**WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care**

**Worksheet author(s)**

<table>
<thead>
<tr>
<th>William J Brady</th>
<th>Current Submission: February 2, 2010</th>
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<tbody>
<tr>
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<td>Original Submission: February 12, 2009</td>
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**Clinical question.**

"In patients with suspected ACS (P), does the presence of any specific factors (e.g. history, examination, ECG, and/or biomarkers) or combination into a specific clinical decision rule (I), compared with standard care (C), increase accuracy of prediction of prognosis (e.g. decision rule for early discharge) (O)?"

Is this question addressing an intervention/therapy, prognosis or diagnosis?  **Prognosis**

State if this is a proposed new topic or revision of existing worksheet: **New topic**

**Conflict of interest specific to this question**

No conflict of interest.

**Search strategy (including electronic databases searched).**

MedLine Search

1. acute coronary syndrome.mp. or *Acute Coronary Syndrome/ 4499
2. *Coronary Disease/ or *Myocardial Infarction/ or risk stratification.mp. or *Risk Assessment/ or Angina, Unstable/ 76586
3. *Emergency Service, Hospital/ or emergency department.mp. 22979
4. prognosis.mp. or *Prognosis/ 186580
5. outcome.mp. or *Treatment Outcome/ 591727
6. predictive.mp. or "Predictive Value of Tests"

   *Decision Making/ or *Decision Support Systems, Clinical/ or *Decision Support Techniques/ or decision rule.mp. or *Emergency Service, Hospital/ or Emergency Medicine/ 30899
7. 1 and 3 290
8. 8 and 7 109
9. 6 and 8 1
10. 8 and 5 77
11. 8 and 4 39
12. 8 and 2 178
13. 11 or 9 or 10 or 13 or 12 240
14. limit 14 to (humans and yr="1986 - 2009") 240
240 references from Search #15 were reviewed.  
NB: The above search was performed again with the only addition of 2010 as time end-point of search.

### State inclusion and exclusion criteria

**Inclusions:**
--acute coronary syndrome, acute myocardial infarction, coronary disease;  
--risk stratification, prognosis, outcome, treatment outcomes, predictive, predictive value of tests, decision making, decision support systems, decision support techniques, decision rule, or decisions; and  
--emergency service (hospital), emergency department

**Exclusions:**
--therapy (medical, catheter-based, stent, etc)  
--inpatient / non-ED focus  
--off topic (non-ACS)  
--novel diagnostic tests (new or introduction; no substantial data)

**Number of articles/sources meeting criteria for further review:** 240 Articles found by literature search. 217 excluded because of exclusion criteria noted above. 23 reviewed, evaluated, and used in worksheet completion. Note that 3 additional references were added [Han JH, Lindsell CJ, et al (2007); Jayes RL, Beshansky JR, et al (1992); and Turnipseed SD, Trythall WS, et al (2009)] which were not found in the described literature review. 26 articles were used for worksheet completion. One additional article [Hamm (1997)] was added by suggestion of worksheet review committee, leaving 27 articles ultimately used for worksheet completion.
Summary of evidence

NB: Regarding “Support for the Clinical Question,” such references will be considered **supporting** if the study supports the contention that clinical data in the ED can **assist** in the identification of those patients that can be safely discharged from the ED; such references will be considered **neutral** if the study neither supports nor opposes this contention; and such references will be considered **opposing** if the study opposes this contention.

### Evidence Supporting Clinical Question

| Fair | |
| Poor | |
| | Ghaemmaghami C (2008), E3 |

**Level of evidence**

<table>
<thead>
<tr>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
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<tbody>
<tr>
<td>E1 = Clinical Presentation (Symptoms, Medical History, Examination)</td>
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<tr>
<td>E2 = Electrocardiogram</td>
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<td>E3 = Serum Marker</td>
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<td>E4 = Other Diagnostic Study</td>
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<td>E5 = Decision Rules, Risk Scores, Medical Decision with Combination of Clinical Variables</td>
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<td>E6 = Diagnosis (Primary or Alternative)</td>
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Evidence Neutral to Clinical question

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<th>Level of evidence</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
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<tr>
<td></td>
<td>P1</td>
<td>P2</td>
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Level of evidence

E1 = Clinical Presentation (Symptoms, Medical History, Examination)
E2 = Electrocardiogram
E3 = Serum Marker
E4 = Other Diagnostic Study
E5 = Decision Rules, Risk Scores, Medical Decision with Combination of Clinical Variables
E6 = Diagnosis (Primary or Alternative)
## Evidence Opposing Clinical Question

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<td>P1</td>
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**Level of evidence**

E1 = Clinical Presentation (Symptoms, Medical History, Examination)
E2 = Electrocardiogram
E3 = Serum Marker
E4 = Other Diagnostic Study
E5 = Decision Rules, Risk Scores, Medical Decision with Combination of Clinical Variables
E6 = Diagnosis (Primary or Alternative)
In the ED-based evaluation of the patient with chest pain or equivalent presentation suspected of acute coronary syndrome, it is relatively easy to identify those patients clearly deserving admission to the hospital (the high risk patient with ACS) and those patients suitable for discharge from the ED with minimal evaluation (the very low risk patient without ACS). Within these two risk extremes, the true challenge is found in ACS evaluation -- the identification of those low to intermediate risk patients. The evaluation is performed in the ED using the history, examination, electrocardiogram, and biomarkers; additional studies such as exercise stress testing, nuclear scanning, echocardiography, coronary CT, etc. can be used in certain institutions by certain providers yet, importantly, these studies are not available at all times in all medical centers -- thus their impact is limited when one considers this evaluation in all centers by all providers. Additional studies were thus not considered in this worksheet evaluation. The period of observation in this worksheet focused on an approximate 12 hour time period during which the evaluation and observation occurred.

In this worksheet, an adverse event rate less than 1% was pursued in the evaluation of the various decision rules. The ED evaluation reviewed included the following elements: history, examination, electrocardiogram, and cardiac biomarkers. The patient group considered is the intermediate to low risk population. The evaluation strategy included a 6 to 12 hour period of test performance (biomarkers and ECG) along with clinical observation. Lastly, short-term outcomes (i.e., 30 days) were reviewed whenever possible -- it is assumed that once the ED evaluation is complete, the patient will follow-up with an outpatient healthcare provider.

This review revealed that current prediction rules for ACS have substantial methodological limitations (varying definitions, reference standards, etc.); furthermore, significant heterogeneity among the studies was also noted. Lastly, the focus of several studies was risk stratification in the ED rather than the identification of a subgroup of patients who could be safely discharged from the emergency department. In other words, the literature exploring this issue is suboptimal at best.

This review demonstrated that individual elements of the evaluation did not perform consistently in a satisfactory fashion – thus individual features of the presentation are of limited value in the identification of patients who are appropriate for ED discharge. The clinical history of the chest pain event, which includes the chief complaint, descriptors of the discomfort, associated symptoms, past medical history, and CAD risk factors, demonstrated mixed results in this discrimination. For instance, Schillinger M, Sodeck G, et al (2004) and Bassan R, Pimenta L, et al (2004) report that the clinical history can guide the clinician in this decision. Schillinger M, Sodeck G, et al (2004) concluded that atypical features are potentially of value in “ruling out” ACS or, at least, identifying a very low risk group of patients; Bassan R, Pimenta L, et al (2004) reported that chest pain type is the best single diagnostic tool to rule out ACS in the ED – thus individual features of the presentation are of limited value in the identification of patients who are appropriate for ED discharge. The clinical history itself, recommending that additional ancillary tools should be considered in this decision; in fact, the “low risk” category demonstrated an 8% adverse event rate at 30 days. CAD risk factor analysis does not appear to add increased concern for ACS in individual patient evaluation -- nor does this analysis identify patients who are safe for discharge. Han JH, Lindsell CJ, et al (2007) and Jayes RL, Beshansky JR, et al (1992) reported that risk factor analysis did not add value to the ED evaluation of the suspected ACS patient, noting that these data are a population phenomenon and do not increase or decrease the likelihood of any condition in any one patient. Another single element consideration, the physical examination does not add to this decision -- in other words, the absence of abnormality in this patient population does not equate with a “safe to discharge” scenario as noted by Schillinger M, Domanovits H, et al (2002) in a review of chest pain patients with pulmonary edema. Lastly, the ECG, was reported by Challa PK, Smith KM, et al (2007) in which the authors hypothesized that ED chest pain patients initially suspected of ACS whose initial electrocardiogram (ECG) is normal do not require hospital admission; in fact, that is exactly what they found -- with electrocardiographic increasing abnormality, increasing risk was seen; importantly, patients with normal ECGs could be safely discharged from the ED with a very low risk.

Combinations of these elements – e.g. clinical decision rules -- in certain populations performed in a more satisfactory, yet still limited, fashion. Clinical decision rules, heterogeneous in construction, yield mixed results with supporting, neutral, and opposing results. Christenson J, Innes G, et al (2006) developed a rule which is certainly of value in the younger patient (less than 40 years of age) with a negative ED evaluation (history, examination, ECG findings, and cardiac biomarker results) – it essentially identifies a subgroup of patients who can be safely discharged from the ED after a brief evaluation; it is of markedly less clinical value in older patients or in those individuals with a past history of ischemic heart disease. Marsan RJ, Shaver KJ, et al (2005) note that a clinical decision rule developed in the ED population which states that younger patients without past IHD, no traditional CAD risk factors, a normal ECG, and negative biomarker could be safely discharged; importantly, the history and ECG did not perform well yet, with the addition of the biomarker testing, the rule’s ability to identify a group suitable for ED discharge. Lai C, Noeller TP, et al
(2003) suggested that a negative ED evaluation involving serial electrocardiograms and biomarkers can identify patients at very low risk of short-term cardiac events -- thus, appropriately selected patients can be safely discharged for subsequent outpatient testing. Using the TIMI risk score, Soiza RL, Leslie SJ, et al. (2006) concluded that this approach is a valid tool for risk stratification in unselected cases with possible ACS; it is important to note that this paper is the most supportive of the reports investigating the use of non-ED-derived risk scoring systems in this consideration. Lastly, Ghaemmaghami C (2008) reports in a personal communication that negative serial troponin determinations, in the setting of a stable, lower suspicion patient with a normal to near-normal ECG, is associated with an extremely low adverse event rate in adult chest pain patients who have competed the “rule out MI” ED evaluation. Hamm CW, Goldmann BU, et al. (1997) used serial troponin testing in ED chest pain patients who lacked ST segment elevation on the initial ECG; they found that negative serial troponin determinations were associated with a very low rate (1% or less) of adverse outcome (death and nonfatal MI) within 30 days of ED evaluation.

Other clinical decision rule reports are less supportive of the ED’s ability to identify patients which are safe for discharge. Importantly, Hess EP, Thiruganasambamamoorthy V et al (2008) performed a meta-analysis of 8 decision rules attempting to identify selection criteria for ED chest pain discharge -- no safe criteria were found; further, the existing literature was termed “less than adequate” to address the issue. A range of studies, typified by Limkakeng A, Gibler WB, et al (2001) and Chase M, Robey JL, et al (2006), explore the use of inpatient-derived risk scoring systems, such as TIMI, Goldman, GRACE, etc.; these studies found that risk scoring correlated with outcome; unfortunately, the scoring systems did not separate patients into discrete risk groups, allowing for the identification of individuals appropriate for ED release. Other such studies [Hollander JE, Robey JL, et al (2007), Conway MA, Caesar AD, et al. (2006), Jaffery Z., Hudson MP, et al. (2007), Karounos M, Chang AM, et al. (2007), Lyon RA, Morris AC, et al. (2007), Pollack CV, Sites FD, et al. (2006), and Campbell CF. Chang AM. et al (2009)] demonstrated a correlation with risk yet did not identify discrete groups suitable for discharge nor demonstrate an acceptably low rate of adverse event at low levels of calculated risk. The use of inpatient-derived risk scoring systems (e.g. TIMI) are not appropriate for use in the ED and do not assist in the identification of patients who can be safely discharged from the emergency department.

After completion of the ED evaluation, the demonstration of an alternative diagnosis (i.e., not ACS) yielded mixed results regarding the diagnosis and outcome. For instance, Miller CD, Lindsell CJ, et al (2005) concluded that, despite an initial impression of noncardiac chest pain, the presence of traditional coronary risk factors or established histories of coronary artery disease or CHF should prompt further consideration of ACS due to increased risk. Furthermore, Hollander JE, Robey JL, et al (2007) and Campbell CF. Chang AM. et al (2009) reported that the presence of an alternative noncardiac diagnosis was associated with a reduced risk of AMI yet this noncardiac group experienced an elevated rate of negative outcome from noncardiac causes. Hillis GS, Oliner C, et al (2001) documented the presence of CAD in patients who have completed the “R/O MI” process successfully in the ED – after the evaluation and planned discharge, 33% of these patients had evidence of coronary artery disease at subsequent cardiac catheterization.

### Conclusion

In the ED-based evaluation of the patient with chest pain suspected of ACS, the assessment of risk in the low to intermediate suspicion presentation -- and determination of safe discharge -- is quite difficult. This evaluation occurs over a 6 to 12 hour period using the history, examination, biomarkers, and electrocardiogram. The existing literature, heterogeneous with numerous limitations, suggests that younger patients with atypical presentations, non-troublesome medical histories, and no past ischemic heart disease, have very low rates of short-term adverse outcome. Further, the use of serial 12-lead electrocardiograms and biomarkers, if normal, can identify a subgroup of patients who can be safely discharged from the ED for continued outpatient evaluation. Younger patients as described above demonstrate a short-term outcome suitable to allow for ED discharge; older patients and those patients with known CAD are less effectively evaluated in this fashion. Lastly, the use of inpatient-derived risk scoring systems (e.g. TIMI) are not appropriate for use in the ED; these scoring systems are not appropriate to identify patients who can be safely discharged from the ED.

### Acknowledgements

None
Reference List

Clinical History
SUPPORTING -- Good / P2 / E1
This paper suggests that the type of chest pain is the best discriminator for ACS vs non-ACS identification and thus determining which patients can be safely discharged from the ED.

Management of chest pain patients in the emergency department has been a dilemma because of difficulty in identifying those who can be immediately discharged and those who need to be hospitalized. We assessed the efficacy of a probability stratification model and a systematic diagnostic strategy in 1003 consecutive chest pain patients prospectively evaluated and stratified for acute coronary syndromes according to chest pain characteristics and admission electrocardiogram. Patients with no suspicion of acute coronary syndromes (n = 224) were immediately discharged, whereas those with very-high probability (n =119) were admitted to the coronary care unit. Remaining patients were evaluated in a Chest Pain Unit and investigated during a 9-hour period (intermediate-probability, n = 433) (route 2) and a 6-hour period (low-probability, n = 277) (route 3). Sensitivity and negative predictive value of chest pain type for the diagnosis of acute myocardial infarction (94% and 97%, respectively) was much better than the admission electrocardiogram (49% and 86%, respectively) and admission creatine kinase-MB (46% and 86%, respectively). Serial creatine kinase-MB determinations ruled out acute myocardial infarction by the third-hour postadmission in all route 3 patients but only at the ninth-hour in route 2 patients. For patients with no ST-segment elevation, chest pain type was the strongest independent predictor of acute coronary syndromes. The authors concluded that chest pain type is the best single diagnostic tool to rule in/out acute coronary syndromes on admission to the emergency department. Patients with suspicious chest pain must have serum creatine kinase-MB measurements up to 9 hours postadmission to rule out acute myocardial infarction. This paper is interesting in that it suggests that the history (chest pain description) is the best discriminator of ACS vs non-ACS – which is in disagreement with other published work suggesting that the history alone is not a powerful discriminator.

Decision Rule plus Alternative Diagnosis
OPPOSING -- Good / P2 / E1 & E5
The TIMI risk score stratifies patients with and without an alternative diagnosis. Unfortunately, patients with both a low TIMI risk score and a clinical impression of an alternative noncardiac diagnosis still have a risk of 30-day adverse events that is not low enough to allow safe discharge from the ED.

The Thrombolysis in Myocardial Infarction (TIMI) risk score is a validated risk stratification tool useful in patients with definite and potential acute coronary syndromes (ACS) but does not identify patients safe for discharge from the emergency department (ED). Likewise, the use of a clear-cut alternative noncardiac diagnosis risk stratifies patients but does not identify a group safe for discharge. We hypothesized that the presence of an alternative diagnosis in patients with a TIMI risk score less than 2 might identify a cohort of patients safe for ED discharge. In prospective cohort study, we enrolled ED patients with potential ACS. Data included demographics, medical history, components of the TIMI risk score, and whether the treating physician ascribed the condition to an alternative noncardiac diagnosis. Investigators followed the patients through the hospital course, and 30-day follow-up was done. The main outcome was 30-day death, myocardial infarction, or revascularization. A total of 3169 patients were enrolled (mean age, 53.6+/-14 years; 45% men; 67% black). There were 991 patients (31%) with an alternative diagnosis, 980 patients with a TIMI risk score of 0, and 828 with a TIMI score of 1. At low levels of TIMI risk (<3), adding in a clinical impression of an alternative diagnosis did not reduce risk; at higher levels of TIMI risk, it did. The incidence of 30-day death, myocardial infarction, or revascularization for patients with a clinical impression of an alternative diagnosis and a TIMI score of 0 was 2.9% (95% confidence interval, 1.6%-5.0%). The TIMI risk score stratifies patients with and without an alternative diagnosis. Unfortunately, patients with both a low TIMI risk score and a clinical impression of an alternative noncardiac diagnosis still have a risk of 30-day adverse events that is not low enough to allow safe discharge from the ED.

ECG
SUPPORTING -- Good / P2 / E2
These authors correlated the degree of ECG abnormality with risk – with increasing abnormality, increasing risk was seen; patients with normal ECGs could be safely discharged from the ED.

The authors of this study hypothesized that ED chest pain patients initially suspected of ACS whose initial electrocardiogram (ECG) is normal do not require hospital admission. ED patients with chest pain suspected of ACS who were admitted to the hospital for ACS (#250) were reviewed. The initial ECG of each patient was evaluated and compared with the final diagnosis. Of the 75 patients presenting with normal ECGs, 1 (1.3%) was subsequently diagnosed with an NSTEMI. Of the 55 patients presenting with abnormal ECGs (i.e., confounding pattern such as LBBB), 2 (3.6%) were diagnosed with AMI. Of the 48 patients presenting with abnormal ECGs (minimally abnormal with nonspecific findings), 7 (14.6%) were diagnosed with an AMI. Of the 72 patients who presented with abnormal ECGs (ST segment deviations), 39 (54.2%) were shown to have evidence for AMI. The authors concluded that normal ECGs were associated with an extremely low risk for AMI while other categories of abnormal ECGs (confounding, nonspecific, and diagnostic) demonstrated increasing levels of AMI risk. They suggested that patients with chest pain and initial ECGs with ST segment deviation should be admitted to the hospital while patients with minimally abnormal ECGs are at a lower risk for AMI – admission decisions should be based on an analysis of other clinical data. Lastly, they recommend that patients with normal ECGs can be considered for further evaluation on an outpatient basis.

Decision Rules

OPPOSING -- Good / P1 / E5
TIMI Risk Score did not identify a discrete group of patients who were safely discharged from the ED.


Chase et al attempted to use the TIMI risk score to describe ED chest pain patients in a risk stratification sense. The investigators found that the TIMI risk score correlated very nicely with outcome; unfortunately, the scoring system did not separate patients into discrete risk groups, allowing for the identification of individuals appropriate for emergency department release, recommending that the TIMI risk score should not be used in isolation to determine disposition of ED chest pain patients.

Decision Rules

SUPPORTING -- Good / P2 / E5
Clinical decision rule developed in the ED population which states that younger patients with no past IHD and a normal ECG can be discharged; older patients with these features plus “low-risk” features of the chest pain and negative serial biomarkers could also be discharged.


Clinical decision rules have incorporated not only the clinical history but also the remainder of the ED data (examination, ECG, and biomarker). In just such an application, the Vancouver Chest Pain Rule is focused on the identification of ED chest pain patients with a low risk of acute coronary syndrome – ie, those patients that can be safely discharged from the ED. In this study, patients greater than 25 years of age were evaluated at presentation with ultimate ACS vs non-ACS diagnosis assigned at 30 days from the initial visit; data considered in the development of the rule included coronary artery disease risk factors, chest pain characteristics, physical examination and ECG findings, and cardiac biomarker results. In the 769 patients studied, approximately 20% had ACS (10% AMI and 11.4% unstable angina); the remaining 80% of the patients were diagnosed with non-ACS conditions. The decision tool demonstrated an impressive sensitivity (98.8%) in the identification of patients who were safely discharged from the ED. In this group, the authors noted that patients who exhibited a normal initial ECG, lacked previous ischemic chest pain, and were younger than 40 years demonstrated a very low risk of acute coronary syndrome. In addition, in patients over age 40 years who demonstrated a normal initial ECG, lacked previous ischemic chest pain, had low-risk pain characteristics, revealed and negative initial / repeat serum markers were also at low risk for ACS. This rule is certainly of value in the younger patient with a negative ED evaluation – it essentially identifies a subgroup of patients who can be safely discharged from the ED after a brief evaluation; it is of less clinical value in older patients or in those individuals with a past history of ischemic heart disease; of course, these subgroups are frequently encountered in the ED.

Decision Rules

OPPOSING -- Good / P2 / E5
The UK authors attempted to apply TIMI risk score in 2 forms – “front-door” score and standard -- to ED patients; unfortunately, patients with a zero “front-door” TIMI scores still had adverse event rates greater than 1% (5%) while the standard TIMI score of zero had no adverse events.

This study took place in an urban emergency department in the UK. 1000 consecutive patients presenting with potentially cardiac chest pain were enrolled. Patients were followed up to hospital discharge or 30 days after enrolment. TIMI scores were then calculated for each patient. The TIMI score consists of seven elements, each scoring one point. The elements are age >65 years, three or more risk factors for coronary artery disease, known coronary artery stenosis, use of aspirin for the past seven days or more, raised cardiac markers, >0.5 mm deviation of the ST segment on ECG, and two or more episodes of angina in the past 24 h. An initial score was also calculated by removing the cardiac marker element from the TIMI score. The first ECG was used to calculate scores. Owing to small numbers TIMI score groups 6 and 7 were amalgamated in keeping with the original paper.

Outcomes of interest were STEMI and troponin-positive ACS not diagnosed at presentation, PCI, all cause mortality at 30 days, and readmission within 30 days. Combining these outcomes gave a single measure: the 30-day major cardiac event rate. 38 patients had a myocardial infarction or troponin-positive acute coronary syndrome at presentation. The median age was 60 years (range 20–95, mean 59 years) and 62% were men. 137 (14%) had an outcome event. Outcomes identified were STEMI (n = 41), troponin-positive acute coronary syndrome (n = 76), PCI (n = 31), all cause death within 30 days (n = 16) and readmission with MI within 30 days (n = 1, initial TIMI and front door score 2). Twenty eight patients had multiple outcomes. The authors demonstrated a clear relationship between the TIMI and front door TIMI scores and the risk of significant cardiac events and 30-day mortality in an undifferentiated chest pain population. They felt that such information could assist with early triage decisions yet it must be noted that patients with a zero “front-door” TIMI scores still had adverse event rates greater than 1% (5%) while the standard TIMI score of zero had no adverse events. Thus, this study does not support the use of TIMI risk scoring as a decision tool supporting early ED discharge.

<table>
<thead>
<tr>
<th>TIMI score</th>
<th>Total in score group</th>
<th>Number of patients with events (% event rate, 95% CI)*</th>
<th>Front door score</th>
<th>Total in score group</th>
<th>Number of patients with events (% event rate, 95% CI)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>231</td>
<td>0 (0%, 0 to 1.5)</td>
<td>0</td>
<td>244</td>
<td>13 (5%, 3 to 9)</td>
</tr>
<tr>
<td>1</td>
<td>215</td>
<td>15 (7%, 4 to 11)</td>
<td>1</td>
<td>219</td>
<td>17 (8%, 5 to 12)</td>
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<tr>
<td>2</td>
<td>184</td>
<td>24 (13%, 9 to 18)</td>
<td>2</td>
<td>195</td>
<td>32 (16%,12 to 22)</td>
</tr>
<tr>
<td>3</td>
<td>167</td>
<td>40 (24%, 18 to 31)</td>
<td>3</td>
<td>163</td>
<td>35 (21%, 16 to 28)</td>
</tr>
<tr>
<td>4</td>
<td>96</td>
<td>23 (24%, 17 to 33)</td>
<td>4</td>
<td>90</td>
<td>20 (22%, 15 to 32)</td>
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<tr>
<td>5</td>
<td>39</td>
<td>19 (49%, 34 to 68)</td>
<td>5</td>
<td>32</td>
<td>13 (41%, 25 to 58)</td>
</tr>
<tr>
<td>6/7</td>
<td>22</td>
<td>16 (72%, 52 to 86)</td>
<td>6</td>
<td>11</td>
<td>7 (64%, 35 to 85)</td>
</tr>
<tr>
<td>ROC AUC</td>
<td>0.79</td>
<td>95% CI 0.75 to 0.84</td>
<td>ROC AUC</td>
<td>0.70</td>
<td>95% CI 0.65 to 0.75</td>
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</table>

*Significant at <0.01 by Kruskal–Wallis.

AUC, area under the curve; ROC, receiver operating characteristic; TIMI, Thrombolysis in Myocardial Infarction.

Biomarkers

SUPPORTING -- Poor / P5 / E3

Very important data set -- currently only in the form of a personal communication -- stating that negative serial troponin determinations, in the setting of a stable patient with a normal to near-normal ECG, is associated with an extremely low adverse event rate in adult chest pain patients who have competed the “rule out MI” ED evaluation.


The investigators have suggested that negative serial troponin determinations, in the setting of a stable patient with a normal to near-normal ECG, is associated with an extremely low adverse event rate in adult chest pain patients who have completed the “rule out MI” ED evaluation. Such information is of extreme value in this patient population – the low to intermediate chest pain population. ED chest pain patients with undetectable circulating
levels of cTnl have very low rates of ACS independent of other clinical variables. In a series of patients with undetectable circulating levels of troponin upon ED presentation and at 8 hrs after presentation, there were zero deaths or AMI's and a 1.8% rate of revascularization at 30 days from time of Ed visit. Measurements of highly sensitive troponin in a serial manner when combined with assessment of clinical variables (persistence of ischemic pain, hemodynamic instability, ECG changes) is a very powerful method of early diagnosis and risk assessment in the ED chest pain patient. Such information would afford the EP the ability to evaluate the patient, determine that ACS was not present, and discharge the individual for timely follow-up for further risk stratification with stress imaging.

**Biomarkers**

**SUPPORTING – Good / P2 / E3**

Important study noting that patients with negative serial troponins (at least 2 samples taken at 4 hour intervals) have a negative event rate of 1% or less at 30 days after ED evaluation, allowing for safe discharge and outpatient follow-up.


The authors evaluated the use of serial troponins in ED chest pain patients; these patients lacked ST segment elevation on the electrocardiogram. Troponin samples (either troponin T or I) were taken at least 6 hours after the onset of chest pain. In 773 patients, 20 deaths and 14 nonfatal MIs were noted. Troponin T and troponin I were found to be strong, independent predictors of cardiac events. In fact, the event rates in patients with negative tests were only 1.1 percent for troponin T and 0.3 percent for troponin I. The authors concluded that troponin testing is highly sensitive for the early detection of ACS (injury and infarction). Negative troponin findings are associated with low risk of cardiac event rates and death.

**Clinical History**

**NEUTRAL -- Good / P2 / E1**

The authors concluded that CAD risk factor burden has limited clinical value in diagnosing acute coronary syndromes in the ED setting, especially in patients older than 40 years. Cardiac risk factor burden has little impact on the ED diagnosis of ACS.


This analysis was a review of the Internet Tracking Registry of Acute Coronary Syndromes (i*trACS) registry, which contains 17,713 ED visits for suspected ACS. CAD risk factors were diabetes mellitus, hypertension, smoking, hypercholesterolemia, and family history of coronary artery disease. Because multiple logistic regression analysis revealed that age modified the relationship between cardiac risk factor burden and acute coronary syndromes, a stratified analysis was performed for 3 age categories: younger than 40, 40 to 65, and older than 65 years. Of 10,806 eligible patients, 871 (8.1%) had ACS. In patients younger than 40 years, having no risk factors had a negative likelihood ratio of 0.17 (95% CI 0.04 to 0.66), and having 4 or more risk factors had a positive likelihood ratio of 7.39 (95% CI 3.09 to 17.67). In patients between 40 and 65 years of age, having no risk factors had a negative likelihood ratio of 0.53 (95% CI 0.40 to 0.71), and having 4 or more risk factors had a positive likelihood ratio of 2.13 (95% CI 1.66 to 2.73). In patients older than 65 years, having no risk factors had a negative likelihood ratio of 0.96 (95% CI 0.74 to 1.23), and having 4 or more risk factors had a positive likelihood ratio of 1.09 (95% CI 0.64 to 1.62). The authors concluded that CAD risk factor burden has limited clinical value in diagnosing acute coronary syndromes in the ED setting, especially in patients older than 40 years. Cardiac risk factor burden has little impact on the ED diagnosis of ACS.

**Decision Rules**

**OPPOSING -- Good / P1 / E5**

A meta-analysis of 8 decision rules attempting to identify selection criteria for ED chest pain discharge; no safe criteria were found; further, the existing literature was termed “less than adequate” to address the issue.


The authors sought to determine the diagnostic accuracy of clinical prediction rules to exclude acute coronary syndrome (ACS) in the emergency department (ED) setting. They reviewed the MEDLINE, EMBASE, Web of Science and the Cochrane Database of Systematic Reviews as well as discussion with content experts for appropriate articles. Eight studies met inclusion criteria, encompassing 7937 patients. None of the studies verified the prediction rule with a reference standard on all or a random sample of patients. Six studies did not report blinding prediction rule assessors to reference standard results, and vice versa. Three prediction rules were prospectively validated. Sensitivities and specificities ranged from 94% to 100% and 13% to 57%, and positive and negative likelihood ratios from 1.1 to 2.2 and 0.01 to 0.17, respectively. The authors concluded that
current prediction rules for ACS have substantial methodological limitations and have not been successfully implemented in the clinical setting. In other words, the literature exploring this issue is suboptimal at best.

**Presence of CAD in this population**

**NEUTRAL -- Good / P2 / E1**

This paper documents the presence of CAD in patients who have complete the “R/O MI” process successfully in the ED -- 33% of these patients had evidence of coronary artery disease at cardiac catheterization.


At initial ED presentation, the chest pain patient is evaluated with the goal of ACS identification; with ACS considered unlikely, the EP then must explore the possibility of significant coronary artery disease. Little information is available regarding the prevalence and severity of coronary artery disease in this patient population. This study focused on chest pain patients with non-ischemic ECGs and normal serial troponin values who remained clinically stable over the initial 12 hours of care. Of the group who might be considered candidates for early discharge, 33% of these patients had evidence of coronary artery disease at cardiac catheterization. While this high rate of CAD is troubling, it does not necessarily mandate hospital admission for all these patients; rather, it emphasizes the need for careful ED evaluation and prompt medical follow-up after discharge. And, it is important to recall that the ED-based strategy in the chest pain patient changes over the time course of the emergency department stay. Early in the process, the EP is focusing on the detection and management of ACS, particularly STEMI. As time passes in the ED, the focus shifts partially to a combined strategy of ACS detection (NSTEMI and unstable angina) and ultimately significant CAD consideration. With completion of the “rule-out MI” protocol, the EP is finally faced with the consideration – what is the likelihood of significant CAD in this patient? This paper very nicely answers this last question -- 33% of these patients had evidence of coronary artery disease at cardiac catheterization.

**Decision Rules**

**NEUTRAL -- Good / P2 / E5**

The presence of an alternative noncardiac diagnosis was associated with a reduced risk of myocardial infarction yet this noncardiac group experienced an elevated rate of negative outcome from noncardiac causes.


Beyond the initial impression, Hollander et al compared the 30-day negative event rate in ED chest pain patients who were diagnosed with an alternative, noncardiac diagnosis with a group of similar individuals in whom a definitive diagnosis could not be established. The study enrolled 1,995 ED patients with potential ACS – 4% were ultimately diagnosed with AMI during hospitalization while, at thirty days, 4% required revascularization (4%) and 1% died. Thirty percent of patients were diagnosed with an obvious noncardiac diagnosis. The presence of an alternative noncardiac diagnosis was associated with a reduced risk of myocardial infarction yet this noncardiac group experienced an elevated rate of negative outcome – meaning that chest pain patients, even without a diagnosed ACS etiology, have reasonably high rates of adverse event. This statement does not translate into the recommendation that “all chest pain patients should be admitted to the hospital;” rather, it indicates that appropriate outpatient follow-up is needed for these patient who obviously do not require inpatient management at the time of ED care.

**Decision Rules**

**NEUTRAL -- Fair / P3 / E5**

This analysis attempted to apply TIMI scoring in the ED and found that a lower score was associated with no adverse events; discrete risk groups, however, were not identified (i.e., a TIMI score of 3 was worrisome while a score of 2 was not).


This study explored the prognostic utility of the TIMI risk score in patients in the emergency department (ED) evaluated for possible ACS. The authors performed a multivariate analysis considering the independent predictive power of the individual components of the TIMI risk score to predict an adverse event at 30 days (all-cause death, myocardial infarction, and coronary revascularization). One hundred fifty one (16%) patients were diagnosed with ACS. At 30 days there were 48 (5%) deaths, 84 (9%) myocardial infarctions, and 49 (5%) coronary revascularization procedures. The mean TIMI risk score was significantly higher in patients with an adverse event compared with those without (2.6 +/- 1.3 vs. 1.7 +/- 1.2, P < 0.0001). Four of the 7 TIMI risk factors (age > or = 65 years, ST segment deviation > or = 0.5 mm elevated troponin I, and coronary stenosis > or = 50%) were independently associated with adverse events. A simplified TIMI risk score was computed and was found to have similar prognostic ability as the 7 variable TIMI risk score. The authors concluded that a modified
TIMI risk score may simplify risk stratification of ED patients with undifferentiated chest pain. This paper is weakly supportive of the mission in this review – a risk score of 3 had a higher rate of negative outcome compared to a score of 2 without poor outcome.

Clinical History
NEUTRAL -- Good / P2 / E1
The presence of an individual risk factor, or a collection of risk factors, is far less important in diagnosing ACS in the ED than the clinical history, the presence of ECG changes, or cardiac biomarker abnormalities.


The objective of this study was to determine whether the presence of the traditional CAD risk factors increases the likelihood of ACS beyond that expected from clinical presentation and ECG. Clinical data and reports of CAD risk factors were collected prospectively from 1743 patients without clinically obvious coronary disease. Patients were selected from 5773 ED patients at 6 hospitals who presented with symptoms suggesting ACS. Logistic regression was used to determine the relative risk of each risk factor report for ACS. In women, the presence of classical risk factor reports does not increase the risk of acute ACS. In men, only diabetes and family history of MI significantly increase the risk (p < 0.05). The relative risks are 2.4 and 2.1, respectively, and are small compared to those conferred by chest pain (12.1), an abnormal ST segment (8.7), or an abnormal T wave (5.3). For a patient presenting to the ED, the traditional CAD risk factors convey minimal risk for acute cardiac ischemia, especially when compared to the overwhelming importance of the chief complaint and the ECG. In fact, Bayesian analysis indicates that risk factors are a populational phenomenon and do not increase or decrease the likelihood of any condition in any one patient. Thus, the presence of an individual risk factor, or a collection of risk factors, is far less important in diagnosing ACS in the ED than the clinical history, the presence of ECG changes, or cardiac biomarker abnormalities.

Decision Rules
OPPOSING -- Good / P2 / E5
The author concluded that the TIMI risk score successfully risk stratifies patients at the time of ED presentation; yet, a measurable adverse event rate is still found in the lower risk groups.


The TIMI risk score is a seven item risk stratification tool derived from trials of patients with non-ST segment elevation acute coronary syndromes (ACS); its use has been extrapolated to the ED population. The authors performed a prospective cohort study of ED patients with potential ACS, considering demographics, medical and cardiac history, and components of the TIMI risk score. The main outcome was death, acute myocardial infarction (AMI), or revascularisation within 30 days as stratified by TIMI risk score and compared between genders. There were 2022 patients enrolled: 1204 (60%) females and 818 (40%) males. The incidence of 30 day death, AMI, revascularisation (n = 168) according to TIMI score is as follows (female vs male): TIMI 0 (n = 670), 1.6% vs 2.0%, p = 0.2; TIMI 1 (n = 525), 4.6% vs 8.5%, p = 0.02; TIMI 2 (n = 378), 6.3% vs 10.4%, p = 0.05; TIMI 3 (n = 234), 6.5% vs 24.6%, p<0.001; TIMI 4 (n = 157), 22.7% vs 24.4%, p = 0.15; TIMI 5 (n = 52), 35.5% vs 39.1%, p = 0.2; TIMI 6 or 7 (n = 6), 33.3% vs 66.7%, p = 1.0. The relationship between TIMI score and outcome was highly significant (p<0.001) for each gender; however, males tended to have worse outcomes at lower TIMI risk scores. The author concluded that the TIMI risk score successfully risk stratifies both males and females with potential ACS at the time of ED presentation; however, males have worse outcomes at lower TIMI scores than females. Yet, as with most of these studies, a measurable adverse event rate is still found in the lower risk groups (1.6 to 8.5%), making this approach much less palatable.

Decision Rules
SUPPORTING -- Good / P2 / E5
The authors suggested that a negative ED evaluation involving serial electrocardiograms and biomarkers can identify patients at very low risk of short-term cardiac events.


Once the ED evaluation is complete, the EP must then consider what disposition is most appropriate: admission to the hospital versus discharge with outpatient follow-up (with or without stress imagining). Lai and fellow investigators explored this issue of appropriate discharge after ED evaluation in an observation unit for outpatient risk stratification via exercise stress testing. Three hundred forty-four patients were entered in the study with 2 patients experiencing fatal out-of-hospital cardiac events; twenty-seven subsequent chest pain visits to the Emergency Department occurred with 9 hospital admissions and 10 readmissions to the observation unit. The authors suggested that a negative ED evaluation involving serial electrocardiograms and biomarkers can identify
patients at very low risk of short-term cardiac events – thus, appropriately selected patients can be safely discharged for subsequent outpatient testing.

**Decision Rules**

**OPPOSING -- Good / P1 / E5**

**The Goldman Criteria did not perform well in this ED chest pain population.**


The Goldman criteria has been used for hospitalized patients in the determination of risk stratification. In this setting, this tool has performed reasonably well yet has not identified any subgroup of individuals appropriate for ED discharge. Limkakeng et al combined the Goldman criteria with cardiac troponin analysis in an attempt to increase the rule set’s ability to identify those low-risk patients appropriate for discharge. Unfortunately, the combination of the Goldman criteria with serum biomarkers in the ED chest pain patient did not identify a subgroup with less than 1% risk for AMI or poor outcome within 30 days.

**Decision Rules**

**NEUTRAL -- Fair / P2 / E5**

As with other such non-ED derived risk scores, the GRACE and TIMI decision rules assisted with risk assessment yet did not invariably identify a subset of patients safe for emergency department discharge.


The Global Registry of Acute Coronary Events (GRACE) and the Thrombolysis in Myocardial Infarction (TIMI) scoring systems predict outcome of adverse coronary events in patients admitted to cardiac units. This study evaluated the relationship between GRACE score and outcome in patients presenting to the ED with undifferentiated chest pain and establishes whether GRACE is preferential to TIMI in stratifying risk in patients in the ED setting. The authors performed a descriptive study of a consecutive sample of 1000 ED patients with undifferentiated chest pain. GRACE and TIMI scores were calculated for each patient and outcomes noted at 30 days. Outcomes included ST and non-ST myocardial infarction, cardiac arrest, revascularisation, unstable angina with myocardial damage and all cause mortality at 30 days. They reported that the GRACE score stratified risk accurately in patients presenting to the ED with undifferentiated chest pain (AUC-ROC 0.80 (95% CI 0.75-0.85). The TIMI score was found to be similarly accurate in stratifying risk in the study cohort with an AUC-ROC of 0.79 (95% CI 0.74-0.85). It was only possible to calculate a complete GRACE score in 76% (n=760) cases as not all the data variables were measured routinely in the ED. The authors concluded that GRACE and TIMI are both effective in accurately stratifying risk in patients presenting to the ED with undifferentiated chest pain. The GRACE score is more complex than the TIMI score and in the ED setting TIMI may be the preferred scoring method. This investigation is weakly supportive of the review question. As with other such non-ED derived risk scores, these decision rules assisted with risk assessment yet did not invariably identify a subset of patients safe for emergency department discharge.

**Decision Rules**

**SUPPORTING -- Good / P2 / E5**

Clinical decision rule developed in the ED population which states that younger patients without IHD, no classic risk factors, a normal ECG, and negative biomarker could be safely discharged.


The use of clinical decision rules in a relatively young patient population can assist with appropriate disposition decisions. Marsan and colleagues attempted to develop a clinical decision rule that young adult chest pain patients without known cardiac disease, coronary risk factors, and an abnormal ECG were at extremely low risk for ACS and adverse short-term outcome. Initially, the investigators used only the data listed above; the model did not perform very well with 5.4% of patients experiencing ACS and 2.2% of patients having an adverse outcome. With the addition of serum marker results into the model, a much better predictive performance was found – in young adult patients without known cardiac history, with either no classic coronary risk factors or a normal ECG, and with initially normal biomarker, the risk of ACS was extremely low (0.14%); no adverse cardiovascular events at one month. Thus, in this group, the history and ECG did not perform well; the addition of the biomarker testing, however, greatly increased the rule’s ability in this young population.

**Alternative Diagnosis**

**OPPOSING -- Good / P2 / E6**
The authors concluded that, despite an initial impression of noncardiac chest pain, the presence of traditional coronary risk factors or established histories of coronary artery disease or CHF should prompt further consideration of ACS.


After completion of the ED evaluation, the presence of an alternative, non-coronary diagnosis is considered by some to be an appropriate discriminator in the selection of outpatient management candidates. Yet prior studies have not examined the impact of a “noncardiac” EP impression or of the utility of an obvious, alternative, noncardiac diagnosis as safe and appropriate justifications for ED discharge in the chest pain patient. Miller et al asked the question “does the initial EP impression of ‘noncardiac chest pain’ reliably predict patients without ACS?” In this review, if the physician's initial diagnostic impression was noncardiac chest pain after the medical history, physical examination, and initial 12-lead ECG, the investigators entered the patient in the study. Of 17,737 patients enrolled, 2,992 had an initial EP impression of noncardiac chest pain; in this group, 2.8% of patients experienced an adverse cardiac event. This adverse event group was characterized as follows: older, more often male, and with more frequent medical histories of diabetes mellitus, coronary artery disease, and congestive heart failure. The authors correctly concluded that, despite an initial impression of noncardiac chest pain, traditional coronary risk factors or established histories of coronary artery disease or CHF should prompt further consideration of ACS.

Decision Rules
OPPOSING -- Good / P2 / E5
In this paper, a TIMI risk score of zero was still associated with an adverse event rate of 2.1%, again highlighting that these inpatient-derived rules are not completely transportable to the ED.


Although validated and used frequently in patients already enrolled in acute coronary syndrome trials, the Thrombolysis in Myocardial Infarction (TIMI) risk score never has been examined for its value in risk stratification in an all-comers, non-trial-based ED chest pain population. The authors performed an analysis of an ED population using a prospective observational cohort study model. 3,929 patients presenting with chest pain syndrome and warranting evaluation with an electrocardiogram were included. These patients had TIMI risk scores determined at ED presentation. The main outcome was the composite of death, acute myocardial infarction (MI), and revascularization within 30 days. The TIMI risk score at ED presentation successfully risk-stratified this unselected cohort of chest pain patients with respect to 30-day adverse outcome, with a range from 2.1%, with a score of 0, to 100%, with a score of 7. The highest correlation of an individual TIMI risk indicator to adverse outcome was for elevated cardiac biomarker at admission. Overall, the score had similar performance characteristics to that seen when applied to other databases of patients enrolled in clinical trials and registries using a 14-day end point. The authors concluded that the TIMI risk score may be a useful tool for risk stratification of ED patients with chest pain syndrome. In this paper, a TIMI risk score of zero was still associated with an adverse event rate of 2.1%, again highlighting that these inpatient-derived rules are not completely transportable to the ED.

Clinical History
OPPOSING -- Good / P2 / E1
Use of clinical history as discriminator to identify patients safe for discharge; such history was not found to be of value.


Sanchis and colleagues explored the value of the clinical history by itself in this evaluation, concluding that the clinical history itself is not a primary determinant of safe discharge. The study was comprised of 1,011 patients presenting to the ED; data regarding the patient’s history reviewed included the clinical presentation (pain characteristics and number of episodes), coronary risk factors, and history of ischemic heart disease and non-cardiac vascular disease. The various models noted an impressive ability to identify patients at low-risk of adverse outcomes at one year. In fact, 44% of the patients were appropriate discharge candidates with an adverse event rate of only 1.4% at one year; unfortunately, the model performed less well at 30 days with an 8% rate of adverse event, largely resulting from revascularization. The authors concluded that patient selection for discharge is not reliably determined by the clinical history itself, recommending that additional ancillary tools should be considered in this decision.
Examination

**NEUTRAL -- Good / P2 / E1**

The presence of pulmonary edema in the setting of chest pain suggests possible ACS and the need for admission; the absence of such finding was not associated with the potential for safe discharge.


The physical examination has largely been of limited value in this consideration. The exception to this statement includes the identification of complications of ACS, such as hypotension and pulmonary edema – yet these patients are identifiably ill and thus the disposition is reasonably straightforward. Exploring this issue, Schillinger and colleagues asked the question – Does the presence of pulmonary congestive in individuals with unexplained chest pain identify a subset of ED patients at increased risk of poor outcome? Such patients demonstrated higher rates of ACS diagnosis as well as increased risk for poor outcome. Thus, in this patient group, admission to the hospital for further evaluation and management of the chest pain syndrome and pulmonary congestion is usually warranted.

Clinical History

**SUPPORTING -- Good / P2 / E1**

Use of clinical history, separated into “typical” and “atypical,” as discriminator to identify patients safe for discharge; an atypical history in younger patients was found to be a reasonable discriminator for safe discharge.


Considering the clinical history and focusing on the description of the chest sensation, Schillinger et al noted that several atypical historical features are associated with a low rate of occurrence of both AMI and adverse outcome. The authors investigated the value of historical features (symptoms, medical history and risk factors) atypical for ACS in the exclusion of acute / subacute coronary events. The study population included 1288 ED patients with chest pain; the patient histories were separated into typical or atypical for ACS using seven discomfort descriptors. Acute myocardial infarction was found in 13% of patients; a six-month adverse event rate of 19% was observed. Atypical presentations with 4 or more atypical descriptors was associated with low likelihood of AMI, death, and revascularization; in younger patients (aged less than 40 years) with at least 4 atypical features, AMI was not seen and the adverse event rate was markedly low. Conversely, typical presentations demonstrated a markedly higher rate of AMI and related poor outcome. The authors concluded that atypical features are potentially of value in “ruling out” ACS yet the same cannot be said of typical features which are not reliable for “ruling out” or “ruling in” AMI and related poor outcome.

Decision Rules

**SUPPORTING -- Good / P2 / E5**

This paper demonstrates that the TIMI risk score is a valid tool for risk stratification in unselected cases with possible acute coronary syndrome and is superior to ECG changes and troponin alone -- although this simpler method also achieves good risk stratification.


The Authors assessed the utility of the TIMI risk score in stratifying patients with possible ACS in routine clinical practice. They performed a prospective observational study and recruited 869 consecutive patients with a diagnosis of possible ACS attending the acute medical receiving unit of a district general hospital. The main outcome measures were recurrent myocardial infarction, urgent revascularization, and all-cause mortality. TIMI risk score was calculated for each patient, and each was also assigned a risk group based on electrocardiographic (ECG) changes and troponin levels only. After follow-up, Cox univariate and multivariate regression was used to evaluate the influence of potential risk factors on duration of event-free survival, and likelihood ratio tests to assess the fit of the models. The authors reported that increasing TIMI risk score was associated with increased risk of events (p<0.001), as was higher risk group from ECG plus troponin stratification (p<0.001). The likelihood ratio comparison favoured the TIMI risk score (difference 13.910, 5 degrees of freedom, p = 0.016). They concluded that the TIMI risk score is a valid tool for risk stratification in unselected cases with possible acute coronary syndrome. It is superior to ECG changes and troponin alone, although this simpler method also achieves good risk stratification.
Ancillary Studies
SUPPORTING -- Good / P2 / E4
The authors demonstrated that advanced imaging studies in this population assisted in the identification of patients which are safe for discharge; the reader must consider the logistical issues required for such an approach.

The authors hypothesized that regional function (RF) and myocardial perfusion (MP) are superior to the Thrombolysis In Myocardial Infarction (TIMI) score for diagnosis and prognostication in patients presenting to the emergency department (ED) with chest pain (CP) and a nondiagnostic electrocardiogram. Contrast echocardiography was performed to assess RF and MP on 957 patients presenting to the ED with suspected cardiac CP and a nondiagnostic electrocardiogram. A modified TIMI (mTIMI) score was calculated from six immediately available variables. A full TIMI score also was derived after troponin levels were able to be accessed adequately. Follow-up was performed for early (within 24 h), intermediate (30 day), and late primary (death and myocardial infarction) or secondary (unstable angina and revascularization) events. The mTIMI score was unable to discriminate between intermediate- compared to high-risk patients at any follow-up time point, whereas only 2 of 523 patients with normal RF had an early primary event. Regional function provided incremental prognostic value over mTIMI scores for predicting intermediate and late events. In patients with abnormal RF, MP further classified patients into intermediate- and high-risk groups. The full TIMI score could not improve upon these results at any follow-up time point. Contrast echocardiography can rapidly and accurately provide short-, intermediate-, and long-term prognostic information in patients presenting to the ED with suspected cardiac CP even before serum cardiac markers are known. Integrating contrast echocardiography into the ED evaluation of CP may improve the risk stratification of such patients. While this statement is true, the logistics and feasibility of such an approach of all EDs is very questionable.

ECG
OPPOSING -- Good / P1 / E2
A normal ECG during chest pain does not decrease the likelihood that a patient will rule-in for ACS.

These researchers hypothesized that patients with a completely normal ECG during active chest pain are less likely to rule in for ACS than patients with a completely normal ECG when the patient is asymptomatic. They defined “normal” as sinus rhythm with heart rate 55-105 beats/min, normal QRS complex and ST segments, and normal T waves or T-wave flattening. They excluded as “normal” any patients with pathologic Q-waves, left ventricular hypertrophy, non-specific ST-T wave abnormalities, ST-segment depression, and discrepancies in the axis between the T-wave and the QRS (QRS-T wave discordance). A rule-in for ACS was defined as positive troponin-I levels, coronary angiography demonstrating greater than 70% stenosis in a major artery, or positive non-invasive cardiac stress test. 387 patients with clinically-presumed ACS who had normal ECGs, of which 51% were male and 49% were female. A total of 67% of patients were experiencing chest pain during the ECG and 33% had no chest pain at the time of the ECG. A total of 17% of patients ended up ruling-in for ACS (a relatively high-risk group overall). The researchers found that there was no difference in the prevalence of ACS between the chest pain vs. the chest pain-free groups (16% vs. 20%, respectively; p=0.4, odds ratio 0.77). Contrary to their original hypothesis, the researchers concluded that a normal ECG during chest pain does not decrease the likelihood that a patient will rule-in for ACS. Once again, another study demonstrates that, although an abnormal ECG is excellent at ruling-in disease, a normal ECG is poor at ruling-out disease. In the absence of a diagnostic ECG, the disposition and evaluation of a patient with possible ACS must be based on an analysis of the history, ECG, and other data interpreted within the context of the clinical presentation.