

Triage of Patients with Chest Pain in the Emergency Department: A Comparative Study of Physicians' Decisions

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PURPOSE: Little is known about physicians' triage decisions for patients with chest pain in the emergency department. We sought to understand better the variability and accuracy of physicians' triage decisions.

SUBJECTS AND METHODS: We used 20 simulated cases to compare triage decisions by 147 physicians (46 emergency medicine, 87 internal medicine, and 14 cardiology physicians) with triage decisions recommended by a previously validated prediction rule. We calculated triage sensitivity and specificity using the prediction rule to estimate the likelihood that each of the simulated patients would suffer a major complication. Triage sensitivity was defined as the proportion of all patients expected to have major complications who were triaged to the coronary care or inpatient telemetry unit. Triage specificity was defined as the proportion of all patients without complications who were triaged to sites other than the coronary care or inpatient telemetry unit.

RESULTS: Physicians' triage decisions were less sensitive (85% vs. 96%, $P < 0.001$) and less specific (38% vs. 41%, $P = 0.02$)

than decisions recommended by the prediction rule. Physicians overestimated patients' risk of complications and triaged more patients to inpatient monitored beds. Despite their preference for inpatient monitored beds, physicians' decisions would have resulted in four times as many major complications in patients who were not triaged to inpatient monitored beds, compared with decisions recommended by the prediction rule (2.4% vs. 0.6%, $P < 0.001$). Although physicians' decisions were best explained by their provisional diagnoses, interphysician agreement about triage decisions ($\kappa = 0.34$) and diagnosis ($\kappa = 0.31$) was only fair.

CONCLUSIONS: In simulated cases, physicians' triage decisions varied widely and their predictions of patient outcomes differed markedly from that of the validated prediction rule, suggesting that use of the prediction rule in the emergency department could improve physicians' decisions and patients' outcomes. *Am J Med.* 2002;112:95-103. ©2002 by Excerpta Medica, Inc.

Of the 2 million patients with suspected acute cardiac ischemia admitted to hospitals in the United States annually, fewer than half have confirmed acute myocardial infarction or unstable angina (1). Between 2% and 8% of patients having an acute myocardial infarction are discharged mistakenly from the emergency department, resulting in adverse clinical outcomes for patients and costly malpractice judgments against emergency physicians (2-6).

Several investigators have proposed strategies to improve the safety and efficiency of physicians' triage decisions in this area (7-13). The risks of acute myocardial infarction, death, and other serious complications can be estimated accurately using clinical and electrocardiogram findings (11,12), serum markers of cardiac necrosis (14), or noninvasive myocardial imaging studies (15-17). Nevertheless, providing empirically validated risk estimates to attending physicians in the emergency department has

not affected triage decisions substantially (12,18). Indeed, little is known about how physicians make these complex decisions in normal situations or when resources are limited (19-24).

We have shown that Goldman and colleagues' prediction rule accurately risk stratified patients admitted from our emergency department and could safely reduce admissions to the inpatient cardiac telemetry unit (25,26). However, before advocating the use of the prediction rule in our emergency department, we sought to understand its likely impact by using simulated cases to compare physicians' triage decisions with those recommended by the prediction rule.

METHODS

Study Design

We prepared 20 written cases describing patients presenting with chest pain to the emergency department. The cases included information from the patient's history, physical examination, and 12-lead electrocardiogram on initial presentation, but not laboratory data (cardiac enzymes), results of imaging tests, or clinical course after the emergency department. Each case contained sufficient data to estimate the probability of coronary artery disease, acute myocardial infarction, and major cardiac

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Table 1. Clinical Characteristics of the 20 Simulated Patients with Chest Pain

Risk Category*	Case Number	Age (Years)	Sex	History	Electrocardiogram in Emergency Department		Clinical Risk Factors		
					Ischemia [†]	Infarction [‡]	Unstable angina	Congestive heart failure [§]	Hypotension
High	1	55	M	Typical angina [¶]	—	+	—	—	—
	2	50	M	Previous PTCA	+	—	+	+	—
	3	50	F	Atypical angina [¶]	+	—	—	+	+
Moderate	4	35	M	None	+	—	—	+	+
	5	50	M	Previous myocardial infarction	+	—	—	—	—
	6	43	M	Typical angina	—	—	+	+	—
	7	38	F	None	—	—	—	+	+
Low	8	45	M	None	+	—	—	—	—
	9	60	M	Previous myocardial infarction	—	—	+	—	—
	10	65	F	None	—	—	—	+	—
Very Low	11	34	M	Typical angina [¶]	—	—	+	—	—
	12	55	F	None	—	—	—	—	+
	13	50	M	Previous PTCA	—	—	—	—	—
	14	55	M	Atypical angina [¶]	—	—	—	—	—
	15	50	M	PTCA	—	—	—	—	—
	16	55	M	Typical angina [¶]	—	—	—	—	—
	17	48	M	Atypical angina [¶]	—	—	—	—	—
	18	48	M	Atypical angina [¶]	—	—	—	—	—
	19	38	M	None	—	—	—	—	—
	20	38	M	None	—	—	—	—	—

Plus sign (+) indicates condition present; minus sign (—) indicates condition not present.

* Determined by the probability of major cardiac complications within 72 hours of admission (11).

[†] Requires ST-segment depression or T-wave inversion in at least two contiguous leads, not known to be old.

[‡] Requires ST-segment elevation or Q waves in at least two contiguous leads, not known to be old.

[§] Determined by rales heard above both lung bases.

^{||} Refers to systolic blood pressure <110 mm Hg.

[¶] Defined by the criteria of Diamond and Forrester (27).

F = female; M = male; PTCA = percutaneous transluminal coronary angioplasty.

complications as reported in large outcomes studies (Table 1) (9,11,27). For example, in the case illustrated in Appendix A, the probability is approximately 87% for coronary artery disease (27), 10% for acute myocardial infarction (9), and 8% for a major cardiac complication within 72 hours of admission (11). We used a disproportionate number of cases that were at very low risk of myocardial infarction and cardiac complications to reflect the actual incidence in most institutions (9,11,25). We excluded cases describing patients with comorbid conditions that might confound physicians' triage decisions.

For each case, physicians were asked to estimate the probabilities of coronary artery disease (0% to 100%), acute myocardial infarction (0% to 100%), and any major cardiac complication occurring within 72 hours of presentation (0% to 100%). Major cardiac complications were the same events identified by Goldman and colleagues (11): cardiac arrest; ventricular fibrillation; new complete heart block; or the need for intubation, a tem-

porary pacemaker, an intraaortic balloon pump, or urgent revascularization. Physicians were also asked to choose one of five provisional diagnoses and one of five possible triage decisions (Appendix A).

All respondents evaluated the 20 case scenarios in one of five proctored 90-minute group sessions in April 1999. They also quantified their own recent experience caring for patients with chest pain in the emergency department (how many seen in the past year, how many for whom they had personally made the triage decision). None of the respondents had access to print or electronic media during these sessions.

Respondents

Respondents included 19 emergency medicine attending physicians and 27 residents rotating on the clinical emergency department service at the time of the study; 14 cardiology attending physicians and fellows rotating on the clinical cardiology service; 52 internal medicine residents

staffing the general medical ward and telemetry services; and 35 general internal medicine “hospitalist” attending physicians who staff the majority of the inpatient ward services. These five cohorts ($n = 147$) constituted approximately 60% of emergency medicine attending physicians, 50% of emergency medicine residents, 75% of cardiology attending physicians and fellows, 30% of internal medicine residents, and 50% of general medicine hospitalist attending physicians.

Outcome Measures

Primary study outcomes were the sensitivity and specificity of physicians’ triage decisions when compared with those recommended by the prediction rule, which estimates the likelihood that each of the simulated patients would suffer a major complication. Triage sensitivity was defined as the proportion of all patients expected to experience a major cardiac complication who were triaged to either the coronary care unit or inpatient telemetry beds. Triage specificity was defined as the proportion of patients not expected to experience a major cardiac complication who were not triaged to the coronary care unit or inpatient telemetry beds. As illustrated in Table 2, the prediction rule recommends admission to the coronary care unit for high-risk patients (16% probability of major complications), admission to the inpatient telemetry unit for moderate- and low-risk patients (4% to 8% probability of major complications), and triage elsewhere for very low-risk patients (0.6% probability of major complications). Appendix B illustrates risk stratification by the prediction rule.

Secondary outcomes included variation and agreement among physicians’ triage decisions and their estimates of the probability of myocardial infarction and major complications. We also examined predictors of physicians’ triage decisions, including clinical variables (age, sex, angina history, previous myocardial infarction or coronary revascularization, presence or absence of hypotension or congestive heart failure, and electrocardiogram abnormalities); physicians’ probability estimates (for coronary artery disease, acute myocardial infarction, and cardiac complications); physicians’ diagnoses (e.g., acute myocardial infarction, unstable angina, stable angina); and physicians’ specialty, level of training, and self-reported experience.

Data Analysis

Because each physician evaluated the same 20 case scenarios, observations among physicians were not independent and thus accounted for by considering each physician as a “cluster” of nonindependent responses. We compared physicians’ decisions while adjusting for this lack of independence using logit models with robust standard errors that were adjusted for clustering within each physician (STATA 6.0, College Station, Texas) (28). Sen-

sitivity was calculated using the same logit models with probability weights (or sampling weights) equal to the likelihood of a patient experiencing a major cardiac complication. Likewise, specificity was calculated using probability weights equal to the likelihood of not suffering a major cardiac complication.

There were missing data on four of the case scenarios (all very low risk cases) for 18 emergency medicine physicians because their questionnaires were missing the final page. We adjusted for the missing values by giving more weight to the responses for the last four simulated cases by emergency medicine physicians who did not have missing data. This allowed for an unbiased comparison, but with standard errors that were larger than if the missing data had been ignored (29). All analyses that did not involve comparisons among physician groups were performed without adjusting for missing data.

Sensitivity, specificity, areas under the receiver operating characteristic (ROC) curve, and their confidence intervals (CIs) were compared using Screen 4.01 (H. Kulkarni, Lata Research Foundation, Nagpur, India, 1999). Measures of agreement—kappa (κ), generalized κ , and reliability coefficients—were calculated using methods of Fleiss (30). All P values are two sided.

RESULTS

There were 2940 physician-case encounters, of which 2867 responses (98%) were complete and legible. Among the 147 respondents, 68 were attending physicians or fellows, and 79 were residents (postgraduate years 2 to 4). Overall, 44 physicians (30%) reported having made triage decisions for 10 to 50 patients with chest pain in the emergency department during the previous year, 40 (27%) for 50 to 100 patients, and 60 (41%) for 100 to 150 patients. Three physicians did not answer this question.

Physicians’ Agreements with the Prediction Rule

Overall, physicians’ decisions agreed with those recommended by the prediction rule in 58% of cases (1667 of 2867; Table 2). Physicians as a group agreed more frequently when the prediction rule recommended triage to the coronary care unit (83% agreement) than when it recommended triage to inpatient telemetry (50% agreement) or to other areas (63% agreement; Figure 1). Cardiologists agreed with the prediction rule less frequently (51%) than did internists (58%, $P = 0.02$) or emergency medicine physicians (59%, $P = 0.03$).

Interphysician agreement about triage decisions, after adjusting for chance, was only fair (overall $\kappa = 0.34$). Cardiologists’ triage decisions agreed with other cardiologists’ decisions in 50% of cases ($\kappa = 0.24$), with internists’ decisions in 51% of cases ($\kappa = 0.26$), and with emergency medicine physicians in 52% of cases ($\kappa =$

Table 2. Triage Decisions and Estimated Probabilities of a Major Cardiac Complication and Myocardial Infarction, by Risk Strata

Risk Category [‡]	Case Number	Prediction Rule Recommendation [§]	Triage Decisions			Estimated Probabilities			
			Physicians' Decisions*			Major Complication [†]		Myocardial Infarction	
			Coronary Care Unit	Inpatient Telemetry	Other	Prediction Rule [¶]	Physicians	Prediction Rule [¶]	Physicians
Percentage or Mean % (±SD)									
High	1	Coronary care unit	90	9	1	16	41 ± 27	75	82 ± 22
	2	Coronary care unit	92	7	1	16	41 ± 26	25	64 ± 27
	3	Coronary care unit	75	24	1	16	39 ± 30	25	50 ± 29
	4	Coronary care unit	74	16	10	16	46 ± 32	25	56 ± 32
Moderate	5	Inpatient telemetry	25	71	4	8	24 ± 21	25	42 ± 23
	6	Inpatient telemetry	35	51	14	8	28 ± 24	15	42 ± 27
	7	Inpatient telemetry	37	39	24	8	21 ± 23	2	31 ± 27
	8	Inpatient telemetry	9	52	39	8	11 ± 13	15	26 ± 22
Low	9	Inpatient telemetry	30	65	5	4	26 ± 21	15	48 ± 25
	10	Inpatient telemetry	20	57	23	4	22 ± 21	2	36 ± 26
	11	Inpatient telemetry	12	47	41	4	14 ± 17	15	28 ± 24
	12	Inpatient telemetry	3	16	81	4	7 ± 11	2	13 ± 15
Very Low	13	Other	15	63	22	0.6	20 ± 21	2	28 ± 22
	14	Other	7	62	31	0.6	12 ± 15	2	23 ± 20
	15	Other	5	50	45	0.6	12 ± 14	2	18 ± 16
	16	Other	3	36	61	0.6	9 ± 11	2	13 ± 13
	17	Other	2	20	78	0.6	7 ± 10	2	12 ± 15
	18	Other	1	16	82	0.6	7 ± 9	2	11 ± 12
	19	Other	2	13	85	0.6	7 ± 11	2	11 ± 14
	20	Other	1	3	96	0.6	5 ± 9	2	8 ± 11

* There were 147 physician decisions for each case, except for cases 15 to 17 and 19 (n = 129) and case 20 (n = 146). Triage decision options included the coronary care unit, inpatient telemetry unit, or other sites (emergency department observation unit, unmonitored ward, or home).

† Cardiac arrest, ventricular fibrillation, new complete heart block, or the need for intubation, a temporary pacemaker, an intra-aortic balloon pump, or urgent revascularization (11).

‡ Determined by the probability of major cardiac complications within 72 hours of admission (Appendix B) (11).

§ Determined by the risk of major cardiac complications (11): high-risk patients would be triaged to the coronary care unit; low- and moderate-risk patients to the inpatient telemetry unit; and very low risk patients to other sites (emergency department observation unit, unmonitored ward, or home).

|| There were 147 physician probability estimates (0% to 100%) for each case, except for cases 15 to 17 and 19 (n = 129 each) and case 20 (n = 146).

¶ Prediction rule's probability estimates for major cardiac complications determined from an outcomes study of more than 15,000 patients (11), and probability estimates for myocardial infarction determined from an outcomes study of more than 6000 patients (9).

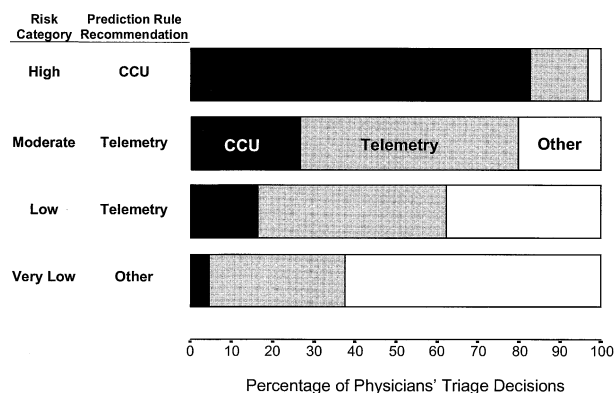


Figure 1. Variation in physicians' triage decisions by risk category. The **horizontal bars** represent the relative proportion of physicians' triage decisions among cases that are high, moderate, low, and very low risk for major cardiac complications. The **black portions** represent the percentage triaged to the coronary care unit; the **gray** represents the percentage triaged to inpatient telemetry; and the **white** represents the proportion triaged to other sites. CCU = coronary care unit.

0.28). Internists' decisions agreed with emergency medicine physicians' decisions in 59% of cases ($\kappa = 0.38$).

Sensitivity and Specificity of Physicians' Triage Decisions

The sensitivity and the specificity of physicians' triage decisions, however, were inferior to that of the prediction rule (Table 3). Physicians' decisions would result in a smaller proportion of all patients predicted to suffer major complications being triaged to inpatient monitored beds (sensitivity = 85% vs. 96%; difference = 11 percentage points [95% CI: 9% to 13%]; $P < 0.001$). In addition, a smaller proportion of all patients predicted not to suffer major complications were not being triaged to inpatient monitored beds (specificity = 38% vs. 41%; difference = 3 percentage points [95% CI: 1% to 5%]; $P = 0.02$). Thus, although physicians would triage more patients to inpatient monitored beds (1821 vs. 1764; $P = 0.09$), the complication rate among patients not triaged by physicians to inpatient monitored beds (2.4% [25 of 1046]) would be 4

Table 3. Comparisons between Physician Triage Decisions and Decisions Recommended by the Prediction Rule

	Triage Decisions Made by	
	Prediction Rule	Physicians
Triage decisions and expected complications		
Coronary care unit		
Number triaged to coronary care unit	588	789
Number of complications in coronary care unit (%)	94 (16)	94 (11.9)
Inpatient telemetry		
Number triaged to inpatient telemetry	1176	1032
Number of complications in inpatient telemetry (%)	69 (5.9)	51 (4.9)
Subtotal: coronary care unit plus telemetry (inpatient monitored beds)		
Number triaged to inpatient monitored beds	1764	1821
Number of complications in inpatient monitored beds (%)	163 (9.2)	145 (7.9)
Other areas*		
Number triaged to other areas	1103	1046
Number of complications in other areas (%)	7 (0.6)	25 (2.4)
Triage sensitivity [†]		
95% confidence interval	0.96 (163/170)	0.85 (145/170)
Range (SD) [‡]	—	0.84 to 0.87
Triage specificity [§]		
95% confidence interval	0.41 (1097/2698)	0.38 (1021/2698)
Range (SD) [‡]	—	0.35 to 0.40
Area under ROC curve		
95% confidence interval	0.76	0.68
	0.73 to 0.79	0.64 to 0.72

* Included the emergency department observation unit, unmonitored ward, or home.

[†] The proportion of patients expected to have a major cardiac complication within 72 hours of admission who are triaged either to the coronary care unit or to the inpatient telemetry unit.

[‡] Describes the minimum and maximum values among the 147 physicians. The SD also describes the variability in sensitivity and specificity among the 147 physicians for the 20 simulated cases.

[§] The proportion of patients not expected to have a major cardiac complication within 72 hours of admission who are triaged to sites other than the coronary care unit or inpatient telemetry unit.

^{||} Measures the extent that a trichotomized decision (coronary care unit vs. inpatient telemetry vs. other) discriminates between patients who will and will not have major cardiac complications. A value of 1.0 is perfect discrimination, and a value 0.5 is no better than chance alone.

ROC = receive operating characteristic.

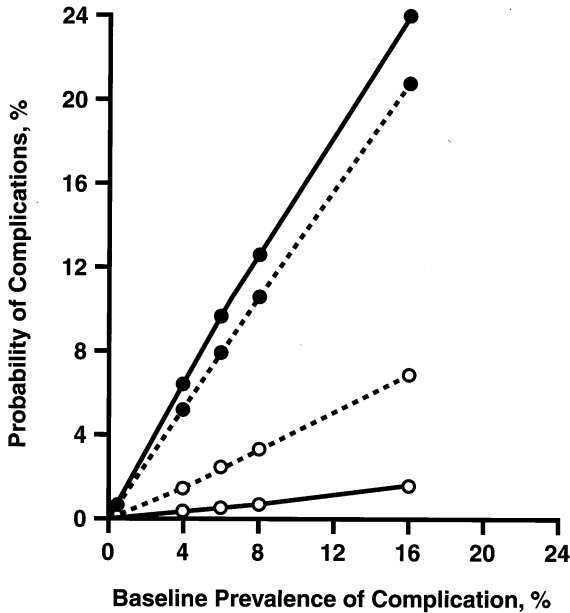


Figure 2. Expected probability of major cardiac complications among patients triaged by physicians' decisions or by the prediction rule at different baseline rates of complications. **Solid lines** depict the performance of the prediction rule (sensitivity = 96%, specificity = 41%); **dotted lines** depict the performance of physicians' decisions (sensitivity = 85%, specificity = 38%) when the predicted outcome is major cardiac complications occurring in either the coronary care unit or the inpatient telemetry unit. **Closed circles** depict the probability of complications expected to occur among patients triaged to the coronary care unit or inpatient telemetry; **open circles** depict the probability of complications expected to occur among patients not triaged to the coronary care unit or inpatient telemetry.

times higher than the rate determined by the prediction rule (0.6% [7 of 1103]; $P < 0.001$).

Physicians' triage decisions were less discriminating than the prediction rule (Figure 2), not only when analyzed as dichotomous decisions (triage to inpatient monitored beds vs. other sites), but also when analyzed as trichotomous decisions (triage to coronary care unit vs. inpatient telemetry unit vs. other areas). The prediction rule's area under the ROC curve was 0.76 (95% CI: 0.73 to 0.79) compared with 0.68 (95% CI: 0.64 to 0.72) for physicians' decisions ($P = 0.003$).

Physicians' triage decisions were best described by a "diagnosis-based" model in which the most important factor was physicians' provisional diagnosis (acute myocardial infarction vs. unstable angina vs. neither; area under the ROC curve = 0.8). However, agreement on provisional diagnosis was not high ($\kappa = 0.31$). Their decisions were also strongly associated with their quantitative estimates of the probabilities of major complications and acute myocardial infarction. Nevertheless, physicians consistently overestimated these probabilities (Table 2),

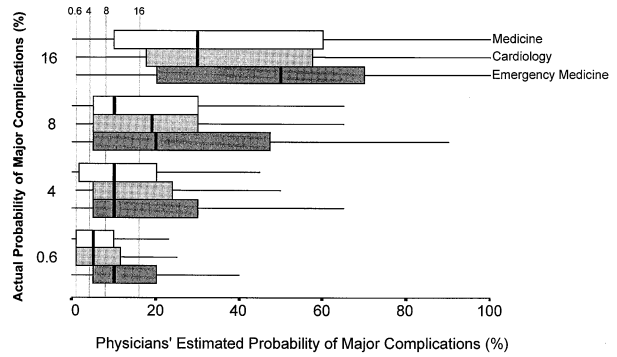


Figure 3. Physicians' estimates of the probability of major cardiac complication by the patient's actual probability of a major complication and by physician specialty. The bars represent the middle half of the estimates of general internal medicine physicians (white bars), cardiology physicians (light gray bars), or emergency medicine physicians (dark gray bars). The whiskers extend to the extreme value or to 1.5 times the interquartile range, whichever is closest. The black vertical line within each bar marks the median value. The light gray vertical reference lines identify the actual probabilities for the very low, low-, moderate-, and high-risk cases (11).

which also varied widely (Figures 3 and 4). The variations in physicians' probability estimates, diagnoses, and decisions were equally wide, regardless of physicians' specialty, level of training, or self-reported clinical experience.

DISCUSSION

Our findings suggest that the use of Goldman and colleagues' prediction rule could improve physicians' triage decisions in the emergency department, resulting in fewer "missed" complications without increasing the use of the coronary care unit and inpatient telemetry beds. Our physicians made triage decisions for simulated patients that varied widely, disagreed frequently, and predicted patients' outcomes less accurately than did the prediction rule (the reference standard). Based on these results and previous studies (25,26), we believe the prediction rule deserves prospective testing as a decision rule in the emergency department.

Triage sensitivity and specificity can be understood best in terms of safety and efficiency. A safe triage means admitting patients who will suffer life-threatening complications to intensive (or intermediate) care units. Triage safety thus depends on a highly sensitive prediction of such complications. Triage specificity—not admitting patients who will not suffer complications to intensive care units—ensures an efficient use and availability of intensive care resources for patients who need them most (19,20,24). However, like "trade-offs" between the sensi-

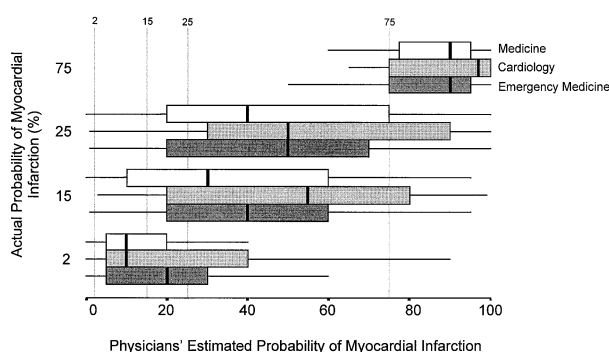


Figure 4. Physicians' estimates of the probability of myocardial infarction by the patient's actual probability of myocardial infarction and by physician specialty. The bars represent the middle half of the estimates of general internal medicine physicians (white bars), cardiology physicians (light gray bars), or emergency medicine physicians (dark gray bars). The whiskers extend to the extreme value or to 1.5 times the interquartile range, whichever is closest. The black vertical line within each bar marks the median value. The light gray vertical reference lines identify the actual probabilities of myocardial infarction for groups of cases (9).

tivity and specificity of diagnostic tests, efforts to increase triage sensitivity may decrease triage specificity, and vice versa. Hence, the importance of our finding that use of the prediction rule may improve both the sensitivity (safety) and the specificity (efficiency) of physicians' triage decisions.

We demonstrated that the prediction rule was more effective than physicians' decisions in predicting major complications (Figure 2). At any given baseline prevalence of complications, it would triage patients with a higher probability of complications to inpatient monitored beds, and patients with a lower probability of complications to other areas. This superior discriminating ability increases as the baseline probability of complications in the triaged population increases. It is important to note that Figure 2 illustrates the potential efficacy of the prediction rule in improving triage performance, not its actual effectiveness. Understanding the gap between efficacy and effectiveness must await prospective studies of the prediction rule in real-time clinical practice (18).

If future studies confirm the prediction rule's clinical effectiveness, achieving and sustaining improvement outside the research setting will remain a challenge. As documented in the present study, physicians' triage decisions vary remarkably and disagree frequently. To improve their decisions systematically, physicians must not only adopt the logic of the prediction rule, but also implement it accurately and reliably. We have shown (25) that physicians' diagnoses of unstable angina and their interpretations of electrocardiograms may be unreliable and inaccurate, thus compromising the specificity of the prediction rule and the efficiency of triage. Research de-

signed to improve physicians' performance in these areas deserves wide attention (12,16,31–37). Furthermore, the prediction rule's effectiveness in "real-world" practice may also vary with emergency department patient volume, case mix, and staffing; availability of coronary care unit and inpatient telemetry beds (12); options for care of very low risk patients (e.g., chest pain observation units); and availability of timely outpatient follow-up. Detailed discussion of these institutional issues is beyond the scope of this paper.

Our study has several limitations. First, we studied physicians in only one institution, and our results may not be generalizable. Second, clinicians' responses to simulated cases may not reflect their actual behavior. However, the triage decisions made by physicians in the present study (64% of simulated patients admitted to inpatient monitored beds) were very similar to physicians' actual triage decisions in two studies (11,12). In addition, risk stratification of the simulated patients triaged to the inpatient telemetry unit in the present study was similar to actual data from our own institution (26). Third, we compared physicians' decisions only with decisions recommended by the prediction rule; we did not compare either with another gold standard because no such standard exists. Our assumption that the prediction rule accurately predicts complications is strongly supported by our previous studies (25,26). Finally, we analyzed relatively simple cases, excluding patients with comorbid clinical conditions that might confound triage decision making. Only prospective testing of the prediction rule in actual patients in the emergency department can address this issue adequately.

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APPENDIX A

Example of a simulated case, including questions
 A 43-year-old man with a history of exertional substernal chest pain relieved by rest or sublingual nitroglycerin complains of chest pain that began while he was watching television. The pain lasted 2 hours and went away spontaneously when he was going to the hospital.

Vital signs: normal

Lung examination: rales 1/4 up above the bases

Cardiac examination: normal

Electrocardiogram: normal

Questions

1. What is your estimate of the probability that this patient has coronary artery disease (i.e., >70% angiographic stenosis of one or more major coronary arteries)?

Probability estimate: _____ (0%–100%)

2. What is your estimate of the probability that this patient will “rule-in” for an acute myocardial infarction during the next 24 hours?

Probability estimate: _____ (0%–100%)

3. What is your estimate of the probability that this patient will suffer a major cardiac complication during the next 72 hours?

Probability estimate: _____ (0%–100%)

4. If you had to choose *only one* of the following diagnoses given the clinical information provided in the case above, which diagnosis would you choose?
- Evolving Q-wave myocardial infarction
 - Evolving non-Q-wave myocardial infarction
 - Unstable ischemic heart disease
 - Stable ischemic heart disease
 - Chest pain, diagnosis uncertain
5. Assume you are the sole decision-making clinician for this patient in the emergency department. Which of the following triage decisions would you make?
- Admit to the coronary care unit.
 - Admit to an inpatient cardiac telemetry unit.
 - Admit to a 23-hour observation unit.
 - Admit to a nontelemetry inpatient medicine ward.
 - Discharge from the emergency department and follow up as an outpatient.

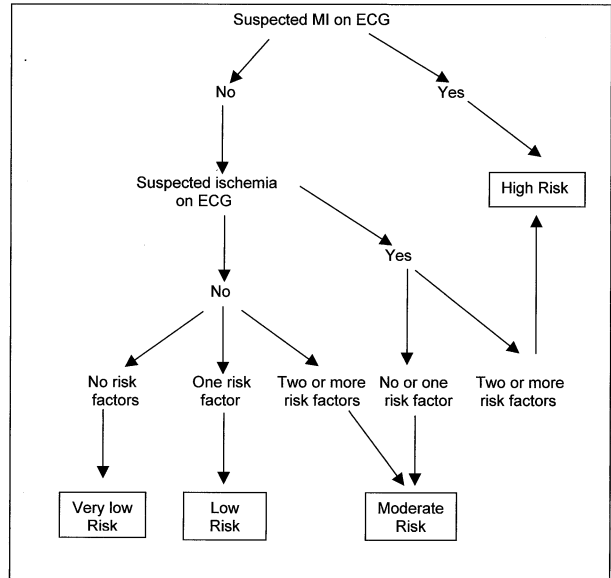


Figure 5. Derivation of the four initial risk groups on the basis of data available on arrival in the Emergency Department.

APPENDIX B

Algorithm depicting the prediction rule

Derivation of the four initial risk groups on the basis of data available at the time of presentation in the Emergency Department (Figure 5). Myocardial infarction (MI) was suspected if the electrocardiogram (ECG) showed ST-segment elevation of 1 mm or more or pathologic Q waves in two or more leads, and these findings were not known to be old. Ischemia was suspected if the ECG showed ST-segment depression of 1 mm or more or T-wave inversion in two or more leads, and these findings were not known to be old. Risk factors included systolic

blood pressure below 110 mm Hg, rales heard above the bases bilaterally on physical examination, and known unstable ischemic heart disease, defined as a worsening of previously stable angina, the new onset of postinfarction angina, or angina after a coronary myocardial infarction. The difference between each adjacent pair of risk groups was significant ($P < 0.001$). Reproduced with permission from Goldman et al (11). Copyright© 1996 Massachusetts Medical Society. All rights reserved.