

Physician Attitudes About Prehospital 12-Lead ECGs in Chest Pain Patients

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Abbreviations

ACLS = advanced cardiac life support
ALS = advanced life support
AMI = acute myocardial infarction
CI = confidence intervals
ECG = electrocardiogram
ED = emergency department
EMS = emergency medical services
EP = emergency physician
IRB = institutional review board
mm = millimeter
VAS = visual analog scale

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Abstract

Introduction: The prehospital 12-lead electrocardiogram (ECG) has become a standard of care. For the prehospital 12-lead ECG to be useful clinically, however, cardiologists and emergency physicians (EP) must view the test as useful. This study measured physician attitudes about the prehospital 12-lead ECG.

Hypothesis: This study tested the hypothesis that physicians had "no opinion" regarding the prehospital 12-lead ECG.

Methods: An anonymous survey was conducted to measure EP and cardiologist attitudes toward prehospital 12-lead ECGs. Hypothesis tests against "no opinion" (VAS = 50 mm) were made with 95% confidence intervals (CIs), and intergroup comparisons were made with the Student's *t*-test.

Results: Seventy-one of 87 (81.6%) surveys were returned. Twenty-five (67.6%) cardiologists responded and 45 (90%) EPs responded. Both groups of physicians viewed prehospital 12-lead ECGs as beneficial (mean = 69 mm; 95% CI = 65–74mm). All physicians perceived that ECGs positively influence preparation of staff (mean = 63 mm; 95% CI = 60–72mm) and that ECGs transmitted to hospitals would be beneficial (mean = 66 mm; 95% CI = 60–72mm). Cardiologists had more favorable opinions than did EPs. The ability of paramedics to interpret ECGs was not seen as important (mean = 50 mm; 95% CI = 43–56mm). The justifiable increase in field time was perceived to be 3.2 minutes (95% CI = 2.7–3.8 minutes), with 23 (32.8%) preferring that it be done on scene, 46 (65.7%) during transport, and one (1.4%) not at all.

Conclusions: Prehospital 12-lead ECGs generally are perceived as worthwhile by cardiologists and EPs. Cardiologists have a higher opinion of the value and utility of field ECGs. Since the reduction in mortality from the 12-lead ECG is small, it is likely that positive physician attitudes are attributable to other factors.

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Introduction

The acquisition of a 12-lead electrocardiogram (ECG) in the prehospital setting has become a standard intervention for advanced life support (ALS) ambulance services.^{1,2} The 12-lead ECG was introduced into this community in 1997. The clinical benefits of acquiring the 12-lead ECG have not been demonstrated clearly

despite its increasingly widespread implementation.^{3,4} For the prehospital 12-lead ECG to be of clinical value, however, the EP and cardiologist must believe that the test is accurate and reliable. This study tested the hypothesis that physicians had "no opinion" regarding the prehospital 12-lead ECG.

1. Please circle your area of practice: Emergency Medicine Cardiology

2. Please enter your age: ___ years.

3. Please circle your gender: male female.

4. Please enter your years in practice: ___ years.
Please answer the following questions by making a single vertical mark on the line.
Sample Item: Chocolate is my favorite candy.
Disagree Strongly |-----|-----| Agree Strongly

5. A pre-hospital 12-lead ECG is beneficial upon patient presentation.
Disagree Strongly |-----|-----| Agree Strongly

6. Reported ECG changes by paramedics in a patient with a complaint of chest pain influences preparation of my staff.
Disagree Strongly |-----|-----| Agree Strongly

7. Paramedics should have the skills and capacity to interpret 12-lead ECGs.
Disagree Strongly |-----|-----| Agree Strongly

8. Transmission of pre-hospital 12-lead ECGs prior to patient arrival would be useful.
Disagree Strongly |-----|-----| Agree Strongly

9. Please write in the number of added minutes that you think would be justified while obtaining a 12-lead field ECG in a patient complaining of (possibly ischemic) chest pain.
___ minutes

10. Check the box to show where you think pre-hospital 12-lead ECGs should be obtained?
[] On scene (may increase scene time by 4-5 minutes.)
[] During transport (there is a potential reduction in ECG quality.)
[] Not ever in the pre-hospital setting.

Please share any ideas, comments, or suggestions you have in the space below:

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Figure 1—Prehospital 12-Lead ECG Survey**Methods***Setting*

The subjects of this study were the 87 physicians who practiced in emergency departments (EDs) and cardiology groups within metropolitan area of the Southwest, United States. Within this area, are eight EDs with a catchment population of 780,000. In 1998, the advanced life support (ALS) service that acquires the field ECGs responded to approximately 70,000 calls.

The service ALS protocols required acquisition of 12-lead ECGs on all patients with chest pain and a broad range of other complaints that might be cardiac related. The prehospital ECG was not transmitted due to highly unreliable radio communications in this area; however, computer and paramedic interpretations of the ECGs were communicated by voice transmission. Approximately 600 patients having an acute myocardial infarction (AMI) were transported by the prehospital ALS service in 1998.

Study Design

The study is a cross-sectional attitudes survey. The survey

instrument was developed using a combination of demographic (gender, age, years in practice, and specialty) and individual opinion questions (Figure 1). To assess physician opinions, four visual analog scales, one fill-in-the-blank item, and one multiple-choice item were provided. Four horizontal, non-segmented, 100-mm visual analog scale (VAS)^{5,6} items were used to assess physician attitudes about the utility of prehospital ECGs.

Survey Administration

The study was reviewed and approved by the institutional review board (IRB). It was conducted during a two-week period in November 1998, approximately 18 months after the introduction of the field 12-lead ECG.

Statistical Analysis

Analysis of the data was conducted using Statgraphics Plus for Windows, version 4.0, (Manugistics, Inc. Rockville, Maryland, USA) and StatXact-3 for Windows 3.0.2 (Cytel Software Corporation, Cambridge, Massachusetts, USA). The results from the VAS questions were tested against a

Item	Mean VAS (mm)	-95%CI (mm)	+95%CI (mm)	p-value*
Beneficial	69	65	74	<0.001
Preparation	62	56	67	<0.001
Transmission	66	60	72	<0.001
Interpret	50	43	56	0.9
Added minutes	3.2 min	2.7 min	3.8 min	

* p-values for a hypothesized test mean of 50 mm

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Table 1—Physician attitudes of prehospital 12-lead ECG usefulness (min = minutes)

Item	EP (mm)	Cardiologist (mm)	Mean Difference (mm)	-95%CI (mm)	+95%CI (mm)	p-value*
Beneficial	64	76	12	3	21	0.008
Preparation	58	71	13	1	25	0.03
Transmission	60	81	21	10	32	0.0002
Interpret	48	55	7	-7	21	0.3
Added Minutes	2.8 min	4.1 min	1.3 min	0.14 min	2.5 min	0.029

* p-values for a hypothesized mean difference of 0.

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Table 2—Differences between attitudes of emergency physicians (EP) and cardiologists

null hypothesis of 50 mm (no opinion). Intergroup means were compared using either Student's *t*-test or the Mann-Whitney *u*-test, as appropriate. Tests of categorical variables were conducted using the Fisher-Freeman-Halton test. Ninety-five percent confidence intervals (95% CIs) were calculated using the *t*-distribution. A Type I error rate of 0.05 and two-tailed tests were used throughout.

Results

Seventy-one of 87 of physician surveys were returned for an overall response rate of 82%. The response rates were 92% (46/50) from EPs and 68% (25/37) from cardiologists. Seventy percent of the respondents were male. The mean age was 44 years with an average of 14 years in practice. Demographic differences between specialties were not significant. Physician specialty (emergency medicine vs. cardiology) was the only demographic characteristic associated with different attitudes about prehospital ECGs.

Overall, responding physicians indicated that the prehospital 12-lead ECG is beneficial, that it influences the ability of staff to prepare for patients, and that the transmission of the ECG prior to patient arrival would be useful (Table 1). They also indicated that paramedics do not need to be able to interpret 12-lead ECGs. The mean justifiable additional field time to perform the test was estimated to be 3.2 minutes (95% CI = 2.7 to 3.8 minutes). Most physicians (65.7%) responded that the 12-lead ECG should be obtained "during transport", with 32.8% preferring that it be obtained "on scene", and 1.4% (1/71) "not ever".

Cardiologists and EPs differed in several responses (Table 2). Cardiologists rated the prehospital 12-lead ECG as more beneficial than did EPs in terms of staff prepara-

tion. They also rated the transmission of the 12-lead ECG as being more useful than did EPs. Neither specialty felt strongly that paramedics should be able to interpret the 12-lead ECG. Cardiologists indicated that a delay of 4.1 minutes while obtaining the prehospital 12-lead ECG would be justified, compared to 2.8 minutes for EPs. The preferred location for obtaining the field ECG did not differ by physician specialty ($p = 0.09$).

Discussion

The prehospital 12-lead ECG now is considered an Advanced Cardiac Life Support (ACLS) Class I procedure, and is accepted as a standard of care for urban and suburban ALS services.⁷ Current guidelines suggest that paramedics can obtain a 12-lead ECG in about four minutes. While non-randomized, retrospective trials suggest that the prehospital 12-lead ECG may save up to 55 minutes from time of onset of symptoms to reperfusion therapy (thrombolytics, angioplasty),^{4,8-10} the prospective, randomized trials provide a more modest estimate of approximately 20 minutes.¹¹⁻¹³

Previous analytic studies of reperfusion therapy suggest that reducing the time to begin the reperfusion procedures for patients suffering an AMI saves 28 lives per 1,000 patients treated per every hour saved.¹⁴⁻¹⁶ In this community, approximately 3,500 AMI patients are transported by EMS each year. Thus, the expected annual benefit in reduced mortality for this patient population is only two patients per year (Table 3) distributed among six hospitals. It is unlikely that this small improvement in mortality is being perceived by the physicians surveyed. Since the reduction in mortality from the 12-lead ECG is small, it is likely that positive physician attitudes are attributable to other factors.

	USA	City (Metropolitan Area)
Acute Myocardial Infarctions ¹	1,250,000	3,470
Proportion of Myocardial Infarctions Alive at Hospital ¹⁷	0.5	
Alive at Hospital	625,000	1,735
Proportion Transported by EMS ²	0.52	
Acute Myocardial Infarctions Transported	331,250	919
Proportion Meeting Reperfusion Criteria ³	0.25	
Transferred, Alive and Reperused	82,812	230
Lives Saved per MI per Hour Delay Reduction ^{14,15}	0.028	
Hours Saved per Transport ¹¹⁻¹³	0.33	
Total Lives Saved	765	2

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Table 3—Estimation of the number of lives saved in one year in the USA and in the City Metropolitan area by introducing 12-lead prehospital ECGs (MI = myocardial infarction)

Other benefits of the 12-lead prehospital ECG may include reduced transports of reperfusion candidates to hospitals that do not have cardiac catheterization capabilities and a concurrent reduction in unnecessary preparation for reperfusion of non-candidates at the receiving hospitals. When a department receives a radio transmission that a patient with chest pain is being transported, the EP and other staff that must prepare the patients that already are present in the department for an additional delay in receiving care. Knowledge of a normal prehospital 12-lead ECG for an incoming patient with chest pain substantially reduces over-preparation and additional stress on an ED. Cardiologists may benefit especially from a reduction in the number of false "reperfusion alerts", since they must often come in from outside the hospital. Future research investigating the costs and benefits of the prehospital 12-lead ECG is warranted based upon the significant costs of the equipment, training, and time to perform the procedure.

There are several limitations to this study. The survey forms were distributed anonymously, and there was no secondary attempt to solicit responses. It cannot be determined from this survey if non-responses indicated neutral, positive, or negative attitudes, or whether survey forms

were not delivered due to absences or other causes. Additionally, the survey only measured attitudes about the prehospital 12-lead ECG; therefore no comparison can be made about physician attitudes regarding other prehospital procedures and treatments.

This study was carried out in a metropolitan area in which AMI patients most often undergo cardiac catheterization. Therefore, this study may not be applicable in areas where thrombolytic treatment for AMI patients is the preferred treatment modality.

This was a cross-sectional survey; there is no way to infer changes in attitudes over time. This survey was limited to the impressions of EPs and cardiologists in this community. It did not determine the attitudes of other EDs or hospital staff, hospital administrators, paramedics, third-party payers, or patients. However, EPs and cardiologists are the clinicians that typically make patient-care decisions based upon the prehospital 12-lead ECG.

Conclusions

Positive attitudes of EPs and cardiologist physicians toward the benefits of the prehospital 12-lead ECG are supported by this study.

References

1. The American Heart Association in Collaboration with the International Liaison Committee on Resuscitation: Guidelines 2000 for cardiopulmonary resuscitation and emergency cardiovascular care. Part 6: Advanced cardiovascular life support: 7C: A guide to the International ACLS algorithms. *Circulation* 2000;102(8 Suppl):I142-157.
2. Aufderheide TP, Bossaert LL, Field J, Herlitz J, Leizorovicz A, Littrell KA, Ornato JP, Peberdy MA, Ribichini F: Acute coronary syndromes. *Ann Emerg Med* 2001;37:S163-181.
3. Joyce SM: Prehospital 12-lead ECG. *Ann Emerg Med* 1997;30(3):352-353.
4. Canto JG, Rogers WJ, Bowlby LJ, French WJ, Pearce DJ, Weaver WD: The prehospital electrocardiogram in acute myocardial infarction: Is its full potential being realized? National Registry of Myocardial Infarction 2 Investigators. *J Am Col Cardiol* 1997;29(3):498-505.
5. Todd KH, Fun LJP: The minimum clinically important difference in physician-assigned visual analog pain scores. *Acad Emerg Med* 1996;3:142-146.
6. Bond A, Lader M: The use of analogue scales in rating subjective feelings. *Br J Med Psychol* 1974;47:211-218.
7. The American Heart Association in collaboration with the International Liaison Committee on Resuscitation: Part 1: Introduction to the international guidelines 2000 for CPR and ECC: A consensus on science. *Circulation* 2000;102(8 Suppl):1-11.
8. Brown SG, Galloway DM: Effect of ambulance 12-lead ECG recording on times to hospital reperfusion in acute myocardial infarction. *Med J Aust* 2000;172(2):81-84.
9. Weaver WD, Cerqueira M, Hallstrom AP, Litwin PE, Martin JS, Kudenchuk PJ, Eisenberg M: Prehospital-initiated vs hospital-initiated thrombolytic therapy. The Myocardial Infarction Triage and Intervention Trial. *JAMA* 1993;270(10):1211-1216.
10. Foster DB, Dufendach JH, Barkdoll CM, Mitchell BK: Prehospital recognition of AMI using independent nurse/paramedic 12-lead ECG evaluation: Impact on in-hospital times to thrombolysis in a rural community hospital. *Am J Emerg Med* 1994;12(1):25-31.

11. Karagounis L, Ipsen SK, Jessop MR, Gilmore KM, Valenti DA, Clawson JJ, Teichman S, Anderson JL: Impact of field-transmitted electrocardiography on time to in-hospital thrombolytic therapy in acute myocardial infarction. *Am J Cardiol* 1990;66(10):786-791.
12. Kereiakes DJ, Gibler WB, Martin LH, Pieper KS, Anderson LC: Relative importance of emergency medical system transport and the prehospital electrocardiogram on reducing hospital time delay to therapy for acute myocardial infarction: a preliminary report from the Cincinnati Heart Project. *Am Heart J* 1992;123(4 Pt 1):835-840.
13. Aufderheide TP, Lawrence SW, Hall KN, Otto LA: Pre-hospital 12-lead electrocardiograms reduce hospital-based time to treatment in thrombolytic candidates. *Acad Emerg Med* 1994;1(2):A13-14.
14. Fibrinolytic Therapy Trialists' (FTT) Collaborative Group: Indications for fibrinolytic therapy in suspected acute myocardial infarction: Collaborative overview of early mortality and major morbidity results from all randomised trials of more than 1000 patients. *Lancet* 1994;343(8893):311-322.
15. Boersma E, Maas AC, Deckers JW, Simoons ML: Early thrombolytic treatment in acute myocardial infarction: Reappraisal of the golden hour. *Lancet* 1996;348(9030):771-775.
16. The American Heart Association in collaboration with the International Liaison Committee on Resuscitation: Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Part 7: The era of reperfusion. *Circulation* 2000;102(8) Suppl 1:1-184.
17. Brown AL, Mann NC, Daya M, Goldberg R, Meischke H, Taylor J, Smith K, Osganian S, Cooper L: Demographic, belief, and situational factors influencing the decision to utilize emergency medical services among chest pain patients. Rapid Early Action for Coronary Treatment (REACT) study. *Circulation*. 2000;102(2):173-178.
18. Seipmann DB, Mann, NC, Hedges, JR: Association between prepayment systems and emergency medical services use among patients with acute chest discomfort syndrome. *Ann Emerg Med* 2000;35(6):573-577.
19. Chen J, Radford MJ, Wang Y, Marciniak TA, Krumholz HM: Do "America's Best Hospitals" perform better for acute myocardial infarction? *N Engl J Med* 1999;340(4):286-292.