
## DISCUSSION

This study supports the translation of current STEMI care guidelines from a ceiling of 90-minutes time to PPCI to 120-minutes, allowing for more patients to reach a PCI capable hospital and receive the superior PPCI treatment. This is especially applicable in large rural systems such as the Essentia Health System in northern Minnesota and North Dakota

## FIGURE 1

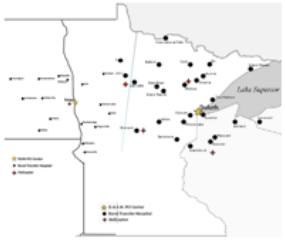

Nonsignificant differences were found in the 1 and 5 year survival rates between urban patients receiving PCI, rural patients with extended times and distances to PCI and rural patients who underwent treatment with fibrinolytics.

## FIGURE 2




The percentage of patients treated with thrombolysis as a reperfusion strategy decreased dramatically, form 23.92% in 2009 to 6.13% in 2018, after the initiation of the STEMI transfer protocol.

## FIGURE 3



Essentia Health's STEMI systems of care. The two PCI-capable hospitals are located in Duluth, MN and Fargo, ND. Each covers a large rural area, with protocols encouraging urgent transport for PPCI treatment of STEMI.

## FIGURE 4

| 30 Day Readmission | All cause Readmission | Cardiac Readmission |
|---|---|---|
| Rural Fibrinolytics | 11.24% | 8.53% |
| Rural PCI | 8.68% | 7.25% |

Hospital all-cause and cardiac related readmission rates after discharge from a STEMI.

## DISCLOSURE INFORMATION

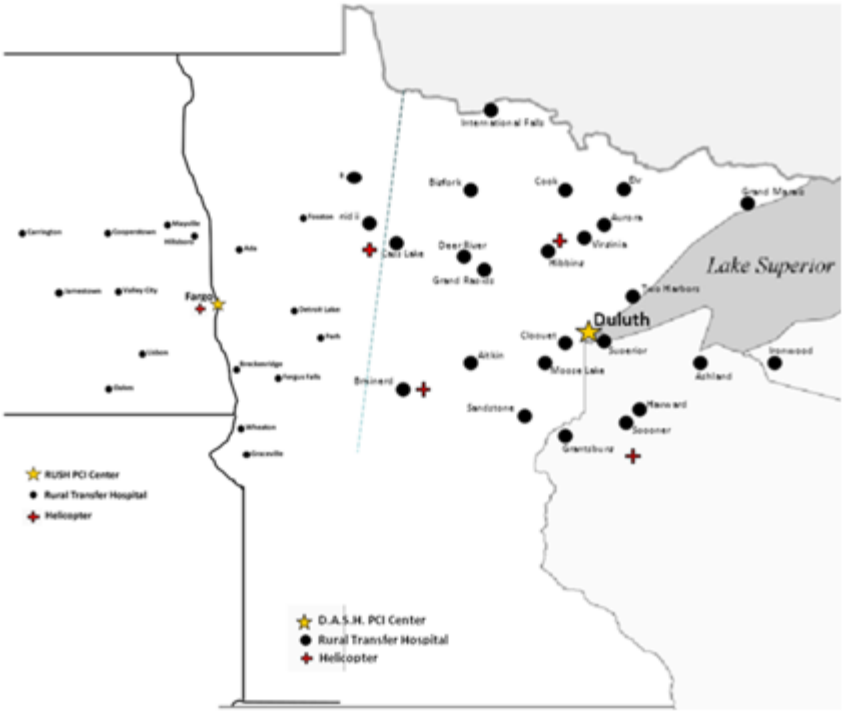
Authors have no disclosures to report.

## ACKNOWLEDGEMENTS

To the team at Essentia Health St. Mary's Cardiovascular Department, Essentia Institute of Rural Health, Duluth Medical School and others who contributed to this project.

Catherine P. Benziger, David Supinski, Richard Mullvain, and Ronald Regal; Less Lytics, Less Critics: Impact of Reducing Fibrinolytic Use on Outcomes in a Large Rural ST-Elevation Myocardial Infarction Program. J Am Coll Cardiol. 2021 May, 77 (18_Supplement_1) 188 https://www.jacc.org/doi/full/10.1016/S0735-1097%2821%2901547-3

# FIGURE 3




Essentia Health's STEMI systems of care. The two PCI-capable hospitals are located in Duluth, MN and Fargo, ND. Each covers a large rural area, with protocols encouraging urgent transport for PPCI treatment of STEMI.

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Catherine P. Benziger, David Supinski, Richard Mullvain, and Ronald Regal; Less Lytics, Less Critics: Impact of Reducing Fibrinolytic Use on Outcomes in a Large Rural ST-Elevation Myocardial Infarction Program. J Am Coll Cardiol. 2021 May, 77 (18_Supplement_1) 188 https://www.jacc.org/doi/full/10.1016/S0735-1097%2821%2901547-3

## BACKGROUND

The ST-elevation myocardial infarction (STEMI) guidelines recommend a mixed treatment strategy - primary percutaneous coronary intervention (PPCI) within 90-120 minutes or fibrinolytic therapy if patients are eligible and unable to receive PPCI within 120 minutes from first medical contact (FMC). We aimed to evaluate reperfusion strategy and outcomes after implementation of a comprehensive, large inter-facility transfer STEMI program.

## METHODS

- Prospective observational cohort study
- All STEMI patients between 5/03/2009-6/24/2019.
- Data analysis using standard STEMI metrics and cox regression method Kaplan-Meier survival curves for survival analysis, logistic regression for mortality and readmission
- Results were adjusted for age and sex.

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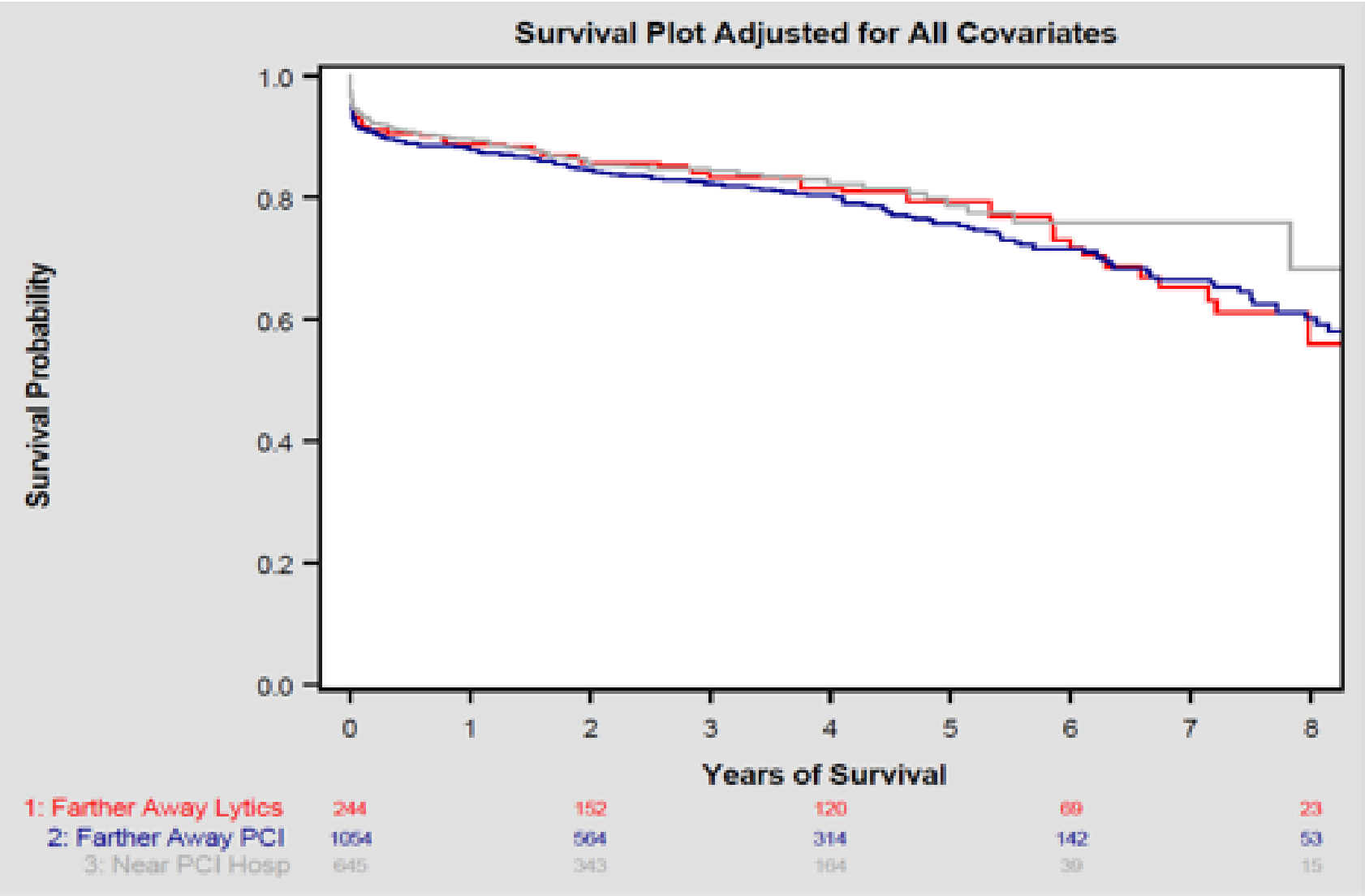
Catherine P. Benziger, David Supinski, Richard Mullvain, and Ronald Regal; Less Lytics, Less Critics: Impact of Reducing Fibrinolytic Use on Outcomes in a Large Rural ST-Elevation Myocardial Infarction Program. J Am Coll Cardiol. 2021 May, 77 (18_Supplement_1) 188 https://www.jacc.org/doi/full/10.1016/S0735-1097%2821%2901547-3

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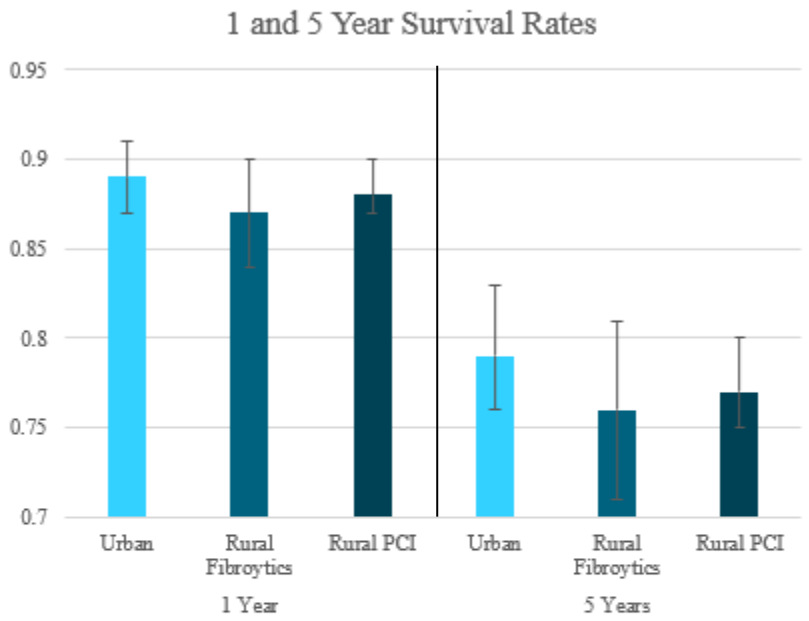
Catherine P. Benziger, David Supinski, Richard Mullvain, and Ronald Regal; Less Lytics, Less Critics: Impact of Reducing Fibrinolytic Use on Outcomes in a Large Rural ST-Elevation Myocardial Infarction Program. J Am Coll Cardiol. 2021 May, 77 (18_Supplement_1) 188 https://www.jacc.org/doi/full/10.1016/S0735-1097%2821%2901547-3

# FIGURE 1




Nonsignificant differences were found in the 1 and 5 year survival rates between urban patients receiving PCI, rural patients with extended times and distances to PCI and rural patients who underwent treatment with fibrinolytics.

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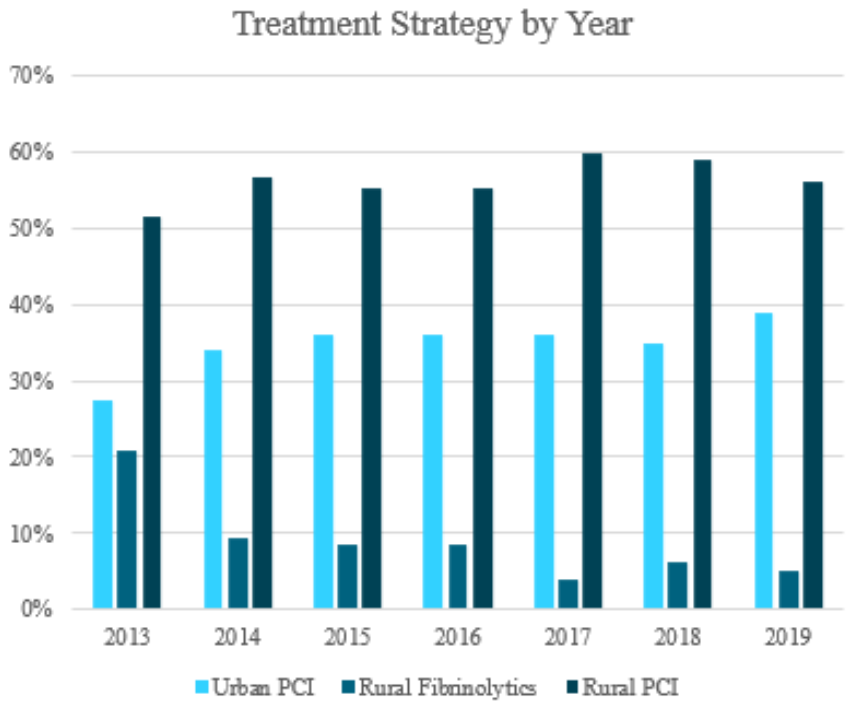
Catherine P. Benziger, David Supinski, Richard Mullvain, and Ronald Regal; Less Lytics, Less Critics: Impact of Reducing Fibrinolytic Use on Outcomes in a Large Rural ST-Elevation Myocardial Infarction Program. J Am Coll Cardiol. 2021 May, 77 (18_Supplement_1) 188 https://www.jacc.org/doi/full/10.1016/S0735-1097%2821%2901547-3

# FIGURE 2




The percentage of patients treated with thrombolysis as a reperfusion strategy decreased dramatically, form 23.92% in 2009 to 6.13% in 2018, after the initiation of the STEMI transfer protocol.

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Catherine P. Benziger, David Supinski, Richard Mullvain, and Ronald Regal; Less Lytics, Less Critics: Impact of Reducing Fibrinolytic Use on Outcomes in a Large Rural ST-Elevation Myocardial Infarction Program. J Am Coll Cardiol. 2021 May, 77 (18_Supplement_1) 188 https://www.jacc.org/doi/full/10.1016/S0735-1097%2821%2901547-3

# 30 Day Readmission Rates

- 30 Day Cardiac Readmission
  - Rural Fibrinolytics = 8.53%
  - Rural PCI = 7.25%

- 30 Day All Cause Readmission
  - Rural Fibrinolytics = 11.24%
  - Rural PCI = 8.68%

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Catherine P. Benziger, David Supinski, Richard Mullvain, and Ronald Regal; Less Lytics, Less Critics: Impact of Reducing Fibrinolytic Use on Outcomes in a Large Rural ST-Elevation Myocardial Infarction Program. J Am Coll Cardiol. 2021 May, 77 (18_Supplement_1) 188 https://www.jacc.org/doi/full/10.1016/S0735-1097%2821%2901547-3

# RESULTS

- 2011 (28.4% female, mean age 62.3 years.) STEMI activations.
- 1765 treated by the PPCI pathway, 246 times for the fibrinolytic pathway.
- Annual fibrinolytic use from 2009 to 2018 decreased from 23.92% to 6.13%.
- Rural patients receiving fibrinolytics had a hazard ratio of 1.06 (95% CI: 0.77-1.47) compared to Rural patient receiving PCI treatment, 1-year survival rates were 0.87, (95% CI 0.84-0.90) and 0.88 (95% CI 0.87-0.90) respectively.
- The 30-day readmission for rural patients in the PPCI protocol was 8.7% compared to 11.2% in the fibrinolytic pathway.

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Catherine P. Benziger, David Supinski, Richard Mullvain, and Ronald Regal; Less Lytics, Less Critics: Impact of Reducing Fibrinolytic Use on Outcomes in a Large Rural ST-Elevation Myocardial Infarction Program. J Am Coll Cardiol. 2021 May, 77 (18_Supplement_1) 188 https://www.jacc.org/doi/full/10.1016/S0735-1097%2821%2901547-3

# CONCLUSION

Noninferior outcomes were demonstrated in patients with extended time to PCI. Readmission rates were significantly lower among PPCI patients compared to those treated with fibrinolytics. There was also no significant change in overall outcomes as treatment strategy shifted towards increased PCI use.

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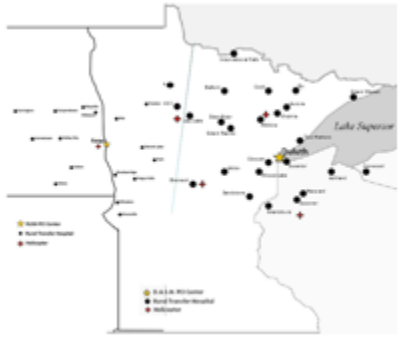
Catherine P. Benziger, David Supinski, Richard Mullvain, and Ronald Regal; Less Lytics, Less Critics: Impact of Reducing Fibrinolytic Use on Outcomes in a Large Rural ST-Elevation Myocardial Infarction Program. J Am Coll Cardiol. 2021 May, 77 (18_Supplement_1) 188 https://www.jacc.org/doi/full/10.1016/S0735-1097%2821%2901547-3



**Noninferior survival** and **decreased readmission rates** supports our protocol to deliver PPCI to more patients in a large rural health system despite extended times to treatment.

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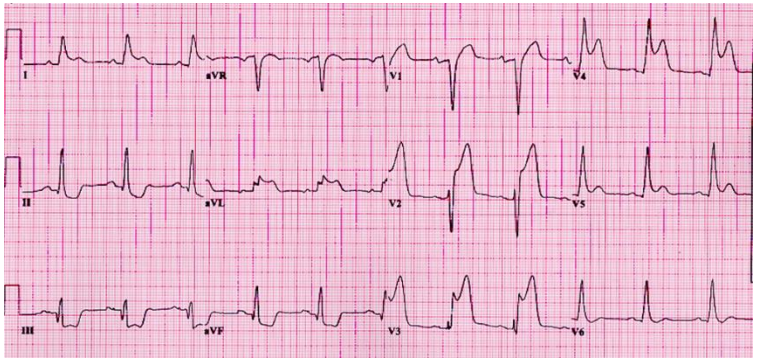
Catherine P. Benziger, David Supinski, Richard Mullvain, and Ronald Regal; Less Lytics, Less Critics: Impact of Reducing Fibrinolytic Use on Outcomes in a Large Rural ST-Elevation Myocardial Infarction Program. J Am Coll Cardiol. 2021 May, 77 (18_Supplement_1) 188 https://www.jacc.org/doi/full/10.1016/S0735-1097%2821%2901547-3

# Is She Really Having A STEMI?

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May 2015
Abstract & Poster – 18th Congress Society of Cardiovascular Patient Care, San Antonio, TX. Richard Mullvain and Ashlee Rostvedt.

# Gender Inequality on ECG to Decision Time for Primary PCI Treatment of STEMI

Critical Pathways in Cardiology 14(3):116-120, September 2015.

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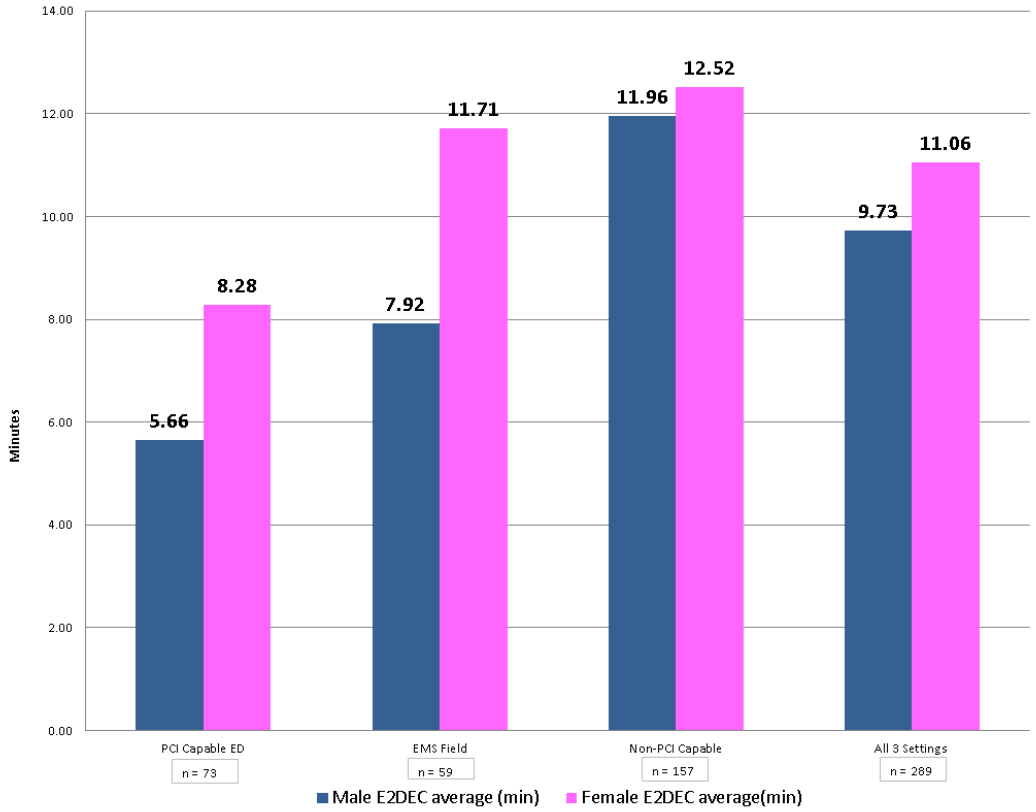
## Impact of Gender on (+) ECG to Average Decision Time for Primary PCI Treatment of STEMI




| | PCI Capable ED | EMS Field | Non-PCI Capable | All 3 Settings |
|---|---|---|---|---|
| Female avg. minutes longer than male | 2.62 | 3.79 | 0.56 | 1.33 |

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# Question For You:

- Once the 12-Lead ECG is obtained…
- …Why does it take longer to decide if a female is having a STEMI?

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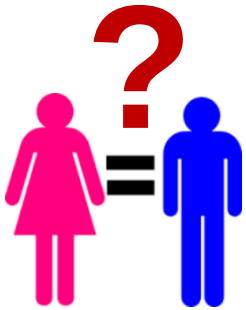
*It seems logical that time performance metrics for STEMI care should not vary by gender*

# Key Question:

***Are there STEMI performance step metrics that take longer for females vs. males?***

***If so, which ones?***

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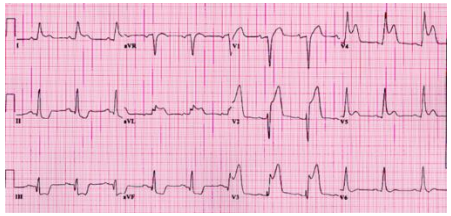
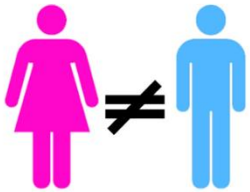
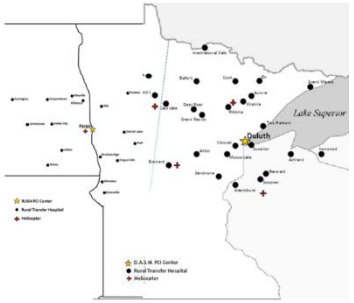
# Female Gender Disparity Observed in STEMI System Time Performance Metrics

## *…Slower Care For Females Found In 12 Different Steps*





Richard Mullvain, RPH BCPS (AQC), CCCC; Mallory Bosch, RN, Nancy Hassinger, MD, Samantha Kapphahn, DO, Lynn Howard, MD, Michael Mollerus, MD
Essentia Health – Duluth, Minnesota & Fargo, North Dakota




QCOR 2017 Abstract ID#: 114 Poster Board #: 30

Circulation: Cardiovascular Quality and Outcomes. 2017;10:A166

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# Results:

| Female Gender Inequality Discovered in Multiple STEMI System Time Performance Metrics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Setting** | **STEMI Metric** | **Female** (mean minutes) | **Male** (mean minutes) | **Minutes Longer for Females (Mean)** | **Female** (median minutes) | **Male** (median minutes) | **Minutes Longer for Females (Median)** | **p-value** |
| **PPCI Capable Hospital** | Door to balloon | 80 | 75 | 5 | 66 | 65 | 1 | 0.309 |
| | **Door to ECG** | 11 | 7 | 4 | 7 | 5 | 2 | **0.027** |
| (n=156) | ECG to STEMI alert | 8 | 8 | 0 | 5 | 4 | 1 | 0.435 |
| (31% Female) | **Patient time spent in the ED** | 69 | 50 | 19 | 46 | 43 | 3 | **0.022** |
| **Non-PPCI Capable Hospital** | Door to balloon | 137 | 135 | 2 | 134 | 123 | 11 | 0.411 |
| | **Door to ECG** | 12 | 8 | 4 | 7 | 6 | 1 | **0.030** |
| (n=289) | **Call ALS transport until they arrive** | 75 | 67 | 8 | 25 | 16 | 9 | **0.037** |
| (21% Female) | Patient time spent in the ED | 24 | 19 | 5 | 73 | 56 | 17 | 0.135 |
| **EMS Field Activation** | **Symptom onset to 911 call** | 198 | 99 | 99 | 45 | 30 | 15 | **0.013** |
| | First contact to ECG | 10 | 9 | 1 | 8 | 6 | 2 | 0.400 |
| (n=191) | ECG to STEMI alert | 13 | 11 | 2 | 7 | 5 | 2 | 0.198 |
| (32% Female) | Symptom onset to balloon | 319 | 226 | 93 | 149 | 133 | 16 | 0.091 |

American Heart Association | American Stroke Association
life is why

QCOR 2017 April 2-3 Arlington, Virginia

Richard Mullvain, Mallory Bosch, Nancy Hassinger, Samantha Kapphahn, Lynn Howard, Michael Mollerus; Female Gender Disparity Observed in STEMI System Time Performance Metrics Circulation: Cardiovascular Quality and Outcomes. 2017;10:A166

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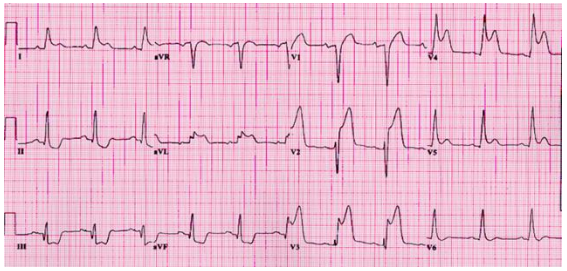
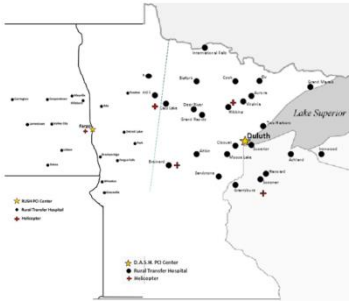
# ECG to Decision Time

## Small Delays Deciding to Transfer a STEMI Patient Adds Much Larger Delays to Reperfusion Time






**Richard Mullvain, RPH, BCPS (AQC), CCCC**
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**Ashlee Rostvedt, RN, BSN, CCCC**
Essentia Health – Fargo, North Dakota


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Mullvain, Rostvedt, ECG to Decision Time; Circ Cardiovasc Qual Outcomes. 2016;9:A147

# Background / Objectives:

***A goal of 10 minutes for Door-to-ECG time[1] for STEMI is a well known STEMI system metric that receives an enormous amount of attention...But little attention appears to be focused on the time then spent recognizing STEMI on a 12 Lead ECG, and deciding to transfer the patient for Primary PCI***

- Non-PCI capable facilities are faced with a time critical challenge to transfer a STEMI patient to a PCI capable hospital for Primary PCI within 120 minutes of first medical contact[1]
- Once a 12-Lead ECG is obtained and printed, a period of time elapses before STEMI is recognized, and a decision is made to transfer the patient for Primary PCI
  - It seems logical that the ECG-to-Decision time should not impact the subsequent Decision-to-PCI time
- We evaluated the impact of the time spent from ECG-to-Decision time on the subsequent Decision-to-PCI time

1 O'Gara, Patrick T, et al. "2013 ACCF/AHA guideline for the management of ST-Elevation Myocardial Infarction: A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines." Circulation. 2013;127:e362-e425.

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*It seems logical that the ECG-to-Decision time should not impact the subsequent Decision-to-PCI time…*

# Key Question:

***Once a 12-Lead ECG that is positive for STEMI is obtained in a non-PCI capable facility, does the amount of time subsequently spent recognizing the STEMI and deciding to activate the system to transfer the patient to a PCI capable hospital, have an impact on the time from that decision to the Primary PCI reperfusion time?***

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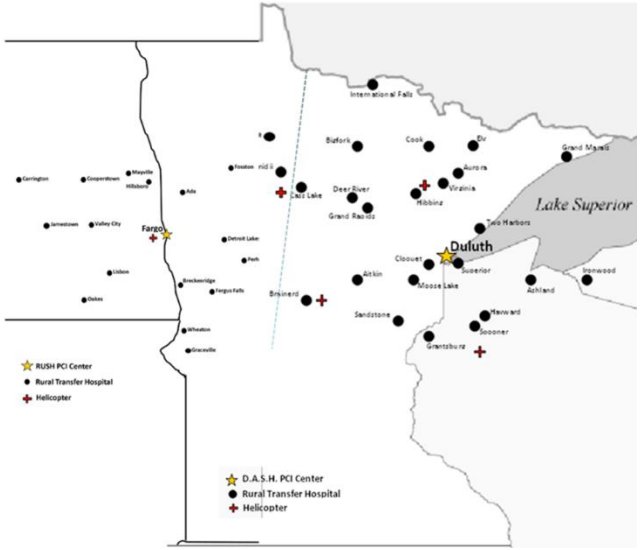
Mullvain, Rostvedt, ECG to Decision Time; Circ Cardiovasc Qual Outcomes. 2016;9:A147

# Methods:

- Data was combined, and retrospectively analyzed on 157 consecutive STEMI cases first identified at 32 non-PCI capable facilities, and transferred to one of two different PCI capable hospitals located in either Duluth, Minnesota, or Fargo, North Dakota
- There were 124 cases from September 2013 through February 2015 at one hospital, and 33 cases from May 2013 through February 2015 at the other
- Decision time was defined by the call time for inter-facility transport for Primary PCI, or the call time to the PCI capable hospital to request activation of the Cath Lab

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# Results:

| Referral Hospital (+) ECG to Decision Time in minutes | Median Decision to PCI time in minuetes | n = | Percentage of All 157 Transfers for PCI | Average Decision to PCI Time in minutes | Decision to PCI Range | Decision to PCI Standard Deviation |
|---|---|---|---|---|---|---|
| E2DEC | DEC2PCI | n = | % of Patients | DEC2PCI Avg. | Range | Standard Deviation |
| 0 - 4 min | 86 | 47 | 30 | 93 | (38 - 231) | 34.76 |
| 5 to 9 min | 103 | 47 | 30 | 102 | (46 - 158) | 23.36 |
| 10 min or more | 124 | 63 | 40 | 131 | (58 - 329) | 47.89 |

- For a 5-9 minute delay in ECG-to-Decision time, an additional **17 minute delay** was added to the median Decision-to-PCI time
- If the ECG-to-Decision time was delayed 10 minutes or more, an additional **38 minute delay** was added to the median Decision-to-PCI time

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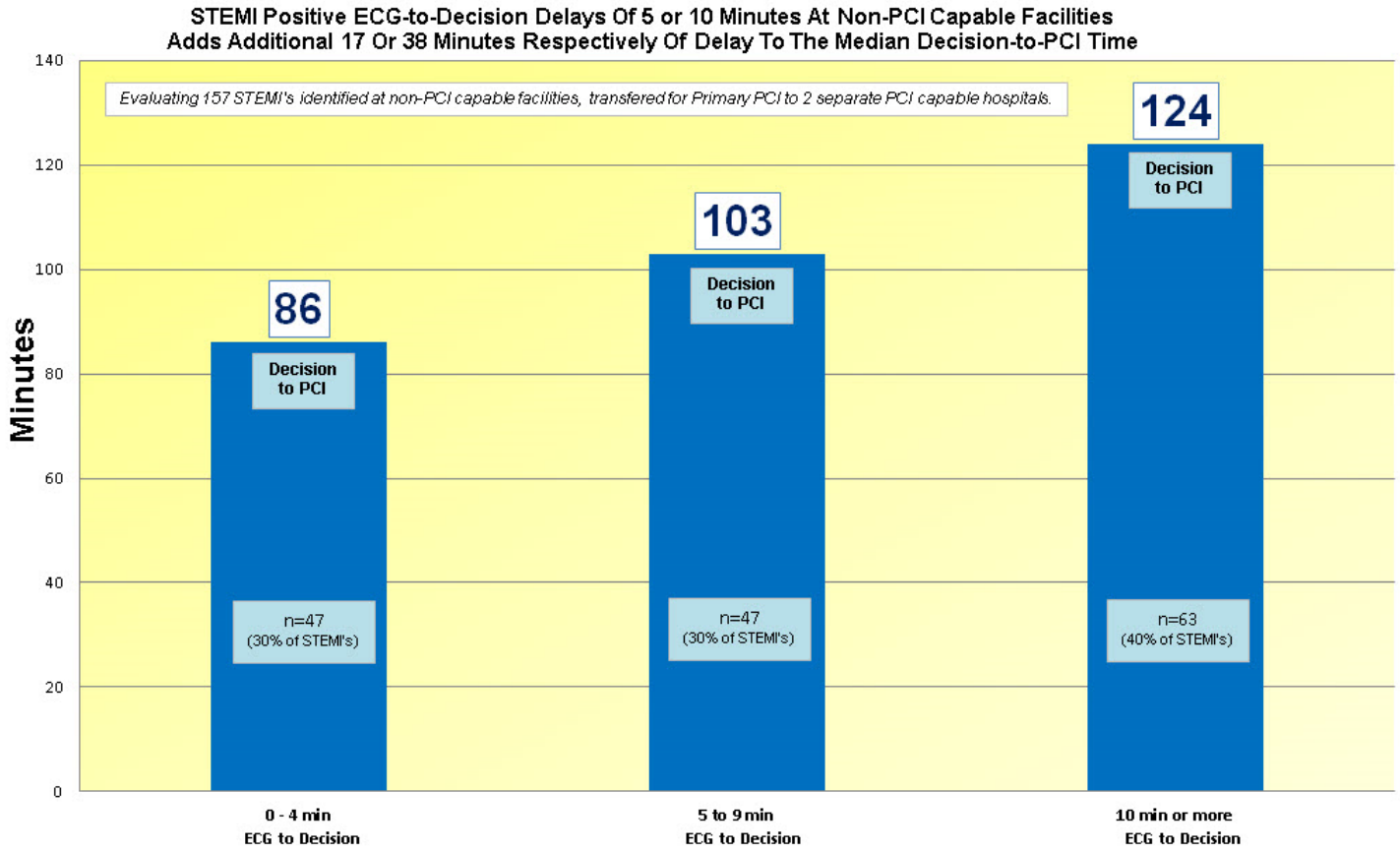
Mullvain, Rostvedt, ECG to Decision Time; Circ Cardiovasc Qual Outcomes. 2016;9:A147

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Mullvain, Rostvedt, ECG to Decision Time; Circ Cardiovasc Qual Outcomes. 2016;9:A147

# Conclusions:

- We observed an escalating impact of delay on Decision-to-PCI time as the result of smaller increases in delay of ECG-to-Decision time
- Our data suggests that a realistic goal for ECG-to-Decision time of under 5 minutes should be considered for non-PCI capable facilities, to avoid escalating delays in Primary PCI time for STEMI patients

***The results of this analysis draws attention to the potential importance of creating a new STEMI system performance metric of : ECG to decision time (E2D).***

***Further research is warranted.***

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Mullvain, Rostvedt, ECG to Decision Time; Circ Cardiovasc Qual Outcomes. 2016;9:A147

ORIGINAL ARTICLE

# ECG-to-Decision Time Impact on 30-Day Mortality and Reperfusion Times for STEMI Care

*Richard Mullvain, RPH, BCPS (AQC), CCCC,* Daniel M. Saman, DrPH,†*
*Ashlee Rostvedt, RN,‡ and Pauline Landgren, RN**


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Mullvain R, Saman D, Rostvedt A, et al. ECG-to-Decision Time Impact on 30-Day Mortality and Reperfusion Times for STEMI Care. Critical Pathways in Cardiology. 2018;17:19-24.
doi: 10.1097/HPC.0000000000000130

# Objectives:

- Little data are published on the unique care performance metric of electrocardiogram-to-decision time (E2Decide) for primary percutaneous coronary intervention (PCI) treatment of ST-elevation myocardial infarction (STEMI)
- The objective of this study is to evaluate E2Decide time on mortality and delayed reperfusion

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Mullvain R, Saman D, Rostvedt A, et al. ECG-to-Decision Time Impact on 30-Day Mortality and Reperfusion Times for STEMI Care. Critical Pathways in Cardiology. 2018;17:19-24.
doi: 10.1097/HPC.0000000000000130

# Methods:

- This was a retrospective study of STEMI activations treated with primary PCI at 2 PCI-capable hospitals located in Duluth, Minnesota, and Fargo, North Dakota, originating in 3 different settings:
  - (1) primary PCI- capable hospital emergency departments
  - (2) non-PCI facilities
  - (3) in the field by emergency medical services

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Mullvain R, Saman D, Rostvedt A, et al. ECG-to-Decision Time Impact on 30-Day Mortality and Reperfusion Times for STEMI Care. Critical Pathways in Cardiology. 2018;17:19-24.
doi: 10.1097/HPC.0000000000000130

# Results:

- There were 289 (96 females) STEMI patients included in our analyses
- Non- significant differences were observed in E2Decide time between male and female patients (9.7 vs. 11.1 min, respectively)
- Generalized linear modeling revealed that only non-PCI facilities significantly affected E2Decide time [β = 6.29; P = 0.007; 95% confidence interval (CI), 1.7–10.9] relative to PCI-capable hospitals

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Mullvain R, Saman D, Rostvedt A, et al. ECG-to-Decision Time Impact on 30-Day Mortality and Reperfusion Times for STEMI Care. Critical Pathways in Cardiology. 2018;17:19-24.
doi: 10.1097/HPC.0000000000000130

# Results (cont.)

- We found that E2Decide time was significantly associated with the metric decision-to-PCI, and that for every additional E2Decide minute, the decision-to-PCI increased by another 1.21 minutes
  - ($P < 0.001$)

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Mullvain R, Saman D, Rostvedt A, et al. ECG-to-Decision Time Impact on 30-Day Mortality and Reperfusion Times for STEMI Care. Critical Pathways in Cardiology. 2018;17:19-24.
doi: 10.1097/HPC.0000000000000130

# Results (cont.)

- We also found a 20.3% increased odds of 30-day mortality for every 5-minute increase in E2Decide time
  - (estimated odds ratio = 1.20; 95% CI, 1.04–1.38)

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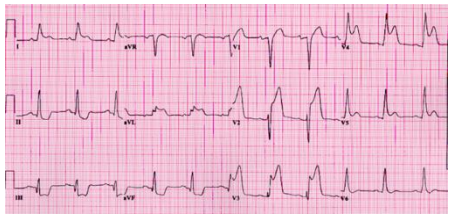
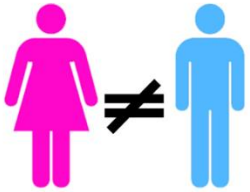
Mullvain R, Saman D, Rostvedt A, et al. ECG-to-Decision Time Impact on 30-Day Mortality and Reperfusion Times for STEMI Care. Critical Pathways in Cardiology. 2018;17:19-24.
doi: 10.1097/HPC.0000000000000130

# Impact of ECG-to-Decision Time, Age and Sex Differences on False Positive STEMI Diagnosis Rates in a Large Rural Healthcare Center



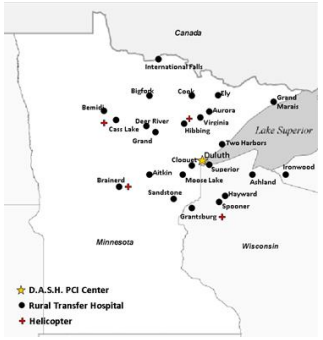



**Richard Mullvain, RPH, BCPS (AQC), CCCC**

**Daniel M. Saman, DrPH**

**Catherine Benziger, MD, MPH, FACC**

**Essentia Health Heart & Vascular Center – Duluth, Minnesota**



QCOR 2018 Scientific Sessions

Quality of Care and Outcomes Research Scientific Sessions

April 6–7, 2018

*Ritz-Carlton Pentagon City | Arlington, Va.*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Mullvain, et al.. Impact of ECG-to-Decision Time, Age and Sex Differences on False Positive STEMI Diagnosis Rates in a Large Rural Healthcare Center; Circulation: Cardiovascular Quality and Outcomes. 2018; 11:A250.

# Background / Objectives:

A false positive diagnosis of STEMI may lead to unnecessary treatments, increased risks and costs.[1,2]
Little data is published on the unique care performance metric of: Electrocardiogram-to-Decision time (E2Decide) for the diagnosis of STEMI.[3]

**E2Decide Time:**
**The interval of time from when a 12-Lead ECG which is positive for STEMI is printed, to the time when STEMI is recognized and a decision is made to activate STEMI Alert or transport for Primary PCI .**

The objective of this quality improvement analysis was to determine the association between E2Decide time, age and sex differences on false positive diagnosis rates for STEMI.

**The 2016 AHA Statement on Acute Myocardial Infarction in Women[4] :**
**…reports a need for more data on gender / sex differences in STEMI care.**
**In response, we seek to add to the body of information on this subject by sharing specific data from our Midwest Rural STEMI system of care.**


1. McCabe et al. Prevalence and Factors Associated With False-Positive ST-Segment Elevation Myocardial Infarction Diagnoses at Primary Percutaneous Coronary Intervention–Capable Centers. A Report From the Activate-SF Registry. *Arch Intern Med*. 2012;172(11):864-871.
2. Bachour F, Asinger R Damage of Improving Door-to-Balloon Time Comment on "Prevalence and Factors Associated With False-Positive ST-Segment Elevation Myocardial Infarction Diagnoses at Primary Percutaneous Coronary Intervention–Capable Centers". *Arch Intern Med*. 2012;172(11):871.
3. Mullvain R, Saman D, Rosfvedt A, et al. ECG-to-Decision Time Impact on 30-Day Mortality and Reperfusion Times for STEMI Care. *Critical Pathways in Cardiology*. 2018;17:19-24.
4. Mehta, Laxmi S, et al. Acute Myocardial Infarction in Women: A Scientific Statement From the American Heart Association." *Circulation*. Feb. 7th, 2016; Vol. 135, Issue 6.


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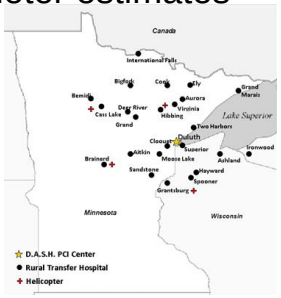
Mullvain, et al.. Impact of ECG-to-Decision Time, Age and Sex Differences on False Positive STEMI Diagnosis Rates in a Large Rural Healthcare Center; Circulation: Cardiovascular Quality and Outcomes. 2018; 11:A250.

# Methods:

- A retrospective analysis was conducted of 1278 consecutive STEMI diagnoses treated at a rural tertiary care hospital, located in Duluth, Minnesota, USA, between May 2013 to December 2017, originating from 4 different settings:
  - (1) non-PCI facilities
  - (2) in the field by emergency medical services
  - (3) tertiary hospital emergency department
  - (4) tertiary hospital inpatient
- A false positive STEMI diagnosis was defined as no culprit lesion or multi-vessel disease found during angiography, or if the cardiologist rejected the initial diagnosis of STEMI and cancelled angiography
- Multivariate logistic regression modeling was used for parameter estimates

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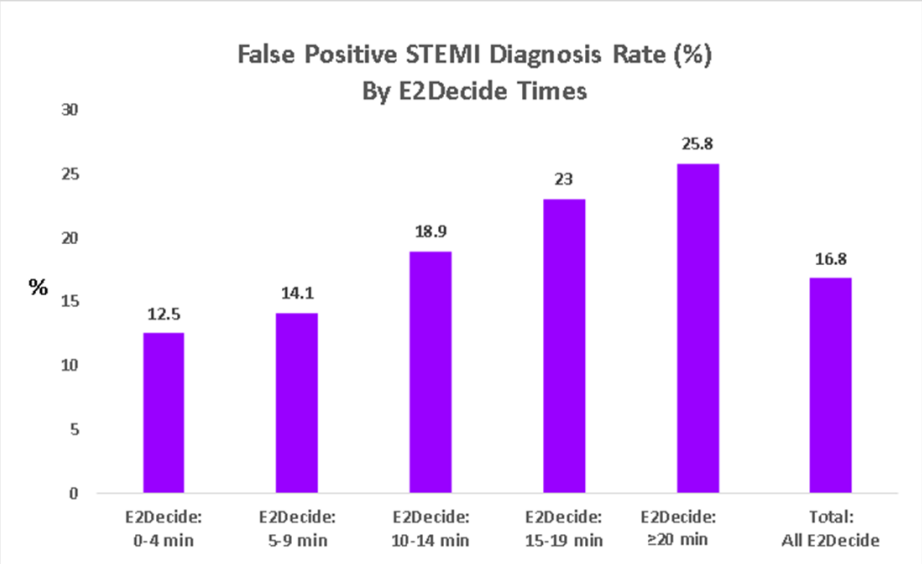
Mullvain, et al.. Impact of ECG-to-Decision Time, Age and Sex Differences on False Positive STEMI Diagnosis Rates in a Large Rural Healthcare Center; Circulation: Cardiovascular Quality and Outcomes. 2018; 11:A250.

# Results:

There were 1278 consecutive STEMI diagnoses in our analysis
429 (33.6%) were female
A total of 215 (16.8%) were false positive

E2Decide time was positively associated with an increase in odds of a false positive STEMI Diagnosis (OR 1.007; 95% CI: 1.001-1.012)

For every 5 minutes of increase in E2Decide time,
there was a 3.6% increase in the odds of a false positive STEMI diagnosis

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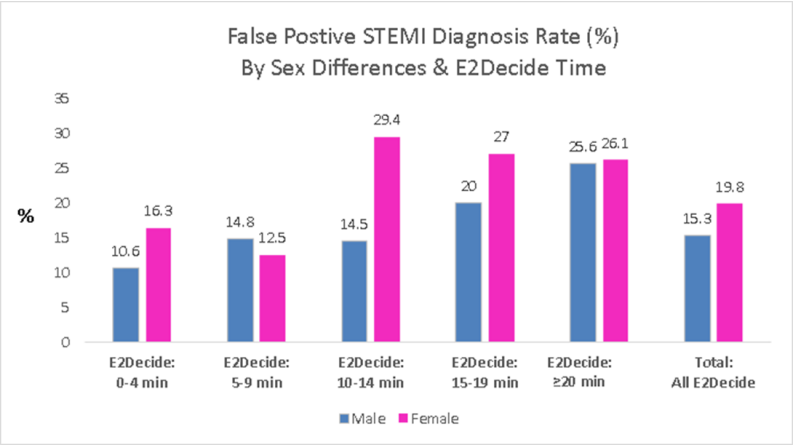
Mullvain, et al.. Impact of ECG-to-Decision Time, Age and Sex Differences on False Positive STEMI Diagnosis Rates in a Large Rural Healthcare Center; Circulation: Cardiovascular Quality and Outcomes. 2018; 11:A250.

# Results:

**Females had a 45.2% increased odds of a false positive STEMI diagnosis compared to males [estimated odds ratio (OR) 1.452 (95% CI: 1.062- 1.984)]**

| Impact of Sex Differences and ECG-to-Decision Time (E2Decide) on False Positive STEMI Diagnosis Rate (%) | | | | | | |
|---|---|---|---|---|---|---|
| Sex | E2Decide: 0-4 min | E2Decide: 5-9 min | E2Decide: 10-14 min | E2Decide: 15-19 min | E2Decide: ≥ 20 min | Total: All E2Decide |
| Male | 10.6% (n = 31 of 292) | 14.8% (n = 37 of 250) | 14.5% (n = 18 of 124) | 20.0% (n = 10 of 50) | 25.6% (n = 34 of 133) | 15.3% (n = 130 of 849) |
| Female | 16.3% (n = 23 of 141) | 12.5% (n = 14 of 112) | 29.4% (n = 15 of 51) | 27.0% (n = 10 of 37) | 26.1% (n = 23 of 88) | 19.8% (n = 85 of 29) |
| All | 12.5% (n = 54 of 433) | 14.1% (n = 51 of 362) | 18.9% (n = 33 of 175) | 23.0% (n = 20 of 87) | 25.8% (n = 57 of 221) | 16.8% (n = 215 of 1278) |

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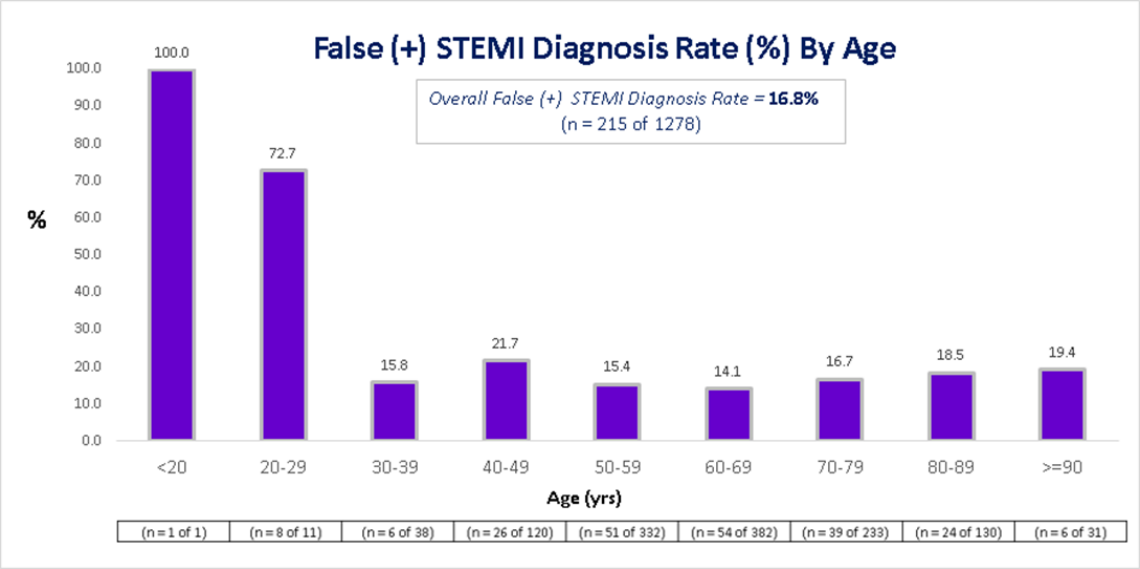
Mullvain, et al.. Impact of ECG-to-Decision Time, Age and Sex Differences on False Positive STEMI Diagnosis Rates in a Large Rural Healthcare Center; Circulation: Cardiovascular Quality and Outcomes. 2018; 11:A250.

# Results:

**Patients under age 30 had the highest false positive STEMI diagnosis rate: 75% (n = 9 of 12)**




| Age (yrs) | False (+) n | Total n | False (+) Rate (%) |
|---|---|---|---|
| <20 | 1 | 1 | 100.0 |
| 20-29 | 8 | 11 | 72.7 |
| 30-39 | 6 | 38 | 15.8 |
| 40-49 | 26 | 120 | 21.7 |
| 50-59 | 51 | 332 | 15.4 |
| 60-69 | 54 | 382 | 14.1 |
| 70-79 | 39 | 233 | 16.7 |
| 80-89 | 24 | 130 | 18.5 |
| >=90 | 6 | 31 | 19.4 |
| Total: | 215 | 1278 | 16.8 |

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Mullvain, et al.. Impact of ECG-to-Decision Time, Age and Sex Differences on False Positive STEMI Diagnosis Rates in a Large Rural Healthcare Center; Circulation: Cardiovascular Quality and Outcomes. 2018; 11:A250.

# Conclusions:

**Longer E2Decide times were significantly associated with higher false positive STEMI diagnosis rates**

**Younger patients appear more likely to receive a false positive STEMI diagnosis**

**We observed significantly higher false positive STEMI diagnosis rates with females**

**In addition to demonstrating the impact of age and sex differences on false positive STEMI diagnosis rates, this analysis demonstrates the potential value of the metric E2Decide time**

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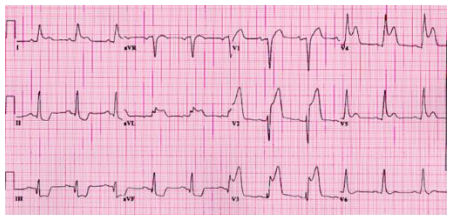
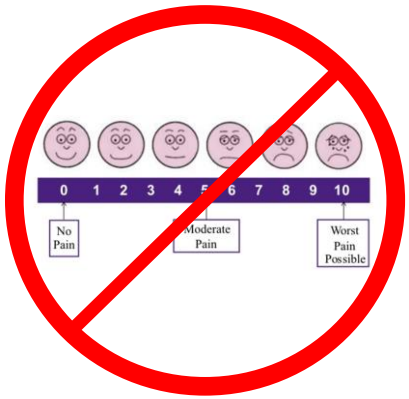
Mullvain, et al.. Impact of ECG-to-Decision Time, Age and Sex Differences on False Positive STEMI Diagnosis Rates in a Large Rural Healthcare Center; Circulation: Cardiovascular Quality and Outcomes. 2018; 11:A250.

American Heart Association. SCIENTIFIC SESSIONS 2018
November 10-12, Chicago, IL

# Enough Already with Chest Pain Severity Ratings to Confirm a ST-Elevation Myocardial Infarction Diagnosis in Males or Females






**Richard Mullvain, RPH, BCPS (AQC), CCCC**

**Catherine Benziger, MD, MPH, FACC**

**Daniel M. Saman, DrPH**

**Essentia Health Heart & Vascular Center – Duluth, Minnesota**

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Mullvain R, Benziger C, Saman D; Enough already with chest pain severity ratings to confirm a STEMI diagnosis in males or females.
November 6, 2018 – Circulation Volume 138, Issue Suppl 1.

# Background / Objectives:

A positive 12-Lead electrocardiogram is required to diagnose ST segment elevation myocardial infarction (STEMI)

But the diagnosis also requires characteristic symptoms of myocardial ischemia[1], often including a chest pain severity rating on a scale of 0-10

Previous appropriate use criteria guidelines for coronary revascularization[2] emphasizing symptom severity may still have some influence on providers deciding to proceed with invasive angiography with intended primary percutaneous coronary intervention?

**Hypothesis:** A higher chest pain rating upon arrival to the STEMI receiving hospital does not correlate with a higher likelihood that a STEMI diagnosis is correct.

1. O'Gara, Patrick T, et al. "2013 ACCF/AHA guideline for the management of ST-Elevation Myocardial Infarction: A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines." Circulation. 2013;127:e362e425.
2. Patel MR, et al. 2012 JAACCF/SCAI/STS/AATS/AHA/ASNC/HFSA/SCCT Appropriate use criteria for coronary revascularization focused update. J Am Coll Cardiol. 2012 Feb 28; 59(9):857-81.

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Mullvain R, Benziger C, Saman D; Enough already with chest pain severity ratings to confirm a STEMI diagnosis in males or females.
November 6, 2018 – Circulation Volume 138, Issue Suppl 1.

# Methods:

We analyzed 1,261 out of 1,402 consecutive STEMI activations for intended Primary Percutaneous Coronary Intervention, over a period of 5 years (May 2013-April 2018), presenting to or after transferring to a STEMI receiving hospital (Essentia Health, Duluth, MN, USA) serving a large rural area.

Exclusions include: patients receiving fibrinolysis (n=117), those with no chest pain rating recorded upon arrival (n=134), those refusing to consent to angiography (n=3), unsure if false positive (n=7), or if they died prior to angiography.

Chest pain rating was recorded upon arrival on a scale from 0 to 10.

We divided these into 4 groups:

0 (no pain), 1-3 (mild), 4-6 (moderate), 7-10 (severe).

A false positive diagnosis was defined by no culprit lesion found during invasive angiography.


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# Results:

Of the 1261 STEMI activations (33.8% female) included in this analysis, 1056 (83.7%) were true positive for STEMI

- Of the true positive-STEMI's, the chest pain rating averaged 3.5 (SD 3.25)
- The false positive STEMI's had a chest pain rating average of 2.1 (SD 3.0)

For true positive STEMI's, 29.5% reported no pain (0), 25.9% reported mild pain (1-3), 22.4% reported moderate pain (4-6), and 22.1% reported severe pain (7-10)

**A total of 54.6% of false positive STEMI's had no chest pain (0)**

For no chest pain (0) compared to any reported level of chest pain for true positive STEMI's, there were statistically significant differences ($p<0.001$)

- However, there was no difference between mild to severe chest pain rating between true positive and false positive STEMI's

Females experienced a higher proportion of false positive STEMI's (females 18.4% versus males 9.0%; $p<0.05$) only when the chest pain rating was 1-3 (mild)

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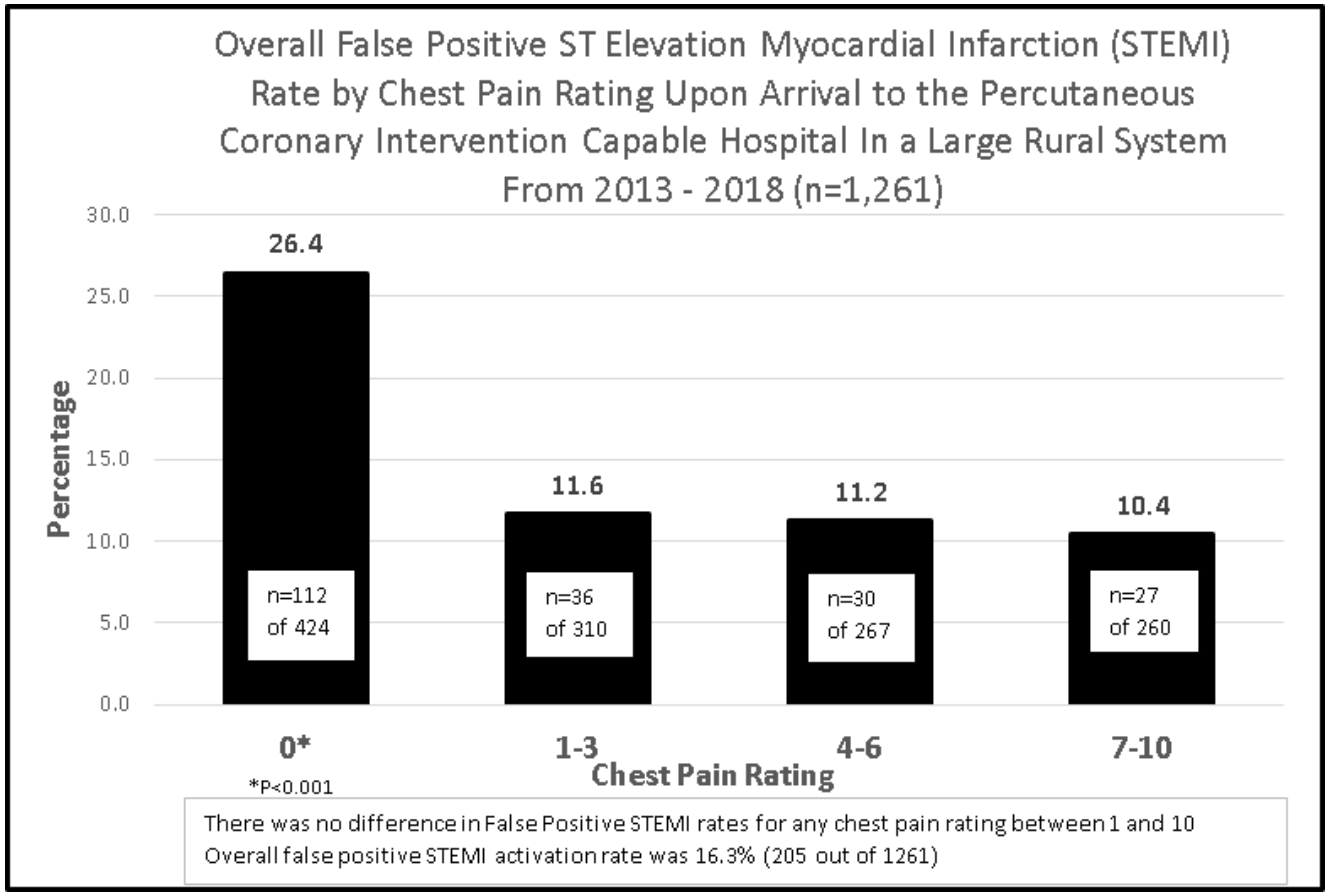
Mullvain R, Benziger C, Saman D; Enough already with chest pain severity ratings to confirm a STEMI diagnosis in males or females.
November 6, 2018 – Circulation Volume 138, Issue Suppl_1.

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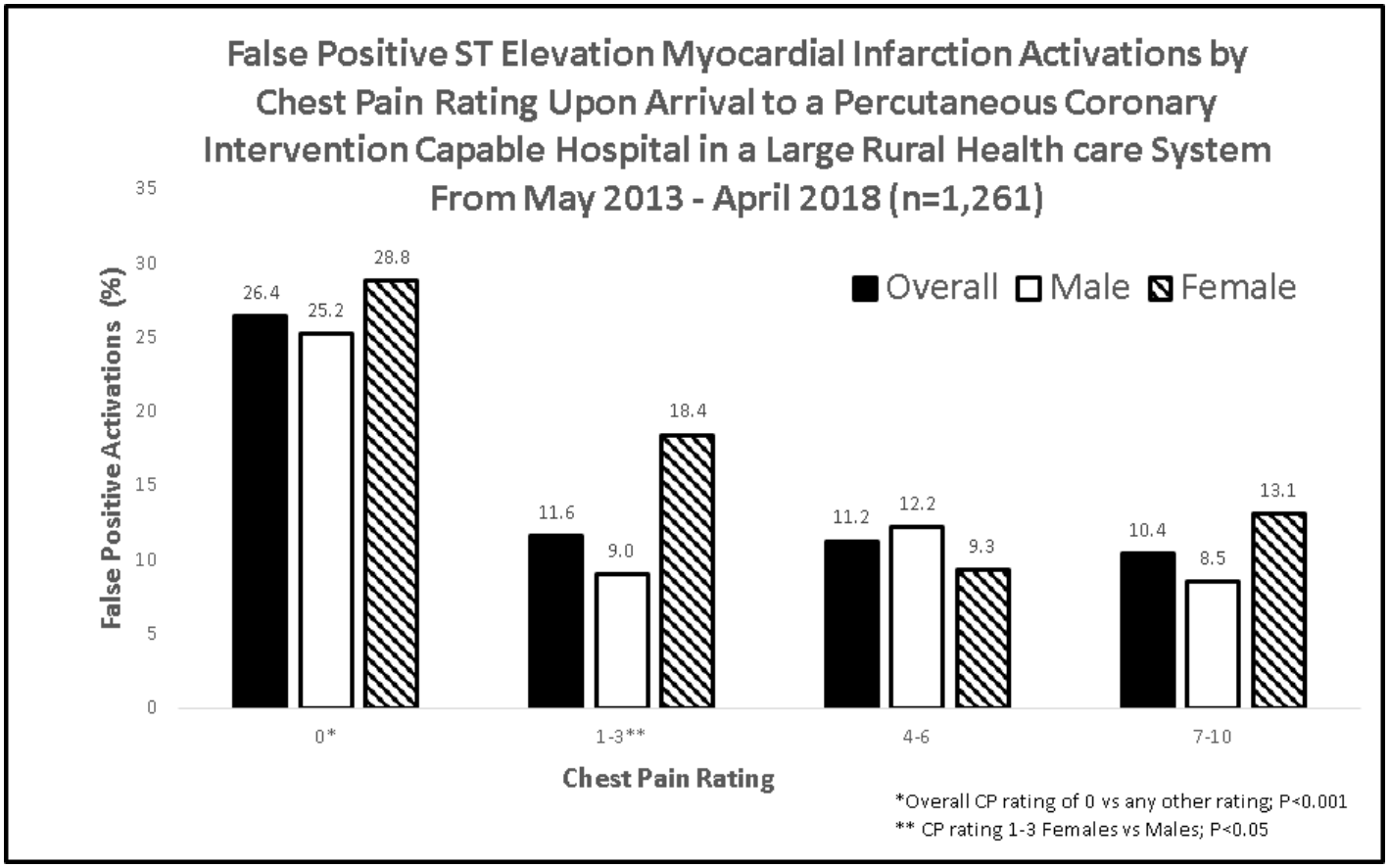
Mullvain R, Benziger C, Saman D; Enough already with chest pain severity ratings to confirm a STEMI diagnosis in males or females. November 6, 2018 – Circulation Volume 138, Issue Suppl_1.

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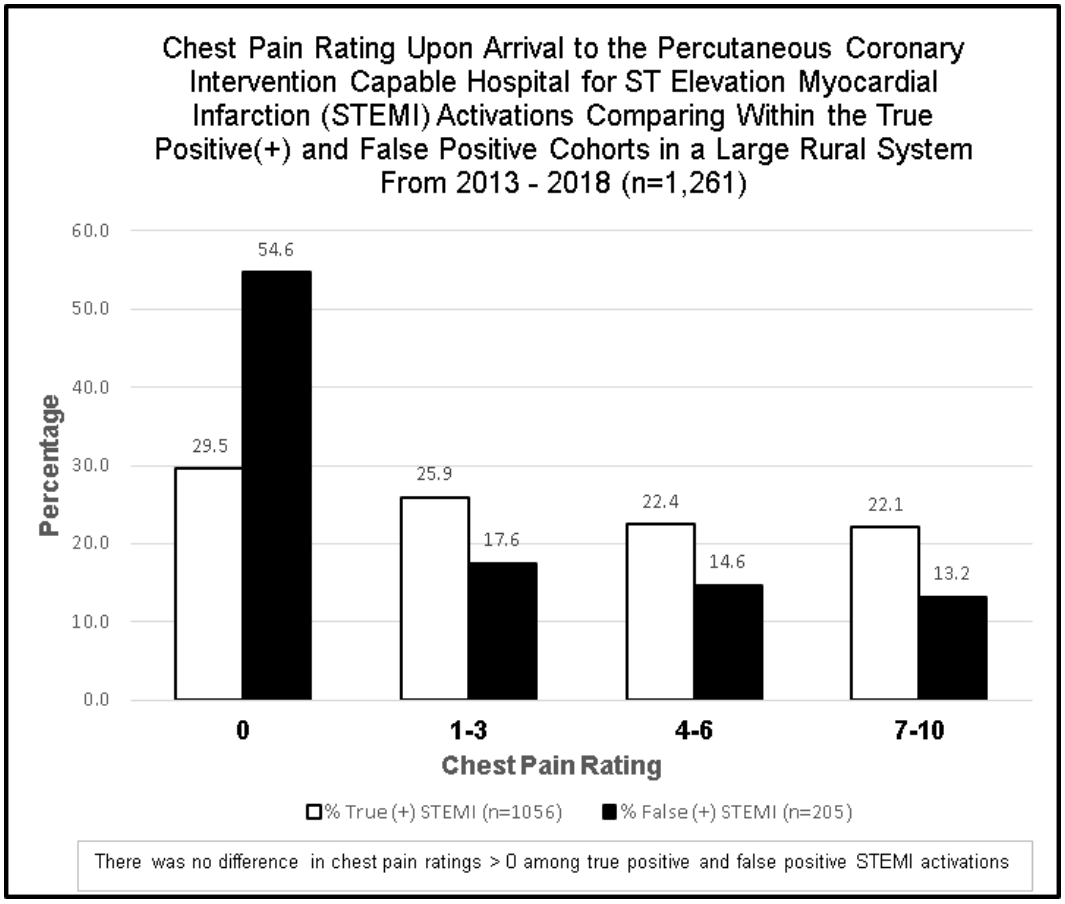


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Mullvain R, Benziger C, Saman D; Enough already with chest pain severity ratings to confirm a STEMI diagnosis in males or females.
November 6, 2018 – Circulation Volume 138, Issue Suppl_1.

# Conclusions:

A chest pain rating of 0 upon arrival to the tertiary care hospital increases the likelihood of a false positive STEMI diagnosis

Females are more likely than males to have a false positive STEMI diagnosis only when the chest pain rating is mild

Increased severity of pain is a poor predictor of a true positive STEMI diagnosis for both males and females

Presence or absence of chest pain rather than severity rating appears to be the important factor

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Mullvain R, Benziger C, Saman D; Enough already with chest pain severity ratings to confirm a STEMI diagnosis in males or females.
November 6, 2018 – Circulation Volume 138, Issue Suppl_1.

# Temporal trends and long-term outcomes of elderly patients with ST-elevation myocardial infarction in a large rural healthcare system

Authors:
Catherine Benziger MD MPH, Patrick Moran BS; Rakin Solaiman BS; Ronald Regal PhD; Paul Hitz MSHI; Wilson Ginete MD; Krysta Kaas MBA; Richard Mullvain RPH BCPS (AQC) CCCC
Essentia Health – Duluth, Minnesota, USA

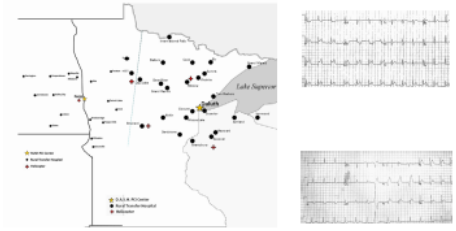
American Heart Association.
Epidemiology and Prevention / Cardiometabolic Health - 2019 Scientific Sessions
March 5-8, 2019 – Houston, TX

## Background / Objectives

Limited data about long-term survival in elderly patients after ST-elevation myocardial infarction (STEMI) exists for patients in rural settings. We aimed to evaluate temporal trends in lytic use compared to primary percutaneous coronary intervention (PPCI) in elderly patients after the American Heart Association's Mission: Lifeline program was implemented.

## Methods

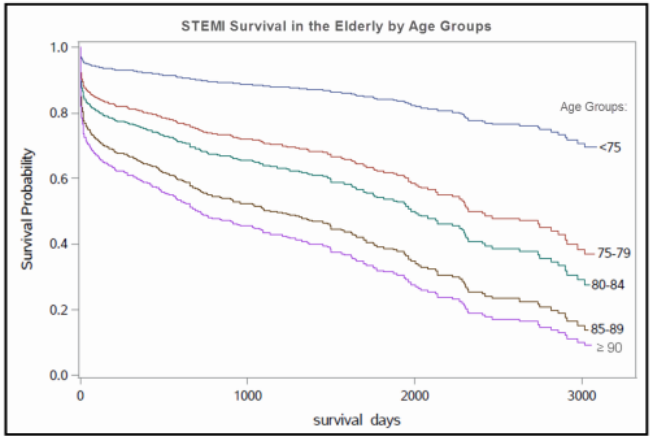
Retrospective cohort included patients aged >=75 years with STEMI presenting to 2 PCI-capable hospitals (Essentia Health in Duluth, MN and Fargo, ND) between 5/2009 to 12/2017. Cox regression was used for survival analysis and logistic regression for 30-day and 1-year mortality and 30-day readmission. Results were adjusted for age and gender.





## Results

A total of 358 elderly patients with true STEMI were included (51.1% female, mean age 82.2 years, 61.5% rural). The percentage of elderly patients who received lytics decreased from 20.3% in 2009-2010 to 4.8% in 2016-2017. Median first medical contact (FMC) to device time was 128 min (IQR 84-169) and median positive ECG to device time was 107 min (IQR 78-140). FMC to Device <120 min. was 44.3%; ECG to device <120 min. was 61.6%. There was no difference in survival between lytic and PPCI (HR:1.11, 95%CI:0.67-1.86, p=0.68). Mortality was not significantly different between the recent cohort (2016-2017) compared to early cohort (2009-2010) (p=0.16, HR 1.43 (0.86-2.30).




## Conclusions

Long-term mortality remains high among elderly patients with STEMI, even among revascularized patients. Prognosis has not significantly changed over the past 8 years despite system changes in treatment strategy.

***The results of this analysis support a guideline based[1] mixed strategy in rural areas for elderly STEMI patients of either urgent transfer for Primary PCI, or fibrinolytic therapy when appropriate.***

***…Further research appears warranted.***

## Author Information

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E-mail: Catherine.Benziger@essentiahealth.org

## References

1. O'Gara, Patrick T, et al. "2013 ACCF/AHA guideline for the management of ST-Elevation Myocardial Infarction: A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines." Circulation. 2013;127:e362-e425.

Disclosures: No relative financial conflicts exist for any authors

AHA EPI | Lifestyle 2019 Scientific Sessions

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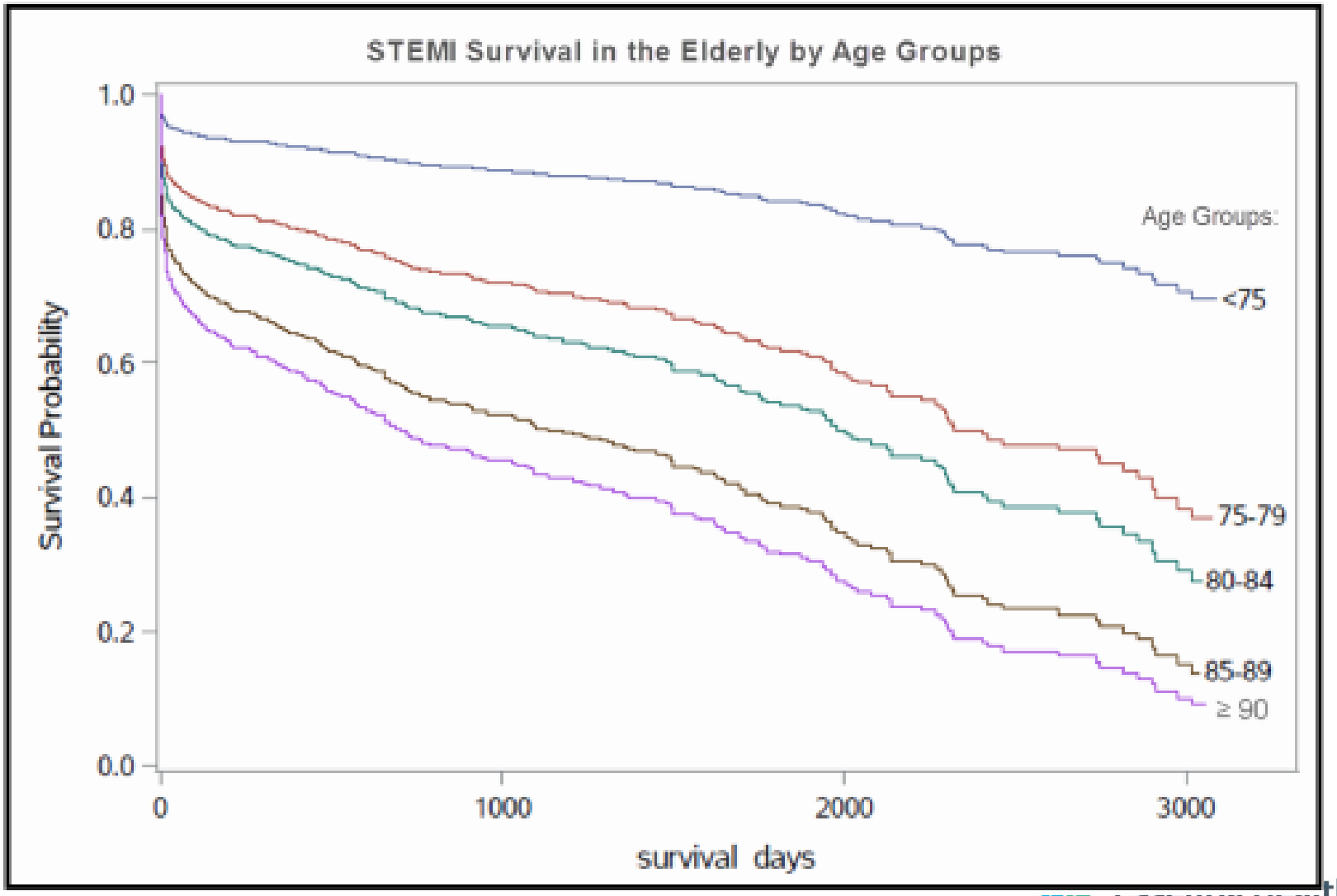
Benziger C, Mullvain R. et al; Temporal trends and long-term outcomes of elderly patients with ST-elevation myocardial infarction in a large rural healthcare system. Circulation. 2019;139:AP211

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Benziger C, Mullvain R. et al; Temporal trends and long-term outcomes of elderly patients with ST-elevation myocardial infarction in a large rural healthcare system. Circulation. 2019;139:AP211

# Long-Term Outcomes Following ST-Elevation Myocardial Infraction After Reducing Fibrinolytic Use in a Rural Cohort

Authors:
Catherine Benziger MD MPH, Patrick Moran BS; Rakin Solaiman BS; Ronald Regal PhD; Paul Hitz MSHI;
Wilson Ginete MD; Krysta Kaas MBA; Richard Mullvain RPH BCPS (AQC) CCCC
Essentia Health – Duluth, Minnesota, USA

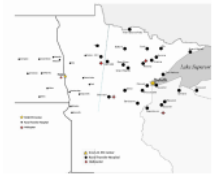
American Heart Association
Epidemiology and Prevention / Cardiometabolic Health - 2019 Scientific Sessions
March 5-8, 2019 – Houston, TX

## Background / Objectives

ST-elevation myocardial infarction (STEMI) guidelines recommend Fibrinolytic therapy if the patient is unable to receive primary percutaneous coronary intervention (PPCI) within 120 minutes from first medical contact (FMC)[1].
Sparse data exists from rural areas, so we aimed to evaluate outcomes in a rural population after implementing an inter-facility transfer protocol and an Emergency Medical Services (EMS) STEMI protocol in a large rural STEMI system.

## Methods

Retrospective chart review of NCDR ACTION and internal STEMI registries presenting to our two PCI-capable hospitals (Essentia Health in Duluth, MN and Fargo, ND) between 5/2009-12/2017.
Only patients with rural rural-urban commuting area (RUCA) codes were included.
Analysis included using standard STEMI metrics with Cox regression and Kaplan-Meier survival curves for survival analysis, and logistic regression for 30-day and 1-year mortality and 30-day readmission. Results were adjusted for age and sex.



## Results

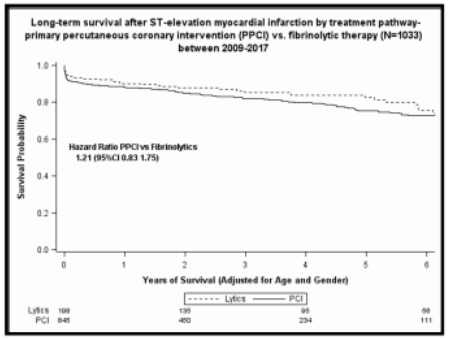
There were 1229 STEMI activations with 1033 true STEMI events (28.3% female, mean age 63.6 years).

Among true STEMIs, 73.3% presented to a non-PCI capable hospital and were transferred to PCI-capable hospital. (Only 9.9% were field activated and transported directly to PCI-capable hospital.)

First Medical Contact to device time was <120 min. 33.2% of the time with a median FMC to device time of 135 min. (IQR 111-174 min.).

Positive ECG to device time was <120 min. 53.9% of the time with a median ECG to device time of 116 min. (IQR 99-144 min).

Lytic use decreased over time from 30.2% in 2009-10 to 6.8% in 2016-17.




**Survival was not different comparing PPCI vs. lytic therapy (hazard ratio 1.21; 95% CI: 0.83, 1.75, p=0.32).**

**For PPCI, 30-day and 1-year mortality were 8.6% (CI:6.8%-10.4%) and 12.8% (CI:10.6%-15.0%), respectively, while for lytics, 30-day and 1-year mortality were 7.2% (CI:4.6%-9.8%) and 10.8% (CI:7.1%-14.3%), respectively.**

**The 30-day readmission for PPCI was not significantly different compared to lytics (7.6%, CI:6.7%-8.7% for PPCI vs. 12.0% CI:9.8%-14.6% for lytic, p=0.056).**

## Conclusions

**Primary PCI in rural areas was associated with similar outcomes compared to fibrinolytic therapy for STEMI patients.**

***The results of this analysis support urgent transfer for Primary PCI in rural areas***

***…Further research appears warranted.***

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## References

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Disclosures: No relative financial conflicts exist for any authors



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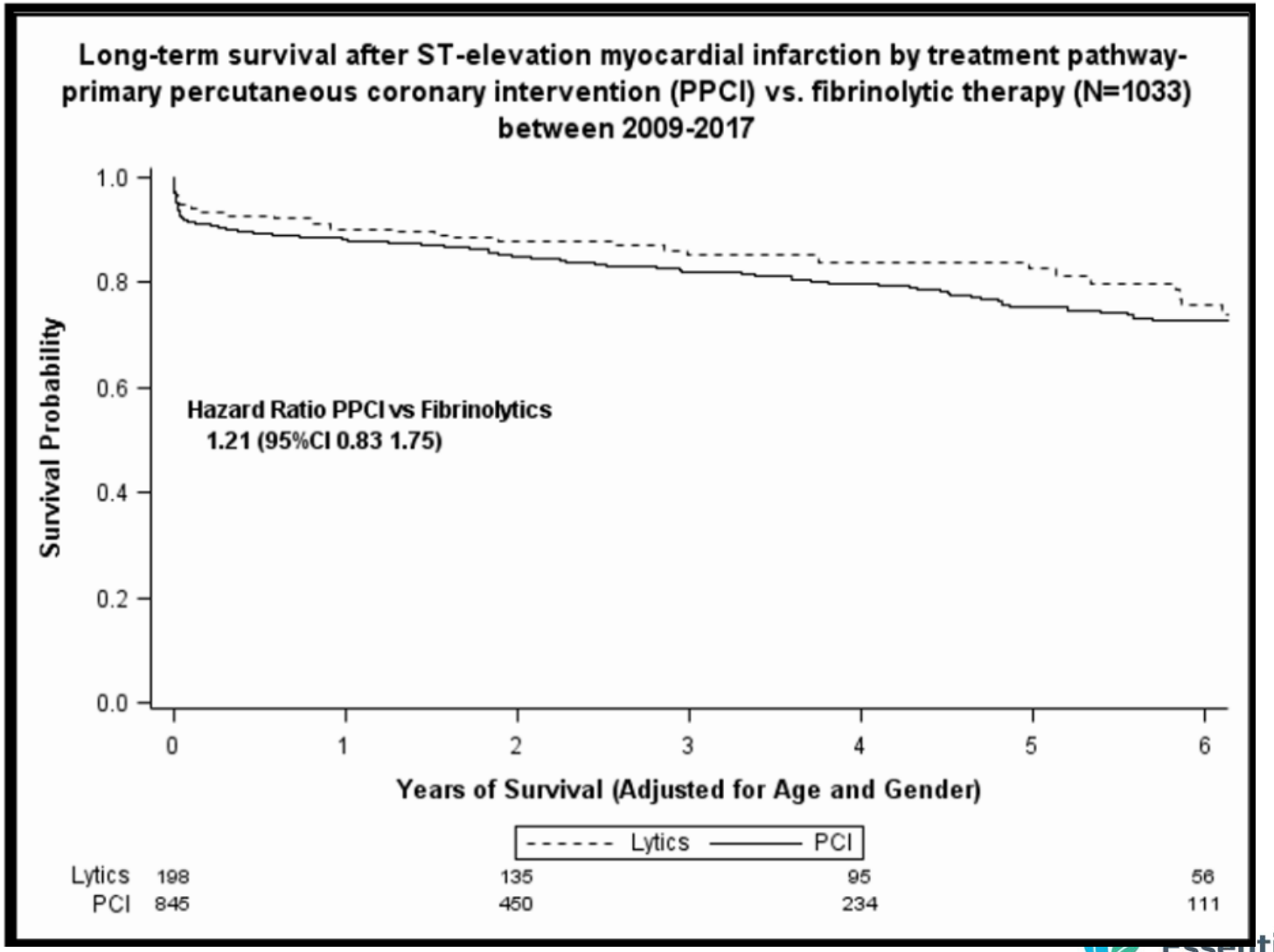
Benziger, Mullvain et al; Long-Term Outcomes Following ST-Elevation Myocardial Infraction After Reducing Fibrinolytic Use in a Rural Cohort; Circulation. 2019;139:AP210

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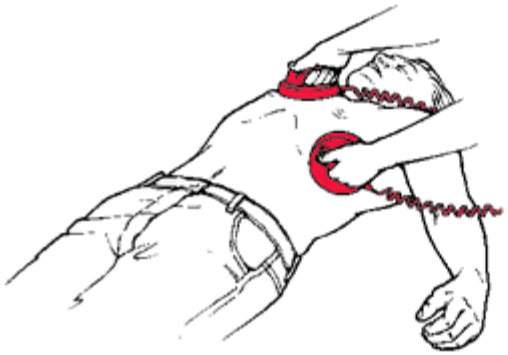
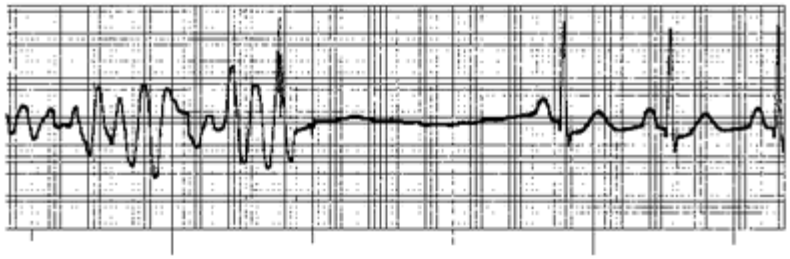
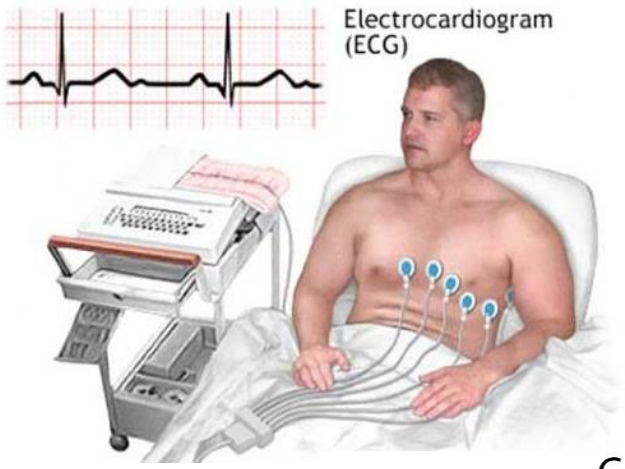
Benziger, Mullvain et al; Long-Term Outcomes Following ST-Elevation Myocardial Infraction After Reducing Fibrinolytic Use in a Rural Cohort; Circulation. 2019;139:AP210

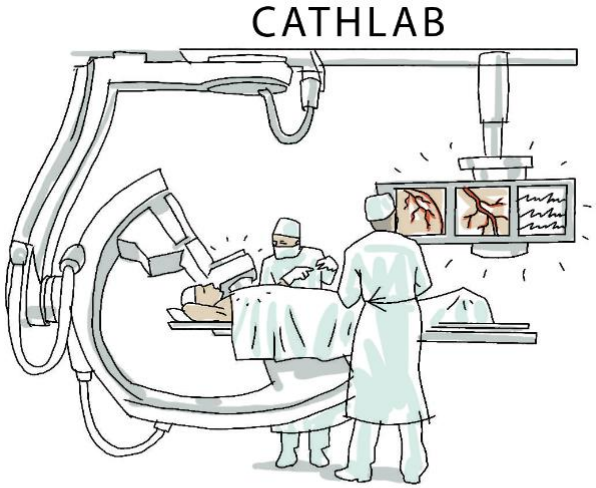
# Case Review from the Northern Border…

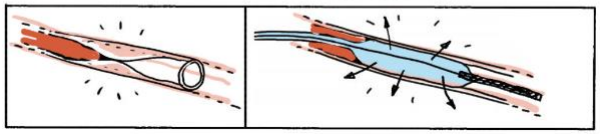










# 69 yo Male With Chest Pain After Chopping Ice & Moving Rocks to Install a Crib Dock…

# 69 yo Male with Chest Pain

- Father had MI at age 36 & passed away at age 45
- History of CABG 23 years ago, at age 46
- COPD
  - Triggered by chemical sensitivity to isocyanate
- Had chest “squeezing / pressure” onset at 4 pm on a Sunday afternoon in late winter while cutting and moving ice and rocks while working on a crib dock

- Was being helped by his neighbor, who happened to be a physician

# Took Nitroglycerin SL tablets

- Offered some relief, but not complete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# Wife is a Registered Nurse

- Extensive hospital nursing career including critical care and cardiac floors
- Helped him move about 100 yards back to the house
  - Gave more nitroglycerin tablets

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# …Should We Call 911 ???

- Wife did not hesitate to call 911
  - She worried how long it would take to get help
    - Was then surprised how fast help arrived

- Neighbor/physician also encouraged the 911 call
  - And stuck around for support!

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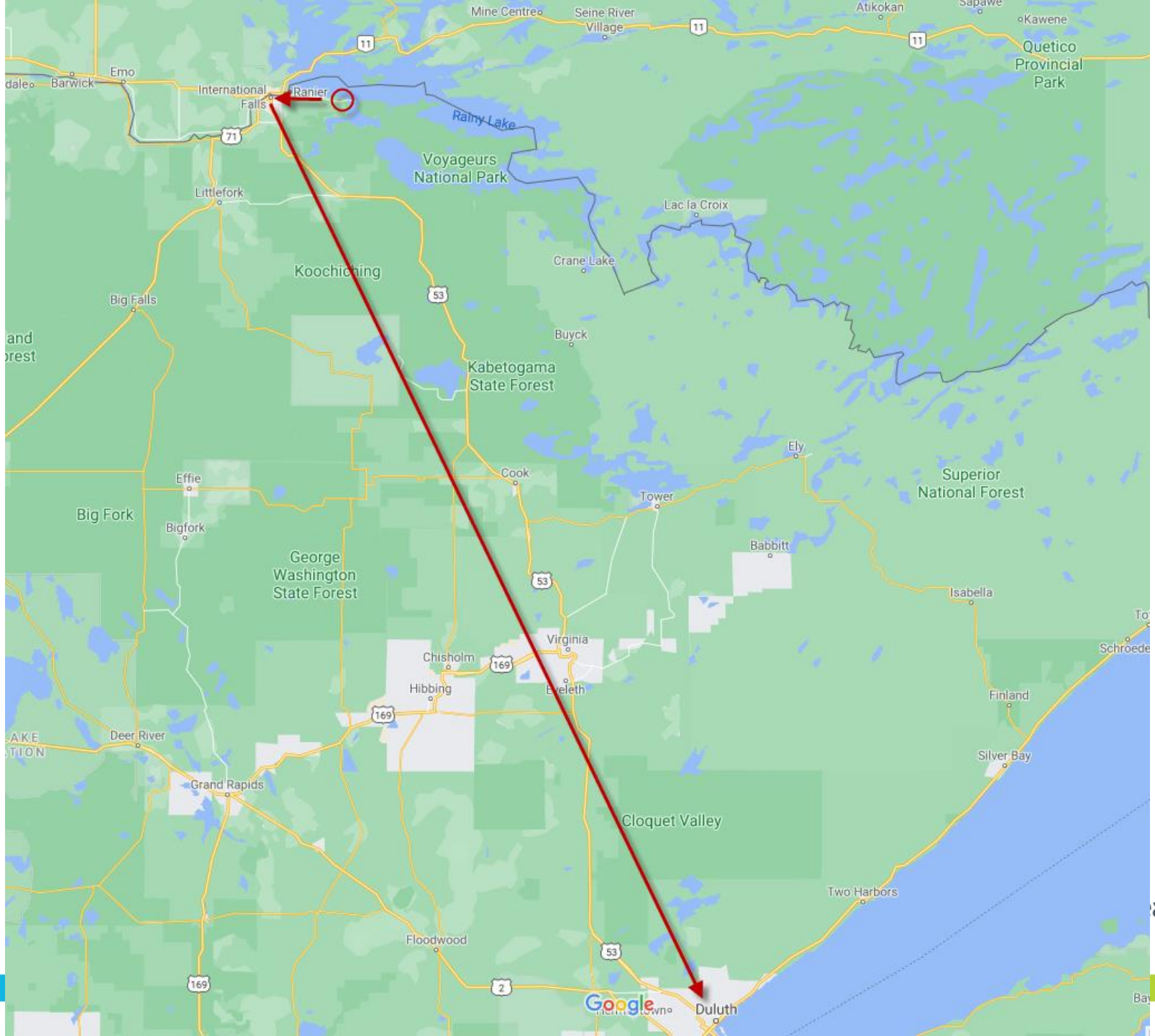
# Sat Down In Recliner

- Wife realized that if she needed to provide CPR, he needed to be on the floor
  - She kicked him out of the recliner!

- She checked his blood pressure
  - Then gave another nitro



Mine Centre
Seine River Village
Atikokan
Sapawe
Kawene
Quetico Provincial Park
Emo
Barwick
International Falls
Ranier
Rainy Lake
Voyageurs National Park
Littlefork
Lac la Croix
Crane Lake
Koochiching
Big Falls
Buyck
Kabetogama State Forest
Ely
Superior National Forest
Effie
Cook
Tower
Big Fork
Bigfork
George Washington State Forest
Babbitt
Isabella
Virginia
Chisholm
Hibbing
Eveleth
Finland
Deer River
Silver Bay
Grand Rapids
Cloquet Valley
Two Harbors
Floodwood
Google
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169
2

## 69 yo Male With Chest Pain After Chopping Ice & Moving Rocks to Install a Dock…

- Called 911 and I-Falls Fire Ambulance Dispatched at 15:25
  - Ambulance arrived on scene at 15:39

# Neighbor On Scene in Carhart Overalls…and a Stethoscope!

- Paramedic did not initially realize the “Neighbor” was a physician

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# *EMS Arrives at 15:39…*

- Patient took 2 nitro's and has rapid breathing
- Found face down on the floor
- Patient was able to respond when asked, "What is going on?"

- Paramedic performs 12-Lead ECG at 15:46

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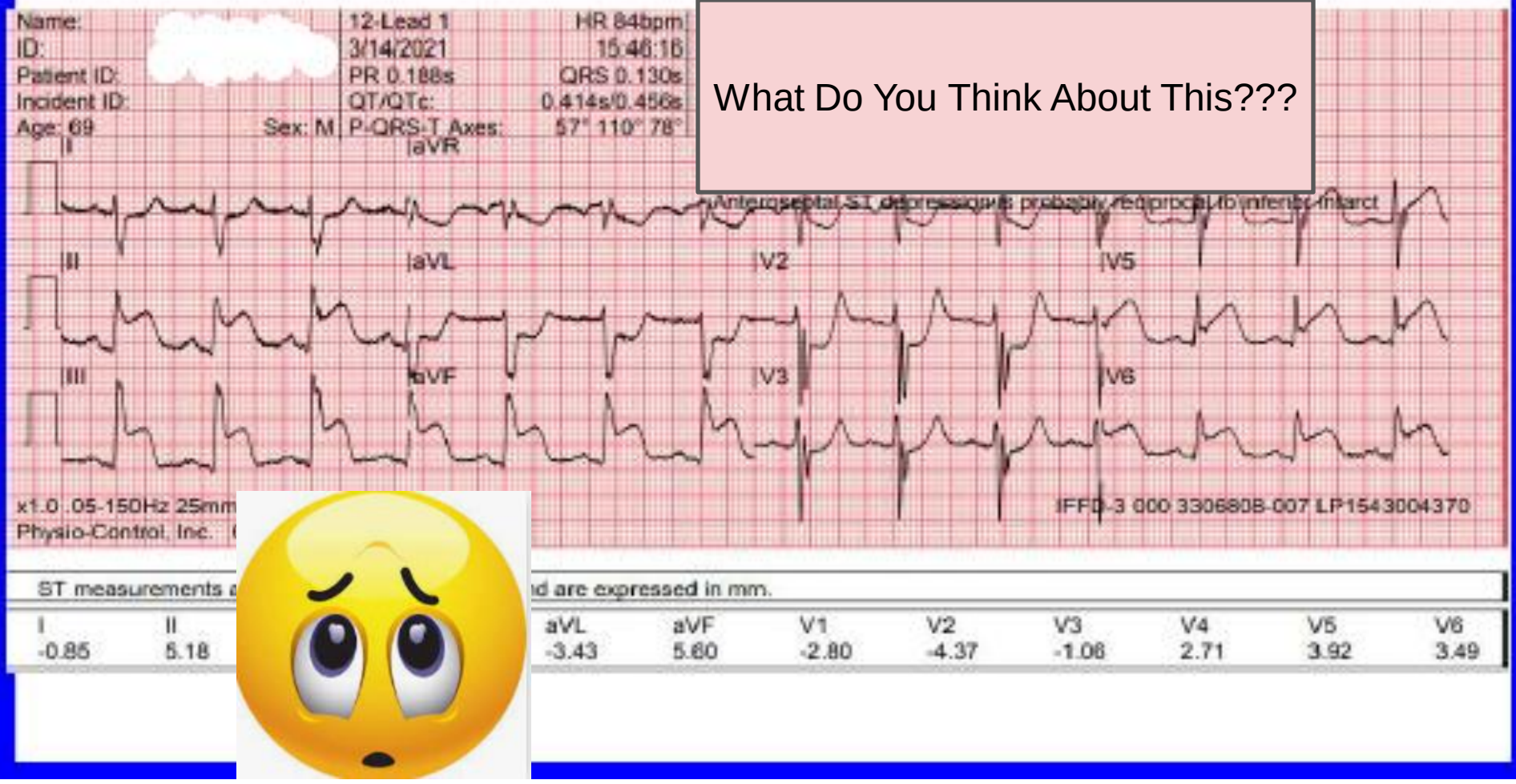
# 12 - Lead ECG




What Do You Think About This???

## 69 yo Male With Chest Pain After Chopping Ice & Moving Rocks to Install a Dock…

- ECG transmitted, showing inferior STEMI
  - *Physician on scene agreed it was a STEMI*
    - *(Wife could also see that it was a STEMI)*

- Fire hall was called
- Flight was called
- RLMC was notified of a STEMI

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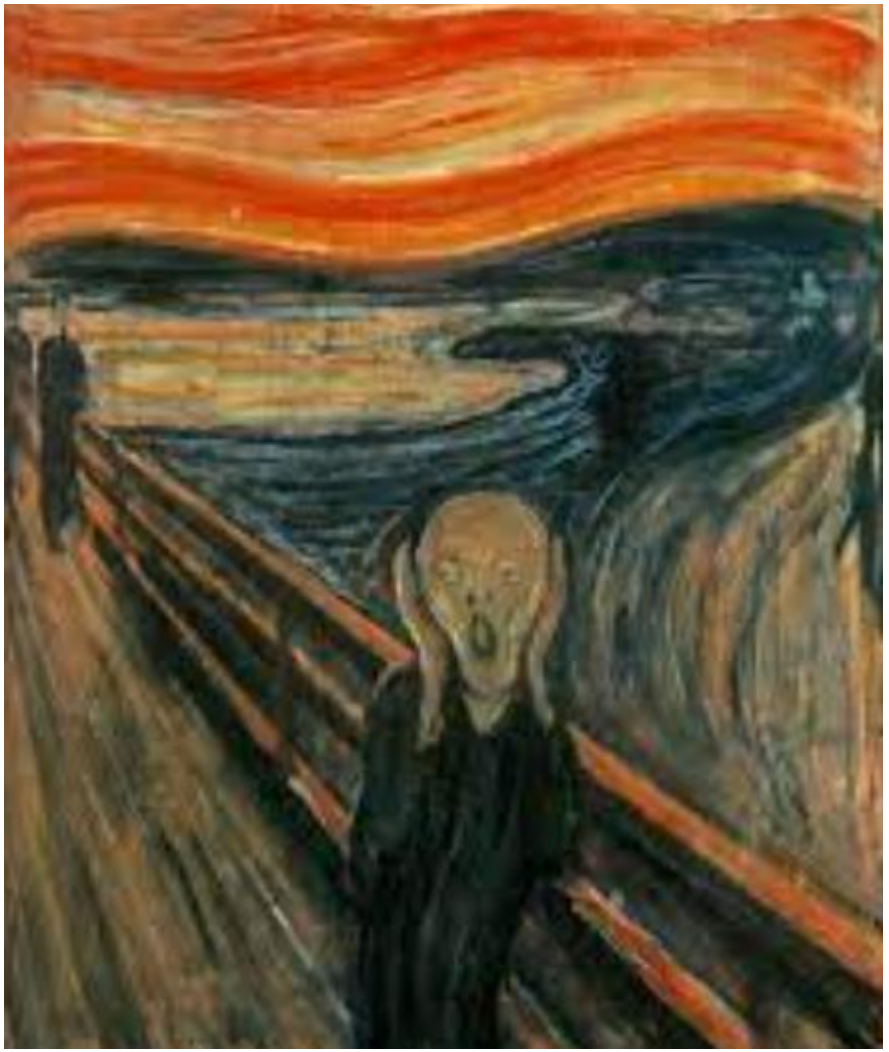
# *EMS Report…*

- “He is nauseated, ashen and clammy”
- “He has an impending sense of doom”



# Fearing the worst as they were leaving, he then looked at his wife and said…

"I love you!"

# *EMS Report…*

- IV started in the **Left** Antecubital

- ASA 324 mg was given PO
- Nitro Spray was given
- He rates his pain at a 7-8, and it is getting worse

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# *Blood Pressure Was Checked…*

- Found to be 80/p
  - He was given Normal Saline wide open

  - Given Zofran 4 mg for nausea

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- Transported to Rainy Lake Medical Center ED
  - International Falls, Minnesota
    - Departed Scene at 16:00
    - Arrive in RLMC ED room at 16:20


## Patient remembers the paramedic talking to him…

- Medic kept telling patient about everything that was going on during transport

- Patient shared that he found this calming and gave him confidence that things were going smoothly

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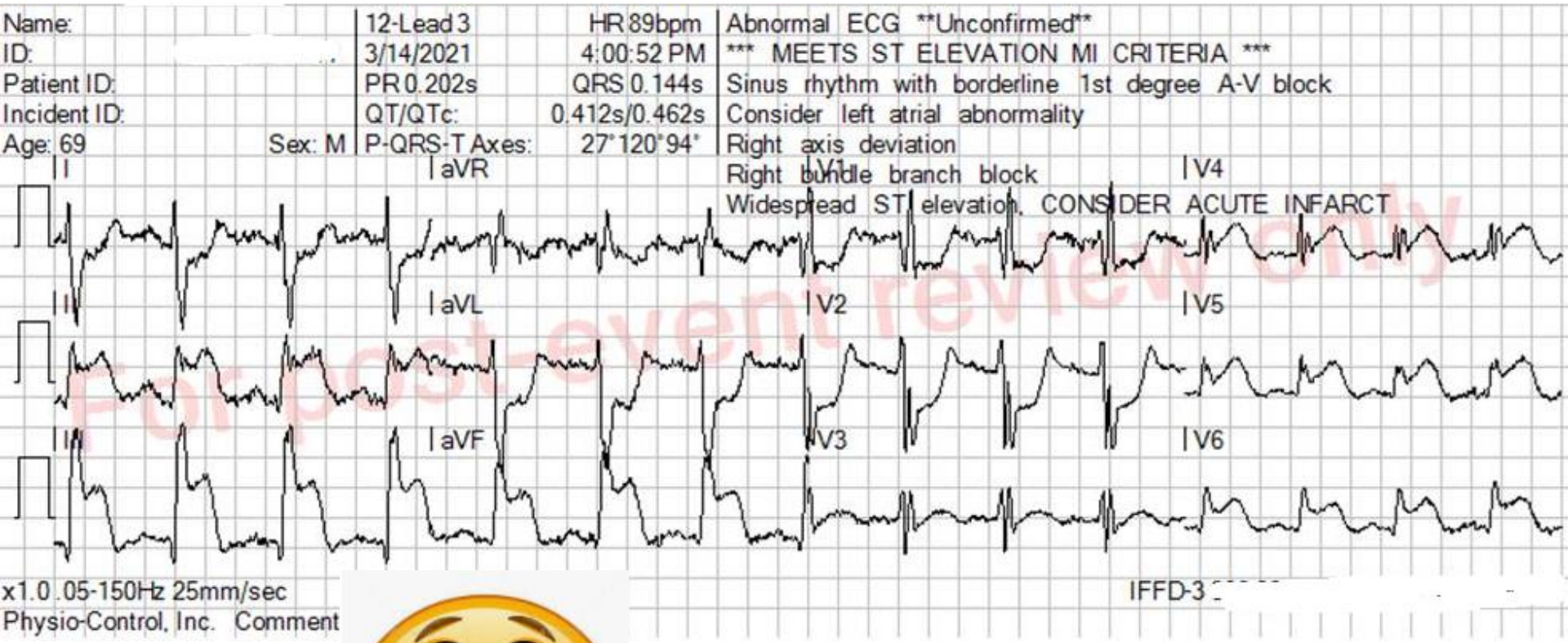
# *Third ECG Obtained…*

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# Hand Off at the ED

- Three field 12-Lead ECG's performed
- First was positive
- …last one was extended
  - Wanted ED MD to know about the extension
- Discuss value of communication during handoff
- Discuss the "Silent Minute"

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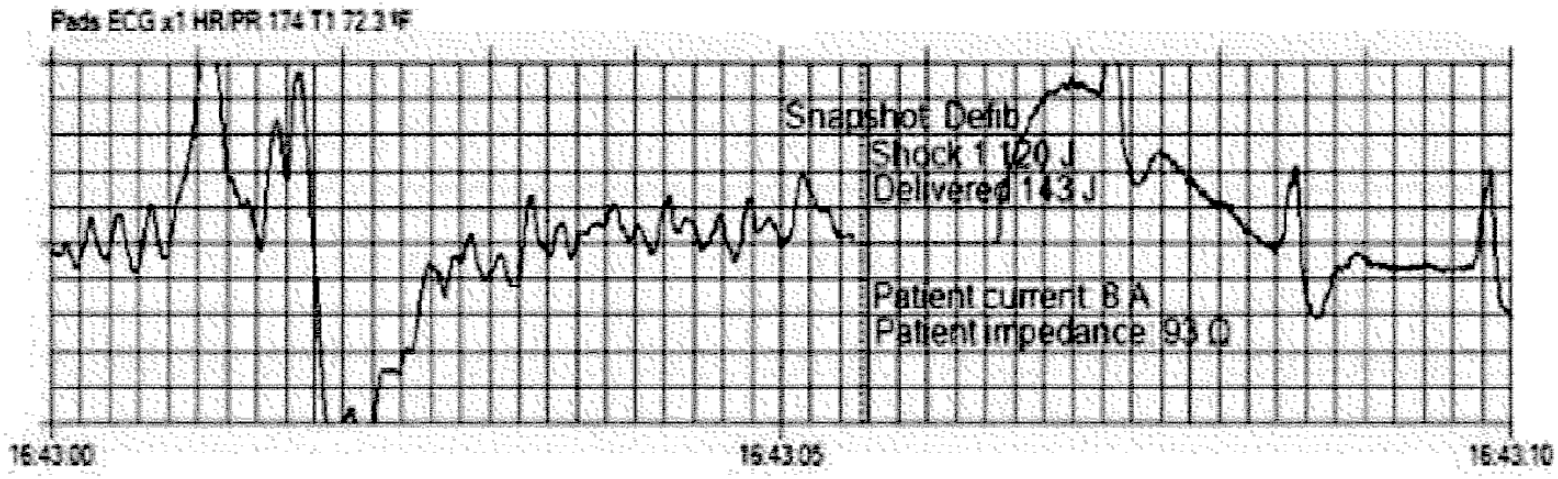
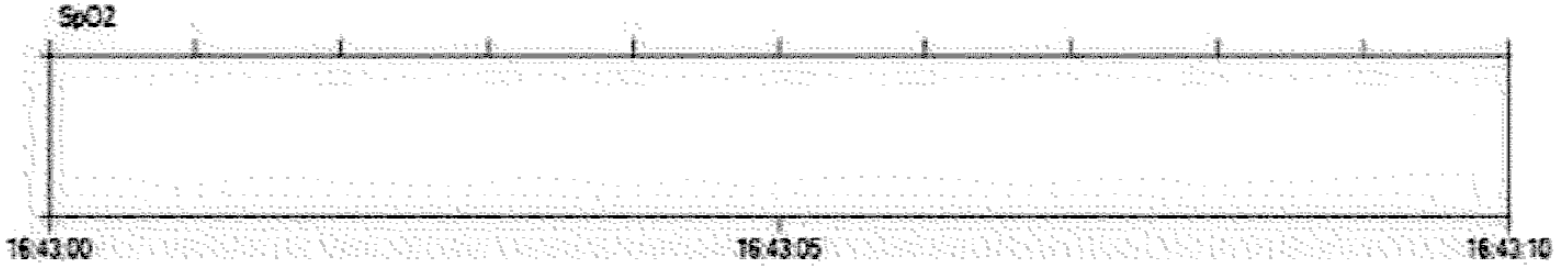
# V-Fib Arrest!!!

- Witnessed V-Fib Arrest at 16:42
  - CPR started immediately
  - Defibrillated at 16:42

Event_Strip_000110_Ecg_1




Event_Strip_000110_Spo2_2



## 69 yo Male With Chest Pain After Chopping Ice & Moving Rocks to Install a Dock…

- Patient V-Fib arrested twice in the ED
  - …but was resuscitated each time

- Wife was out in the waiting room, but could still hear them shout, “Clear” each time…
  - …and knew exactly what was happening

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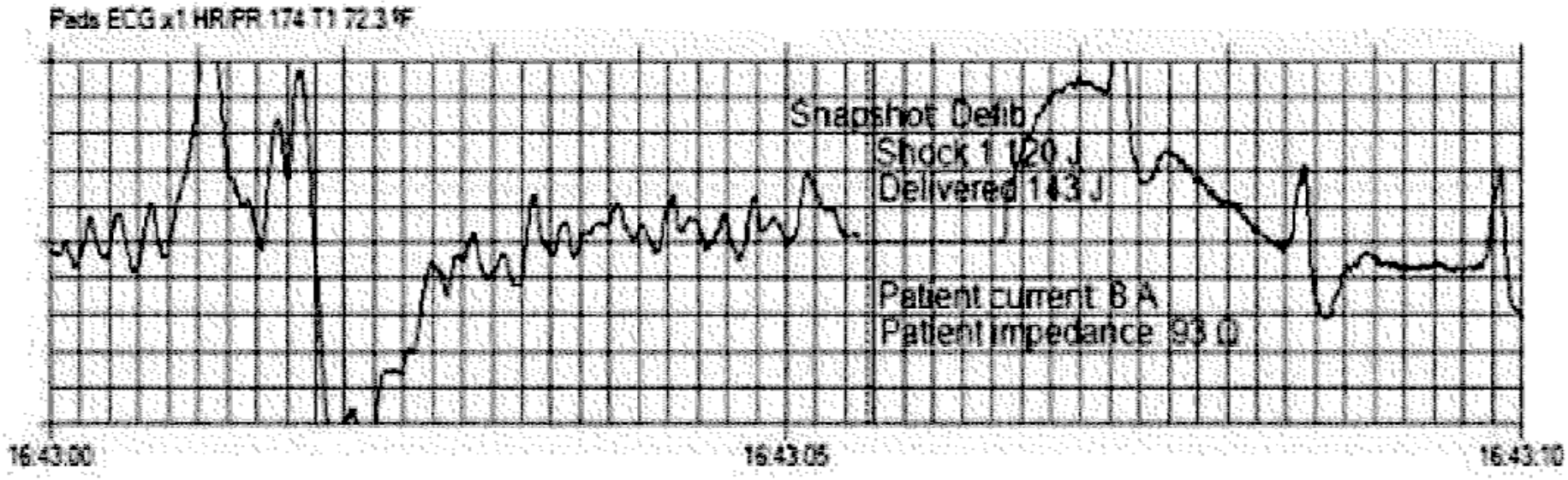
# 5-Minutes Later…Defibrillated Again at 16:47

Event_Strip_000110_Ecg_1

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# 69 yo Male With Chest Pain After Chopping Ice & Moving Rocks to Install a Dock…

- After ROSC, patient was alert and oriented
- ED doctor called St. Mary's
- Discussed case with Cardiologist
  - Did not recommend TNKase at this time…
  - Time to Duluth now close to 1 hour
    - *Lytics often considered when time to balloon likely greater than 2 hours and no contraindications*

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# *"Should We Intubate Before Flight?"*

- Patient coherent / alert after CPR & ROSC
  - Note history of chemical reaction issues
- Decided NOT to intubate

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## *Per ED RN…*

- While loading patient into helicopter, patient vomited
- Immediately turned patient to right side
- Patient able to clear airway
  - airway patent post vomiting
  - pt speaking and alert to voice commands; unmeasured amount

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# “It was like a symphony with everyone playing their part”

- Patient remembers the team worked so well together, and seemed to know their roles and duties

- ED RN was communicating clearly and helped the patient understand what was happening

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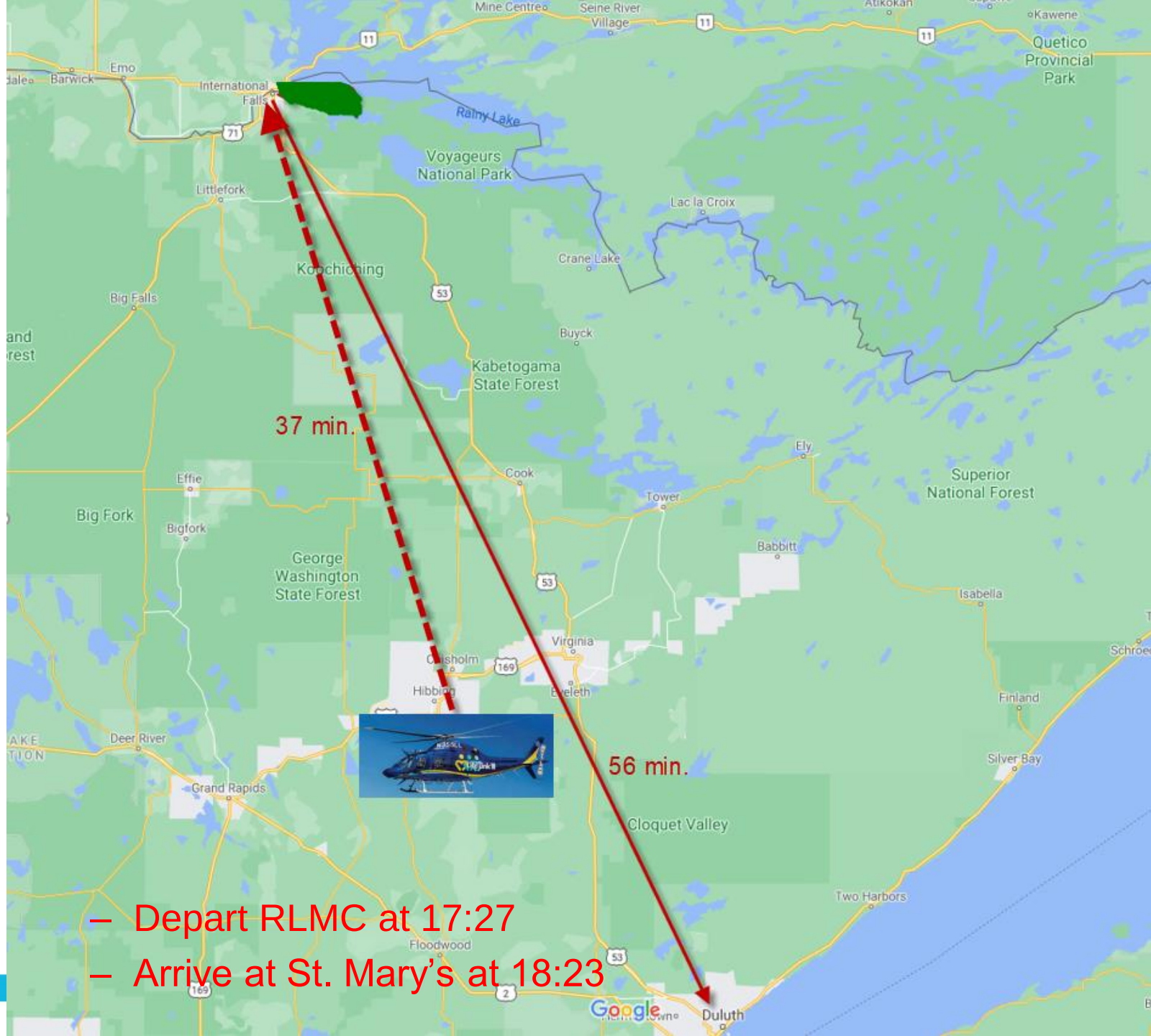
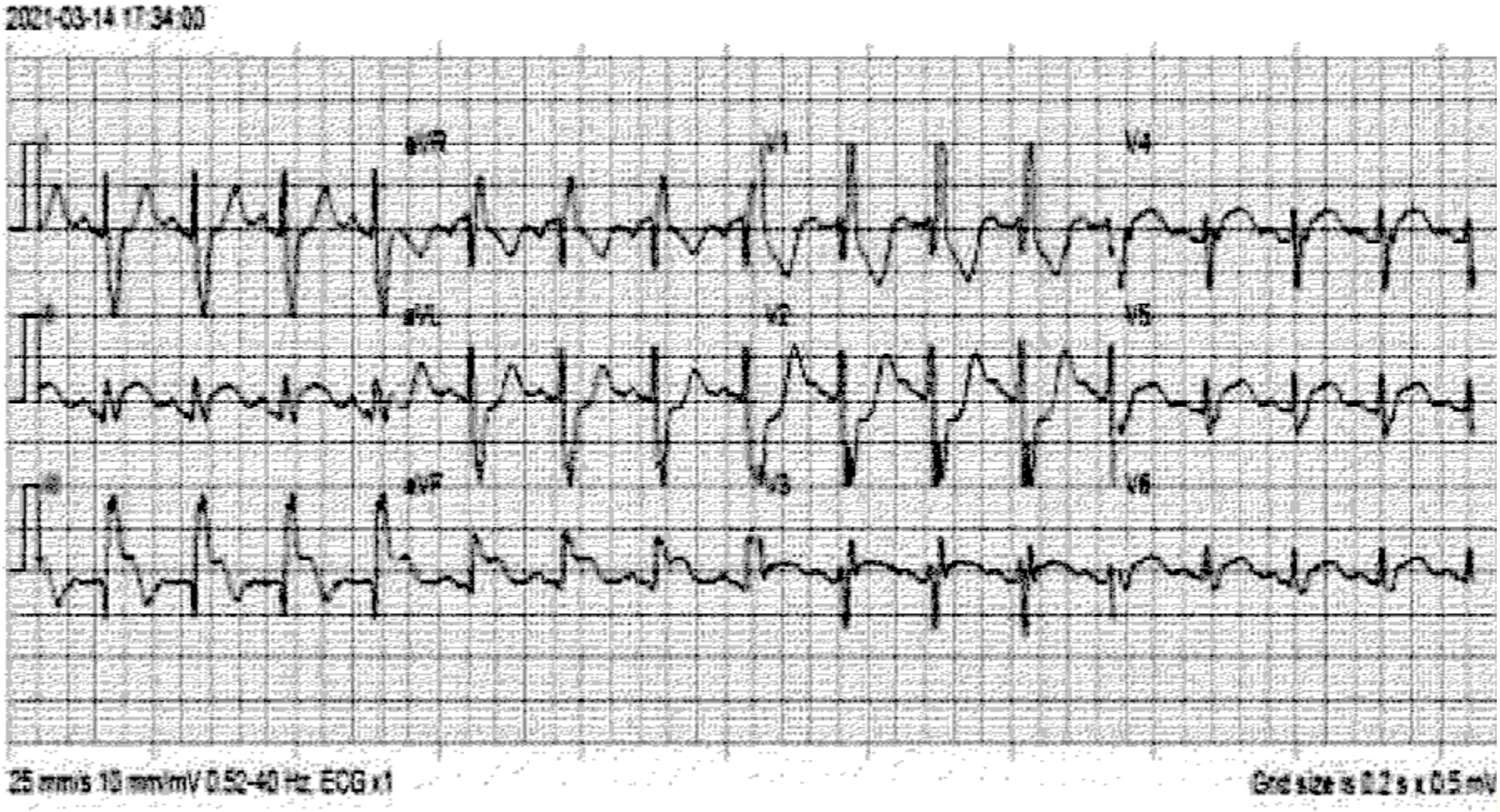



- Depart RLMC at 17:27
- Arrive at St. Mary's at 18:23

# LL3 Repeats ECG at 17:34



# Interventional Cardiologist Summary…

- The right coronary artery was the culprit artery
  - There was hazy thrombotic appearing lesion in the mid right coronary artery
  - The vessel was heavily calcified, and it was quite difficult to deliver equipment into the artery
- We persevered and delivered overlapping 3.5 x 48 and 3.5 x 16 mm Synergy drug-eluting stents
  - *(2 stents placed in the RCA)*
  - With this there was a 20% focal residual stenosis in the mid right coronary
- Echocardiogram demonstrated mildly reduced LVEF = 53%

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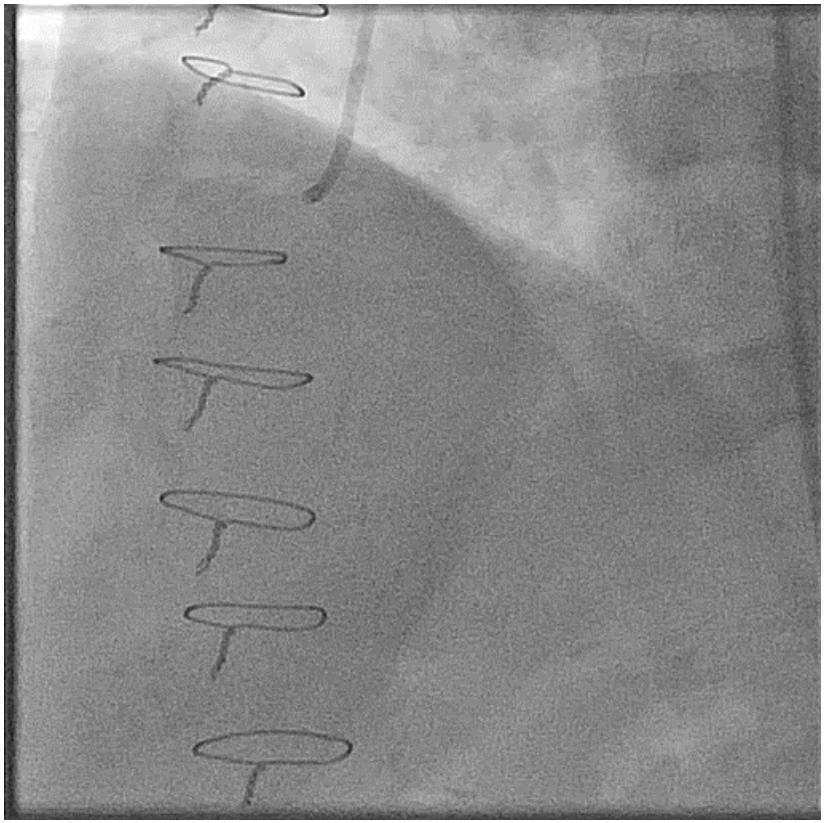
# Cath Lab – First Look at RCA



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# Long Balloon of RCA

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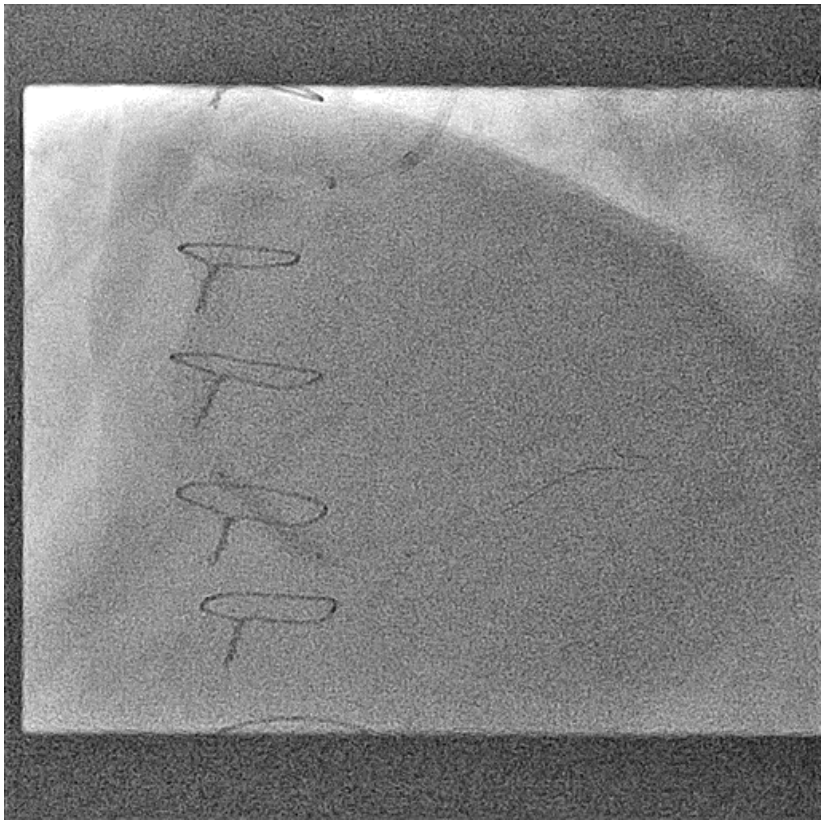
# *Working Down the RCA…*



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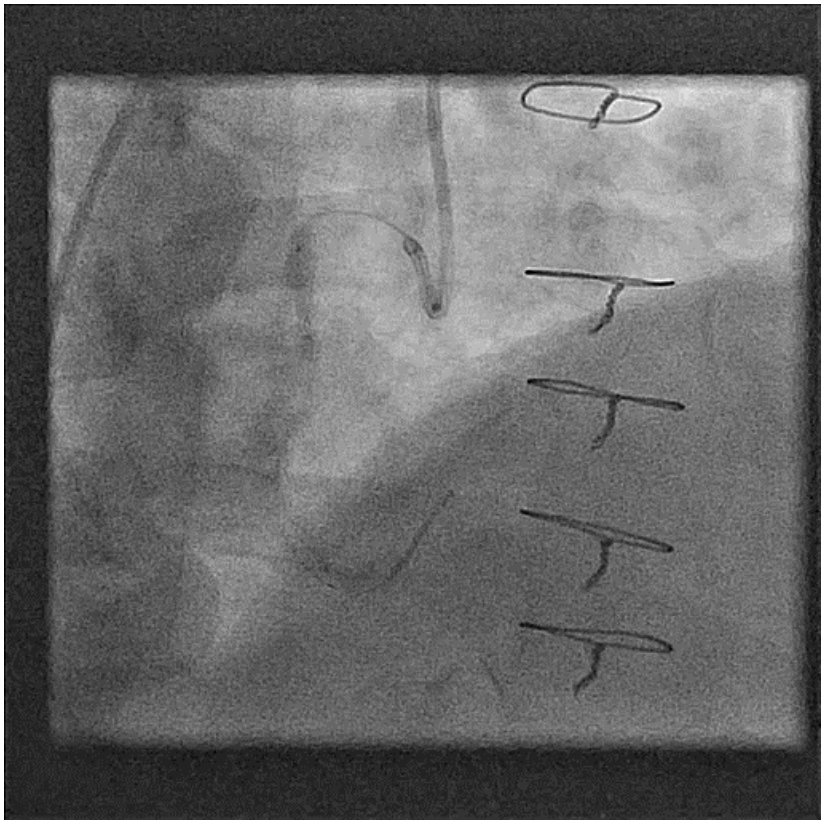
# *Next, Balloon Proximal RCA…*



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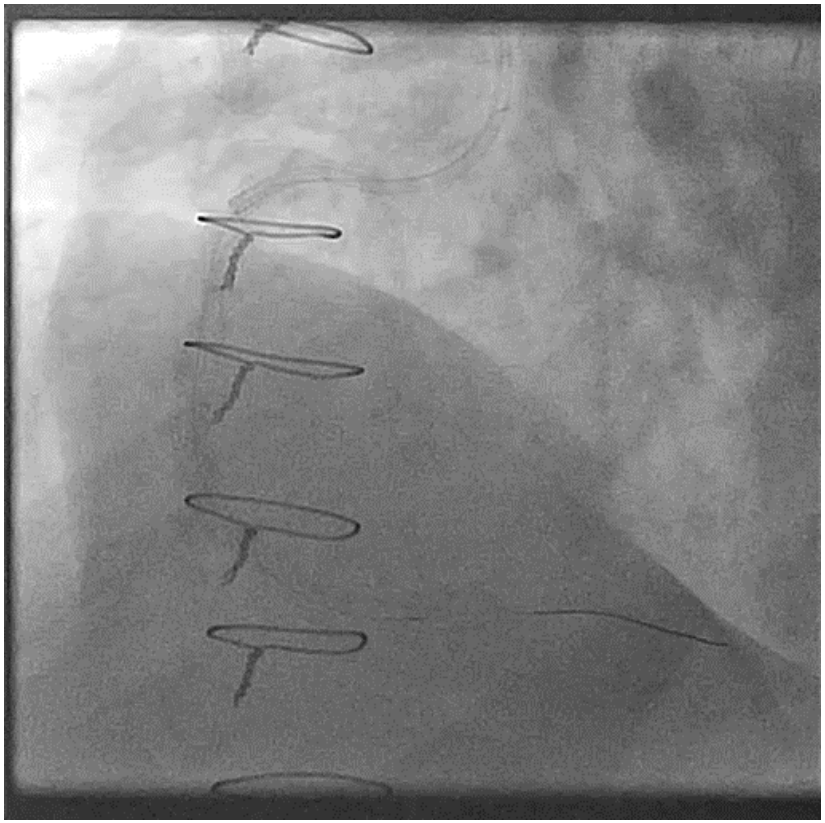
# Final Result: 2 Stents in RCA



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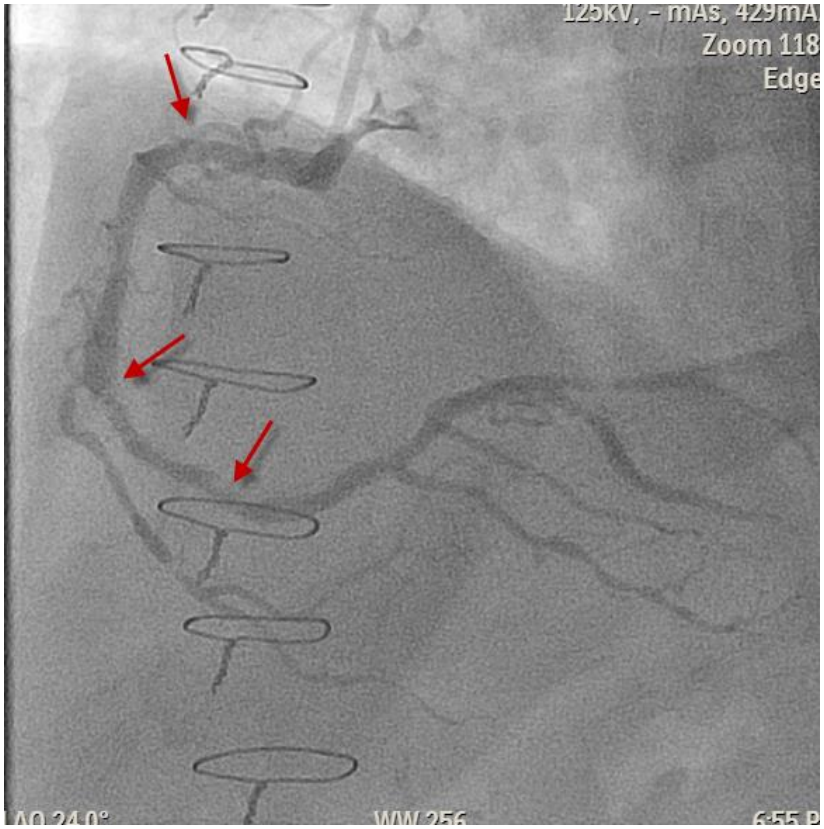
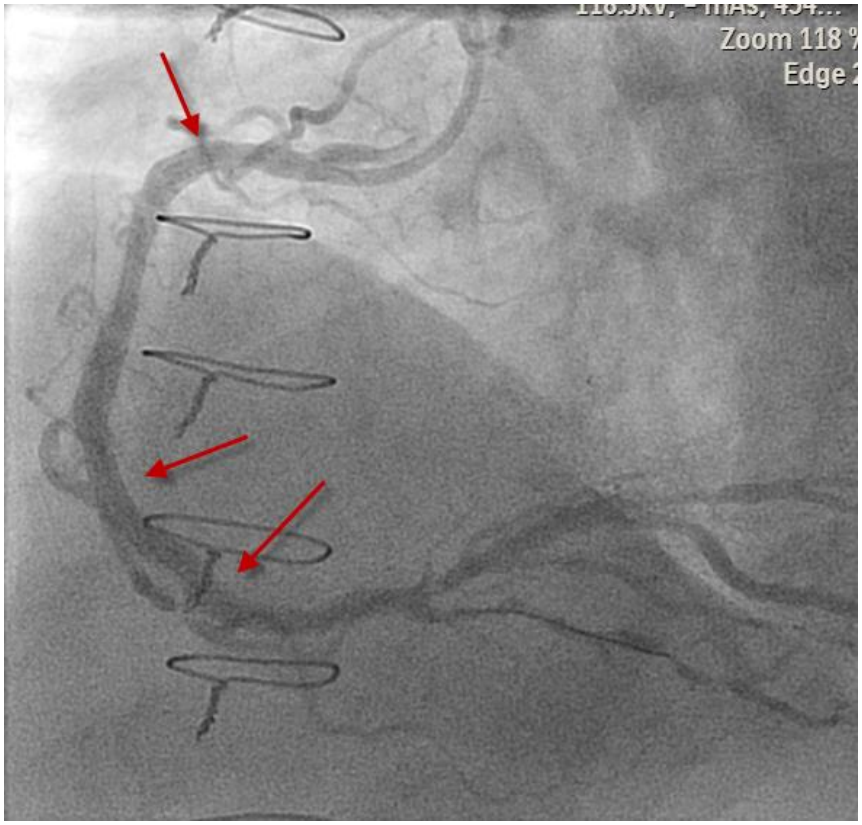
# RCA Before and After…

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# 69 yo Male With Chest Pain After Chopping Ice & Moving Rocks to Install a Dock…

- The patient did better the next day, and went home after 3 days with EF=53%
  - Follow up Echo a few months later now shows EF=59%
    - *Normal EF is usually above 60%*

- Patient and wife authorized sharing his story and want to express gratitude to all of those that cared for him and saved his life!
  - » Signed consent forms on file

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*…Despite 2 V-Fib Arrests!*

# Let's Look at the Time Metrics:

| Symptom Onset to 911 Call (min) | 911 Call to EMS Dispatch (min) | EMS Dispatch to EMS En Route (min) | EMS En Route to Med Contact (min) | EMS 1st Contact to 12-Lead ECG (Goal 10 min) | First EMS (+) ECG to Call for STEMI Activation | EMS Call for Activation to Depart Scene | EMS Scene Time | EMS Depart Scene to Regional Hospital | EMS Depart Scene to Arrival at SMMC |
|---|---|---|---|---|---|---|---|---|---|
| 25 | 0 | 3 | 11 | 7 | 6 | 8 | 21 | 20 | 143 |

| SMMC Door to Device time (Step 3 EMS) | Cath Lab Start Time to Device | EMS first medical contact to device (Goal ≤ 90 min) | EMS (+) ECG to Device Time | 911 Call to Device time | Symptom Onset to Device time | (+) ECG to Decision Time |
|---|---|---|---|---|---|---|
| 26 | 14 | 190 | 183 | 204 | 229 | 6 |

| 1st Med Contact to Ref.Hosptial to Balloon / Device (Goal ≤ 120 min) | Referral Hospital Door to Balloon / Device (Goal ≤ 90-120 min) | Referral Hospital (+) ECG to Balloon / Device | (+) ECG to Decision (Goal ≤ 5 min) | Referral Hospital Door to ECG (Goal ≤ 10 min) | Call for ALS Transport to Arrive | Patient Door-in - Door-out (DIDO) (Goal ≤ 45 min) | EMS Turnaround (DIDO) (Goal ≤ 10 min) | Transport Time Referral Hospital to SMMC (min) | Essentia SMMC Door to Balloon / Device (min) | SMMC Cath Lab Start to PCI (min) |
|---|---|---|---|---|---|---|---|---|---|---|
| 190 | 149 | 149 | 0 | 5 | 41 | 67 | 54 | 56 | 26 | 14 |

Delay due to V-Fib Arrest / CPR / Stabilization

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# THANK YOU!!!

- Almost every participant in today's conference plays a role in improving our STEMI System of Care

- By working together as a SYSTEM, we can improve the care of all STEMI patients in our communities


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