Why it is Essential for Paramedics to Transmit 12 Lead ECGs for Physician Over Read

Corey M. Slovis, M.D.
Vanderbilt University School of Medicine
Metro Nashville Fire Department and
Nashville International Airport
Prehospital ECG’s

- Adds only 1-2 minutes to in-field time
- High quality ECGs equal to hospital’s
- Increases early diagnosis of AMI
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12 Lead ECGs make the paramedic a truly essential part of ACS team
75% of all STEMI patients will receive PCI within 90 minutes of contact with first health care provider.

*Endorsed by ACC, AHA, ACEP, AAEM, ENA, NAEMSP, ACP, SAEM*
Strategies for Reducing the Door-to-Balloon Time in Acute Myocardial Infarction

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6 Strategies Significantly Reduced D₂B Time
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- **EMS 12 leads ECGs for pre-arrival activation**
5 Ways to Diagnose an AMI on ECG

1 mm of ST elevation in 2 or more anatomically contiguous leads
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Reciprocal ST Depression

Q Waves
5 Ways to Diagnose an AMI on ECG

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Reciprocal ST Depression

Q Waves

Compared to prior ECGs

Compare to next ECG in 15-30 minutes
12 Lead on ED Arrival
Pre Hospital 12 Lead
ED ECG 20 min Later (09:56)
Reading ECGs accurately is hard, and a major source of physician error.
Multi-Center Study of 3077 patients

Yale, Brigham and Womens, Univ. of Cinn. and 3 Community Hospitals

Admitted 58% of pts., 26% of whom had AMI

4.0% miss rate but “17 other missed AMI’s were identified during other phases of this study”

7.3 AMI Miss Rate
Clinical Characteristics and Natural History of Patients with Acute Myocardial Infarction Sent Home from the Emergency Room

THOMAS H. LEE, MD, GREGORY W. ROUAN, MD, MONICA C. WEISBERG, RN, DONALD A. BRAND, PhD, DENISE ACAMPORA, MPH, CAROL STASIULEWICZ, PA, JAY WALSHON, MD, GEORGE TERRANOVA, MD, LOUIS GOTTLIEB, MD, BETH GOLDSTEIN-WAYNE, RN, DAVID COPEN, MD, KAREN DALEY, RN, ALLAN A. BRANDT, MD, JOHN MELLORS, MD, RITA JAKUBOWSKI, RN, E. FRANCIS COOK, ScD, and LEE GOLDMAN, MD, MPH

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- 7.3 AMI Miss Rate

½ of all misses due to suboptimal ECG reading skills
Implications of the Failure to Identify High-Risk Electrocardiogram Findings for the Quality of Care of Patients With Acute Myocardial Infarction

Results of the Emergency Department Quality in Myocardial Infarction (EDQMI) Study

• Retrospective study from five EDs
• 1,684 AMIs over 2 years
• Evaluated missed acute findings by MDs
• ST ↓, ST ↑, T Wave ↓
EDQMI Results

Circulation 2006;114:1565-1571

- **12% of high risk changes missed**
- Missed findings more common in older patients with history of CHF, less CP
- **8% STEMI/ST ↑ missed**
- 18% ST depression missed
- 14% T Wave inversions missed
How much does prehospital ECG decreased $D_2B$

Prehospital STEMI Alerts

vs.

ED Walk-ins with STEMI

Also evaluated prior year’s historic controls
Effect of Prehospital 12-Lead Electrocardiogram on Activation of the Cardiac Catheterization Laboratory and Door-to-Balloon Time in ST-Segment Elevation Acute Myocardial Infarction

Jason P. Brown, MD, Ehtisham Mahmud, MD, James V. Dunford, MD, and Ori Ben-Yehuda, MD

Reducing door-to-balloon (D + B) time during primary percutaneous coronary intervention for patients with ST-segment elevation myocardial infarction (STEMI) reduces mor-

• D₂B in under 90 minutes:
  - 80% with EMS alert
  - 10-25% without EMS
5/25 “STEMI’s” were only CP pts with LBBB +/- or LVH

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Over reads essential to avoid erroneous activation.
Can Highly Trained Paramedics Read 12 Lead ECGs Accurately?

Real-time paramedic compared with blinded physician identification of ST-segment elevation myocardial infarction: results of an observational study

James A. Feldman MD,*, Kathryn Brinsfield MD, Sheilah Bernard MD, Daniel White EMT-P, Thomas Maciejko EMT-P

*Department of Emergency Medicine, Boston Medical Center, Boston University School of Medicine, Boston, MA 02118, USA
bDepartment of Cardiology, Boston Medical Center, Boston University School of Medicine, Boston, MA 02118, USA
cBoston Emergency Medical Services, Boston, MA 02118, USA

ACCURACY

Paramedic        ER MD        Cardiologist
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bDepartment of Cardiology, Boston Medical Center, Boston University School of Medicine, Boston, MA 02118, USA  
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ACCURACY

Paramedic 94%  ER MD 93%  Cardiologist 95%
Can Highly Trained Paramedics Read 12 Lead ECGs Accurately?


Real-time paramedic compared with blinded physician identification of ST-segment elevation myocardial infarction: results of an observational study

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\(^a\)Department of Emergency Medicine, Boston Medical Center, Boston University School of Medicine, Boston, MA 02118, USA
\(^b\)Department of Cardiology, Boston Medical Center, Boston University School of Medicine, Boston, MA 02118, USA
\(^c\)Boston Emergency Medical Services, Boston, MA 02118, USA

Paramedics were highly accurate; But did not diagnose 5 of 25 AMIs
Assessed paramedic STEMI Accuracy vs. ED MDs
110 pts: 54 paramedic STEMI Alerts vs. 56 MDs
Compared Paramedic vs. ED MD for:
  – 12 lead STEMI Alert Accuracy
  – % of patients who go on to PCI
  – % of patients at PCI with positive lesions
STEAMI Alert Accuracy
Paramedic vs. ED MD

p = 0.01

Prehosp Emerg Care 2007;11:399-402

True STEMI

Medic MD: 78%
MD: 96%

To PCI

Medic MD: 70%
MD: 89%

Lesion at PCI

Medic MD: 69%
MD: 89%
Paramedics can over or under call STEMIs up to 20% of the time.
Reading for AMI is hard and requires expertise, experience and “mileage.”

You can not rely on a machine.
Atrial flutter with 2:1 AV conduction
ST elevation consider inferior injury or acute infarct
*** *** *** Acute MI *** *** ***
Abnormal ECG
*** Unconfirmed ***
Normal sinus rhythm
Possible Anterior infarct, possibly acute
Cannot rule out Inferior infarct, age undetermined
T wave abnormality, consider lateral ischemia

** ** ** ** * Acute MI * ** ** ** **

Abnormal ECG
*** Unconfirmed ***
Normal sinus rhythm with sinus arrhythmia
ST elevation consider inferior injury or acute infarct

** *** *** Acute MI *** *** **

Abnormal ECG
*** Unconfirmed ***
EMS has a New Central Role:

Prehospital Triage of Chest Pain Patients
$1 + 1 + 1$

is Always Better Than $1 + 1$
1 + 1 + 1

is Always Better Than 1 + 1

Paramedic + Machine + MD

is always better than
Paramedic + Machine.
AHA Scientific Statement

Implementation and Integration of Prehospital ECGs Into Systems of Care for Acute Coronary Syndrome

A Scientific Statement From the American Heart Association Interdisciplinary Council on Quality of Care and Outcomes Research, Emergency Cardiovascular Care Committee, Council on Cardiovascular Nursing, and Council on Clinical Cardiology

Henry H. Ting, MD, MBA, Chair; Harlan M. Krumholz, MD, SM, FAHA, Co-Chair;

- State of the Art Review with Recommendations
- Reviews benefits and available data
- Provides roadmaps for implementation
- Compares: Computer vs. Paramedics vs. Base Station MD
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<th>Method of Interpreting Prehospital ECG</th>
<th>Pros</th>
<th>Cons</th>
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| Computer algorithm interpretation    | Rapid, easy  
                                No wireless network or technology requirements | False-positive and false-negative rates higher than physician interpretation |
| Paramedic interpretation             | Rapid, easy  
                                No wireless network or technology requirements | Requires intensive education and quality assurance program |
| Wireless transmission and physician interpretation | Theoretically, lowest rate of false-positives and false-negatives  
Medical oversight can provide guidance on destination hospital and treatment en route | New technology requirement for EMS providers and hospital  
Reliable wireless network Transmission unit on ambulance  
Receiver station unit at hospital  
Smartphones for physicians  
Requires system to ensure immediate interpretation by physician  
Transmission failures |
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**Table 1. Models for interpreting Prehospital ECGs**

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Always err in a way that the patient suffers the least

(Commandment 10 of the Ten Commandments of Emergency Medicine)
The Computer Algorithm, the Paramedic(s) and the ED MD should work as a TEAM.
Responsibility is a Heavy Responsibility

Cheech of Cheech and Chong
• 7,098 EMS Chest Pain Patients
  (Natl Cardiac Data Registry and ACTION Network)
• Only 27.4% (1,941 pts) had pre-hospital ECGs
• Pre-hospital ECGs decreased D₂B by 14 min (p = 0.003)
• ¾ of EMS patients do not get pre-hospital ECGs