XI congresso nazionale
simeu
ROMA 24-26 MAGGIO 2018

Dolore toracico e dismissione in sicurezza: Heart Pathway

Dott. Spampinato Michele Domenico
Medico in formazione specialistica in Medicina d'Emergenza-Urgenza
Università degli Studi di Ferrara


U.O. Radiologia
O.B.I.
Sala Attesa

AMERICAN COLLEGE of CARDIOLOGY

Which Emergency Department Chest Pain Patients Do Not Need Further Diagnostic Testing After a Normal Troponin?

Mar 18, 2016 | Jaimi Greenslade, PhD; Louise Cullen, MBBS, PhD

Expert Analysis

European Heart Journal (2002) **23,** 1153–1176
doi:10.1053/euhj.2002.3194, available online at http://www.idealibrary.com on IDEAL®

Task Force Report

Task force on the management of chest pain

Members: L. Erhardt (Chairman), J. Herlitz (Secretary), L. Bossaert, M. Halinen, M. Keltai, R. Koster, C. Marcassa, T. Quinn and H. van Weert

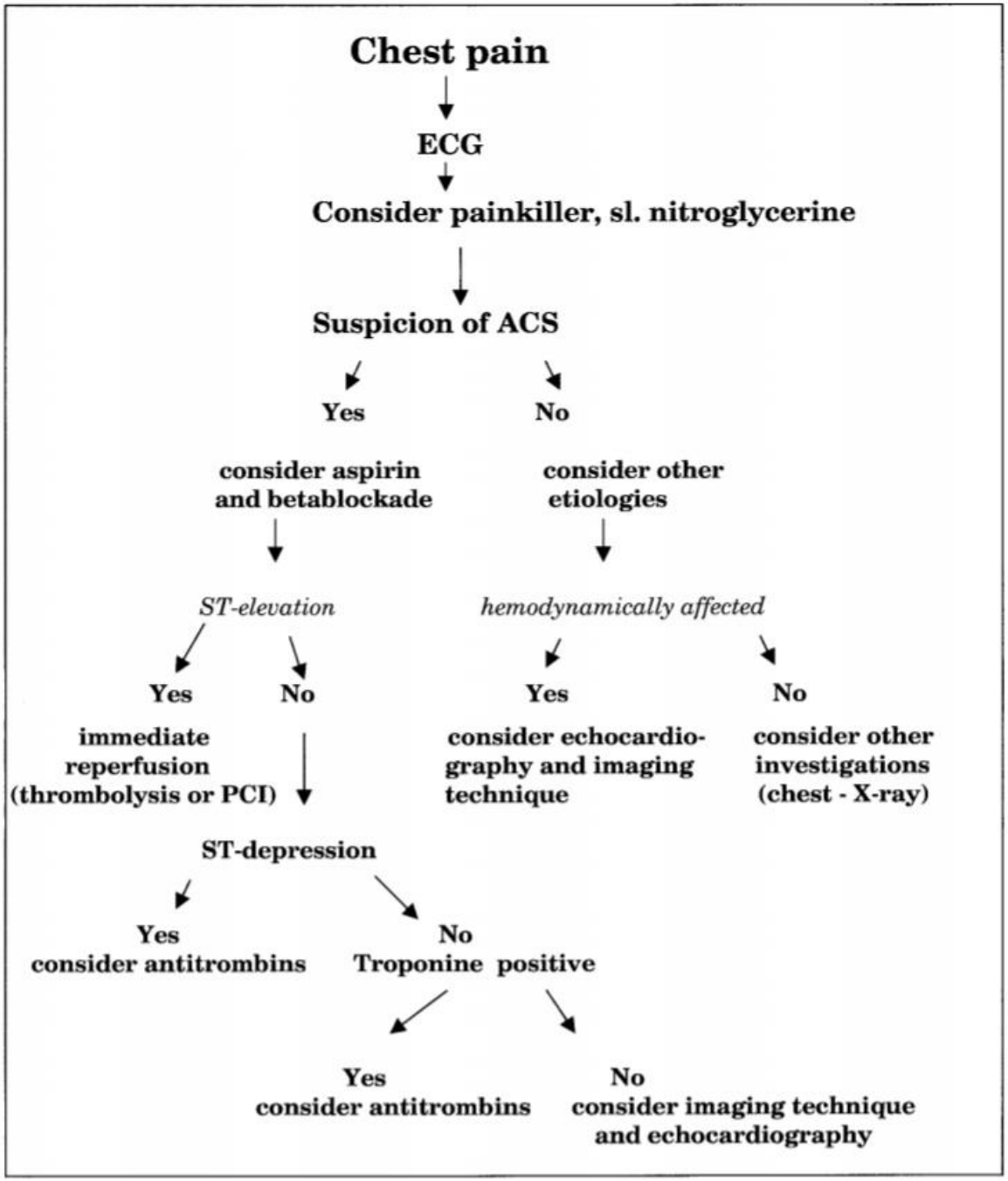


Figure 3 Evaluation and treatment of patients with chest pain in the emergency department.

European Heart Journal (2016) **37**, 267–315
doi:10.1093/eurheartj/ehv320

ESC GUIDELINES

2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation

Task Force for the Management of Acute Coronary Syndromes in Patients Presenting without Persistent ST-Segment Elevation of the European Society of Cardiology (ESC)

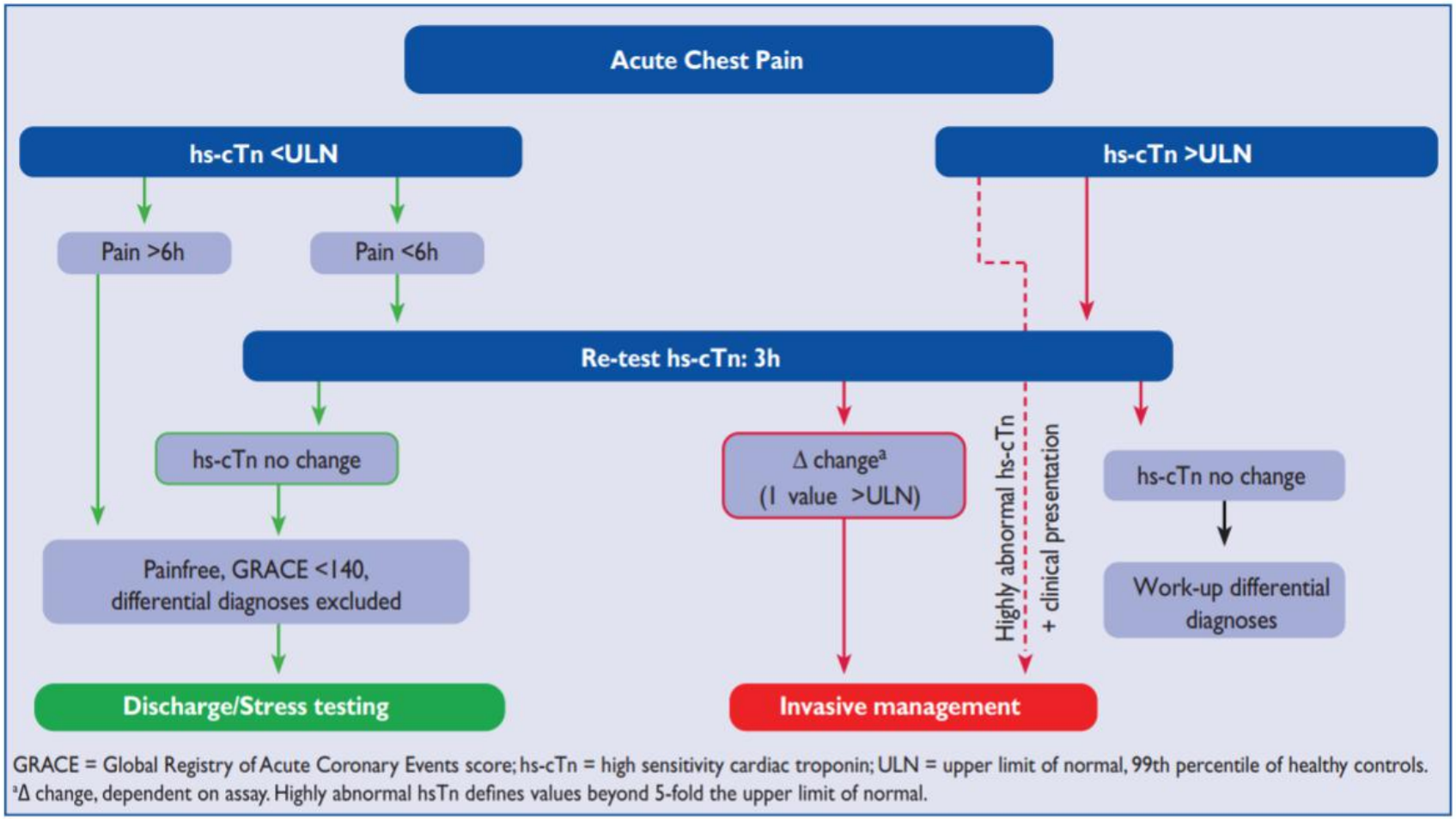
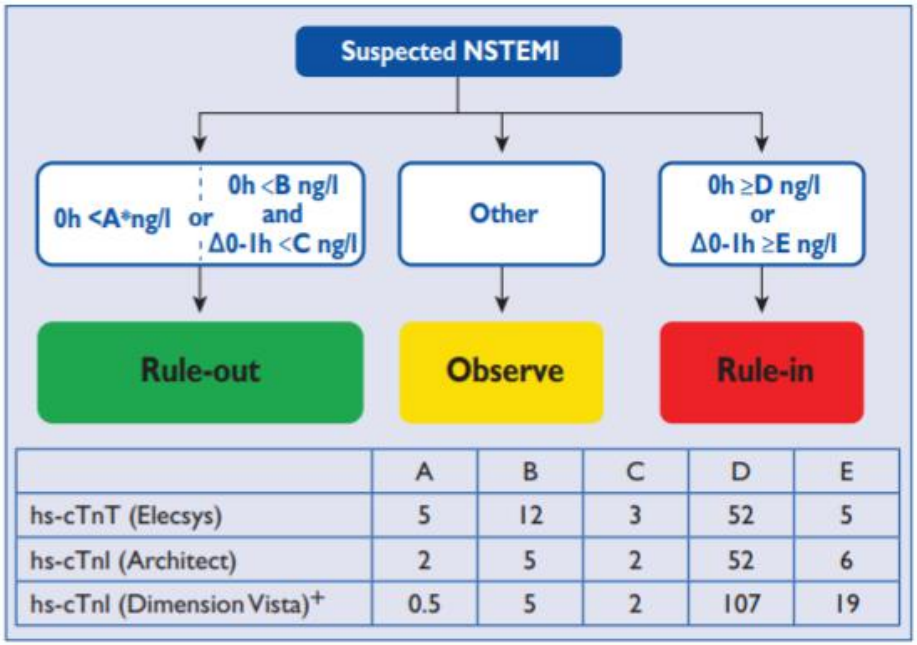


Figure 2 0 h/3 h rule-out algorithm of non-ST-elevation acute coronary syndromes using high-sensitivity cardiac troponin assays.



	A	B	C	D	E
hs-cTnT (Elecsys)	5	12	3	52	5
hs-cTnI (Architect)	2	5	2	52	6
hs-cTnI (Dimension Vista)+	0.5	5	2	107	19

Figure 3 0 h/1 h rule-in and rule-out algorithms using high-sensitivity cardiac troponins (hs-cTn) assays in patients presenting with suspected non-ST-elevation myocardial infarction (NSTEMI) to the emergency department. 0 h and 1 h refer to the time from first blood test. NSTEMI can be ruled-out already at presentation, if the hs-cTn concentration is very low. NSTEMI can also be ruled-out by the combination of low baseline levels and the lack of a relevant increase within 1 h. Patients have a high likelihood for NSTEMI if the hs-cTn concentration at presentation is at least moderately elevated or hs-cTn concentrations show a clear rise within the first hour. Cut-off levels are assay-specific. Cut-off levels for other hs-cTn assays are in development. *Only applicable if chest pain onset >3h, +At the time of the publication of the guideline not yet commercially available.

Table 5 Characteristics of the 0 h/3 h and the 0 h/1 h algorithms

	0h/3 h algorithm	0h/1 h algorithm
Negative predictive value for acute MI	98–100%	98–100%
Positive predictive value for acute MI	Unknown, depending on delta change and assay	75–80%
Effectiveness[a]	++	+++
Feasibility	++ requires GRACE score	+++
Challenges	Pain onset cannot be reliably quantified in many patients	Cut-off levels are assay-specific and different from the 99th percentile
Validation in large multicentre studies	+	+++
Additional advantages	Already used clinically	Shorter time to decision

GRACE = Global Registry of Acute Coronary Events; MI = myocardial infarction.
[a]Effectiveness is quantified by the percentage of consecutive chest pain patients clearly classified as rule-out or rule-in of acute MI (i.e., approximately 60% for the 0 h/3 h algorithm and approximately 75% for the 0 h/1 h algorithm).

Recommendations for diagnosis, risk stratification, imaging and rhythm monitoring in patients with suspected non-ST-elevation acute coronary syndromes

Recommendations	Class[a]	Level[b]	Ref.[c]
Diagnosis and risk stratification			
It is recommended to base diagnosis and initial short-term ischaemic and bleeding risk stratification on a combination of clinical history, symptoms, vital signs, other physical findings, ECG and laboratory results.	I	A	28, 109–112

ACUTE CORONARY SYNDROMES

Intervention in acute coronary syndromes: do patients undergo intervention on the basis of their risk characteristics? The Global Registry of Acute Coronary Events (GRACE)

K A A Fox, F A Anderson Jr, O H Dabbous, P G Steg, J López-Sendón, F Van de Werf, A Budaj, E P Gurfinkel, S G Goodman, D Brieger, on behalf of the GRACE investigators

Heart 2007;**93**:177–182. doi: 10.1136/hrt.2005.084830

Open Access Research

BMJ Open

Should patients with acute coronary disease be stratified for management according to their risk? Derivation, external validation and outcomes using the updated GRACE risk score

Keith A A Fox,[1] Gordon FitzGerald,[2] Etienne Puymirat,[3,4,5,6] Wei Huang,[2] Kathryn Carruthers,[1] Tabassome Simon,[7,8,9,10,11] Pierre Coste, Jacques Monsegu,[12] Philippe Gabriel Steg,[13,14,15] Nicolas Danchin,[3,4,5,6] Fred Anderson[2]

OPEN ACCESS Freely available online

PLoS one

Does Simplicity Compromise Accuracy in ACS Risk Prediction? A Retrospective Analysis of the TIMI and GRACE Risk Scores

Krishna G. Aragam[1☯], Umesh U. Tamhane[1☯], Eva Kline-Rogers[1], Jin Li[1], Keith A. A. Fox[2], Shaun G. Goodman[3], Kim A. Eagle[1], Hitinder S. Gurm[1*]

1 Division of Cardiovascular Medicine, University of Michigan, Ann Arbor, Michigan, United States of America, **2** Cardiovascular Research, Division of Medical and Radiological Sciences, The University of Edinburgh, Edinburgh, Scotland, **3** Canadian Heart Research Centre and Terrence Donnelly Heart Centre, Division of Cardiology, St Michael's Hospital, University of Toronto, Toronto, Ontario, Canada

European Heart Journal (2005) **26**, 865–872
doi:10.1093/eurheartj/ehi187

EUROPEAN SOCIETY OF CARDIOLOGY®

Clinical research

TIMI, PURSUIT, and GRACE risk scores: sustained prognostic value and interaction with revascularization in NSTE-ACS

Pedro de Araújo Gonçalves*, **Jorge Ferreira**, **Carlos Aguiar**, and **Ricardo Seabra-Gomes**

[1] *Cardiology Department, Santa Cruz Hospital, Av. Prof. Dr. Reinaldo dos Santos, 2790-134, Carnaxide, Portugal*

Received 21 November 2004; revised 24 January 2005; accepted 27 January 2005; online publish-ahead-of-print 11 March 2005

SOCIETÀ ITALIANA · SIMEU · MEDICINA D'URGENZA

Journal of the American College of Cardiology
© 2010 by the American College of Cardiology Foundation
Published by Elsevier Inc.

Vol. 55, No. 14, 2010
ISSN 0735-1097/10/$36.00
doi:10.1016/j.jacc.2009.09.071

STATE-OF-THE-ART PAPER

Acute Coronary Syndrome

Emerging Tools for Diagnosis and Risk Assessment

Benjamin M. Scirica, MD, MPH

Boston, Massachusetts

ORIGINAL ARTICLE

Chest pain in the emergency room: value of the HEART score

A.J. Six, B.E. Backus, J.C. Kelder

"How often do we miss the diagnosis of nSTE-ACS in patients with nonspecific chest pain, resulting in a seriously adverse outcome?"

Netherlands Heart Journal, Volume 16, Number 6, June 2008

Chest pain in the emergency room: value of the HEART score

A.J. Six, B.E. Backus, J.C. Kelder

Table 1. Composition of the HEART score for chest pain patients in the emergency room.

HEART score for chest pain patients		Score
History	Highly suspicious	2
	Moderately suspicious	1
	Slightly suspicious	0
ECG	Significant ST depression	2
	Nonspecific repolarisation disturbance	1
	Normal	0
Age	≤65 year	2
	45-65 year	1
	<45 year	0
Risk factors	≥3 risk factors or history of atherosclerotic disease	2
	1 or 2 risk factors	1
	No risk factors known	0
Troponin	>2x normal limit	2
	1-2x normal limit	1
	≤normal limit	0
		Total

Chest pain in the emergency room: value of the HEART score

A.J. Six, B.E. Backus, J.C. Kelder

Netherlands Heart Journal, Volume 16, Number 6, June 2008

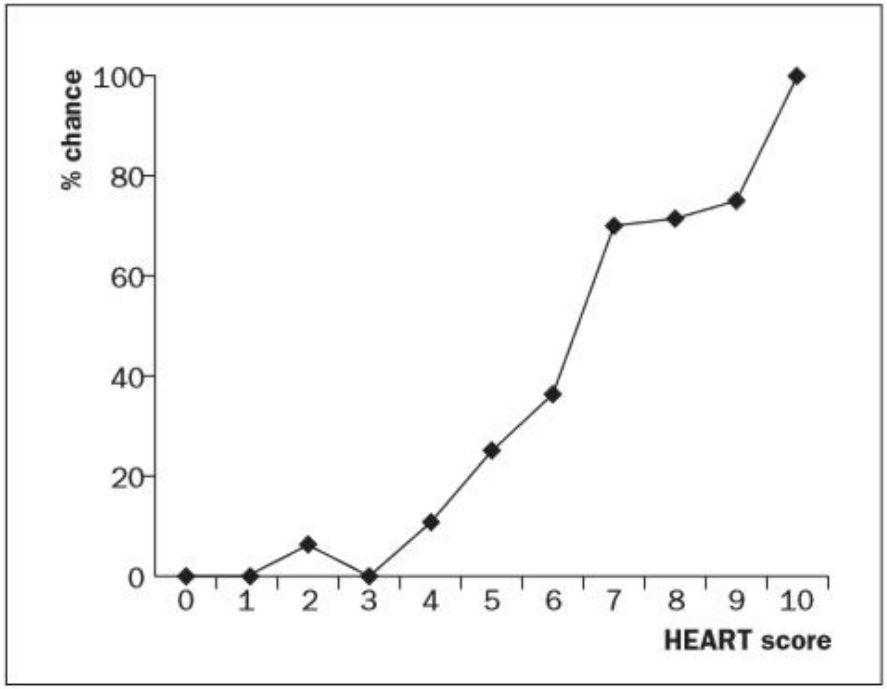


Figure 3. Chances of reaching the combined endpoint in each HEART category.

Endpoints

Endpoints in this study were acute myocardial infarction (AMI), percutaneous coronary intervention (PCI), coronary artery bypass graft (CABG) and death plus a combined endpoint of AMI, PCI, CABG and death.

A score of 0-3 points holds a risk of 2.5% of reaching an endpoint

Intern Emerg Med
DOI 10.1007/s11739-017-1743-4

EM - ORIGINAL

A retrospective external validation study of the HEART score among patients presenting to the emergency department with chest pain

Matthew Jay Streitz[1] · Joshua James Oliver[1] · Jessica Marie Hyams[1] · Richard Michael Wood[1] · Yevgeniy Mikhaylovich Maksimenko[2] · Brit Long[1] · Robert Michael Barnwell[1] · Michael David April[1]

Intern Emerg Med (2017) 12:357–364
DOI 10.1007/s11739-016-1461-3

EM - ORIGINAL

The HEART score with high-sensitive troponin T at presentation: ruling out patients with chest pain in the emergency room

Luca Santi[1] · Gabriele Farina[2] · Annagiulia Gramenzi[3] · Franco Trevisani[3] · Margherita Baccini[4] · Mauro Bernardi[3] · Mario Cavazza[2]

Table 3 Performance of the HEART score with high-sensitive troponin

HEART score	Risk class	Se (95 % CI)	Sp (95 % CI)	PPV (95 % CI)	NPV (95 % CI)
MACE at 30 days					
≤3	Low	100 (98.2–100)	43.7 (40.8–46.6)	23.8 (21.0–26.8)	100 (99.1–100)
4–6	Intermediate	87.4 (82.1–91.6)	71.4 (68.7–74.0)	35.0 (28.5–41.5)	97.0 (96.0–98.0)
7–10	High	73.3 (66.7–79.2)	85.1 (82.9–87.1)	46.3 (39.4–53.2)	94.8 (93.5–96.1)
MACE at 180 days					
≤3	Low	100 (98.4–100)	28.5 (25.9–31.2)	21.9 (16.6–27.2)	100 (99.8–100)
4–6	Intermediate	87.0 (81.9–91.0)	72.6 (69.9–75.1)	38.8 (32.5–45.1)	96.5 (95.4–97.6)
7–10	High	70.4 (64.1–76.3)	85.7 (83.6–87.7)	49.7 (40.2–56.5)	93.5 (92.1–94.9)

SE sensitivity, *Sp* specificity, *PPV* positive predictive value, *NPV* negative predictive value, *CI* confidence interval

European Heart Journal
Acute Cardiovascular Care
EUROPEAN SOCIETY OF CARDIOLOGY®

Review

The HEART score for early rule out of acute coronary syndromes in the emergency department: a systematic review and meta-analysis

European Heart Journal: Acute Cardiovascular Care
1–9

DOI: 10.1177/2048872617710788
journals.sagepub.com/home/acc
SAGE

Table 2. Characteristics of included studies.

Study	Year	Country	Study design	Number of sites	Study period
Backus et al.[8]	2010	Netherlands	Retrospective cohort study	4	1 Jan–31 Mar 2006
Fesmire et al.[14]	2012	USA	Retrospective cohort study	1	13-month period
Backus et al.[9]	2013	Netherlands	Prospective cohort study	10	Oct 2008–Nov 2009
Six et al.[15]	2013	9 Asia-Pacific countries	Retrospective cohort study	14	Nov 2007–Dec 2010
Melki and Jernberg[16]	2013	Sweden	Retrospective cohort study	1	1 Jan–12 Feb 2009
Marcoon et al.[17]	2013	USA	Retrospective cohort study	1	1999–2009
Visser et al.[18]	2014	Netherlands	Prospective cohort study	1	1 Dec 2012–31 Jul 2013
Leite et al.[19]	2015	Portugal	Retrospective cohort study	1	23–29 Jan 2012 and 23–29 Jul 2012
Carlton et al.[20]	2015	UK	Retrospective cohort study	1	Jul 2012–Aug 2013
Bodapati et al.[21]	2016	Australia	Retrospective cohort study	1	1 Jan 2013–16 May 2013
Sun et al.[22]	2016	USA	Retrospective cohort study	8	1 Jun 1999–Aug 2001
Santi et al.[23]	2016	Italy	Retrospective cohort study	1	1 Jan–30 Jun 2014

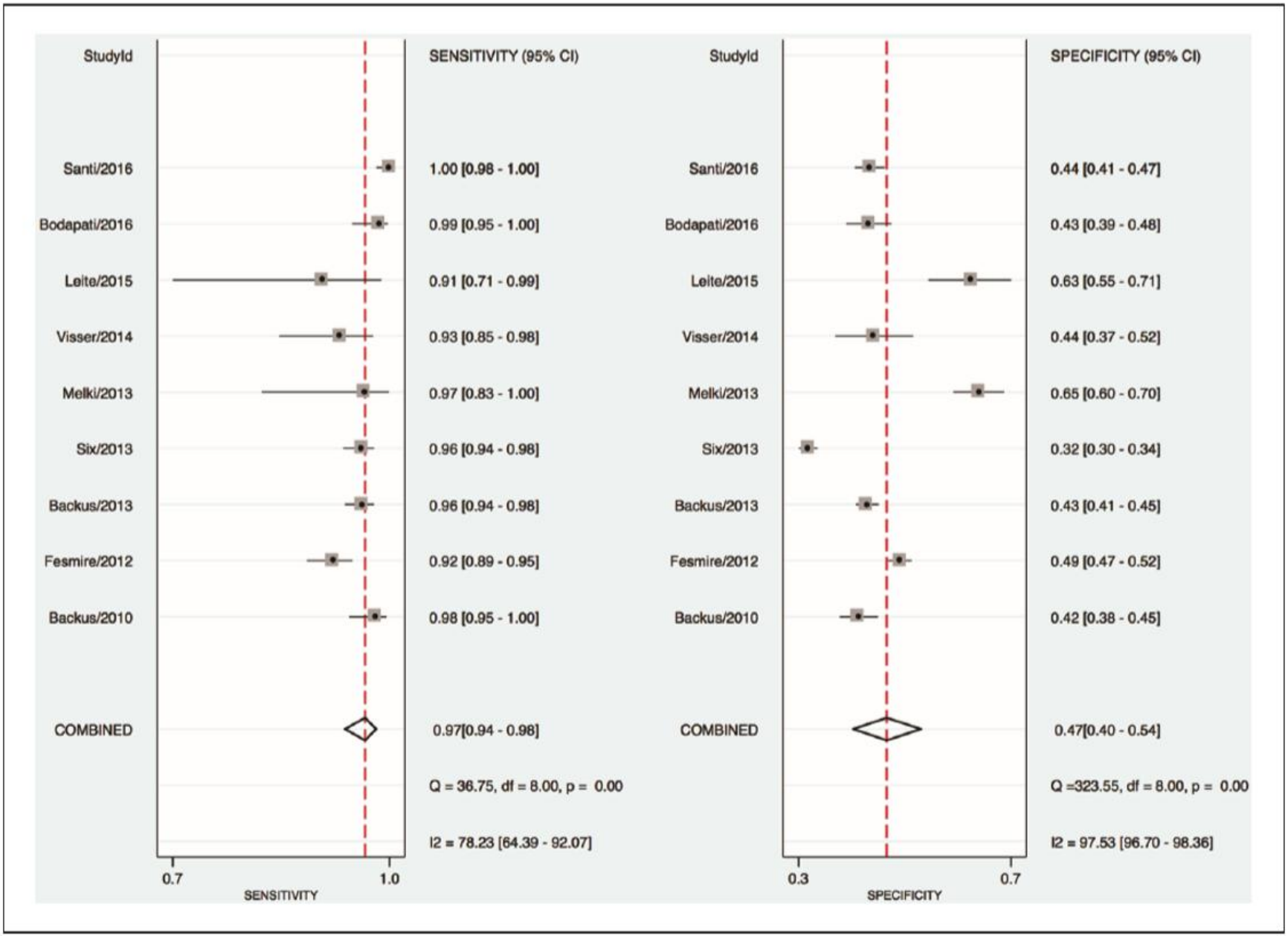


Figure 3. Forest plot of the HEART score sensitivity and specificity for prediciting major adverse cardiac events.

International Journal of Cardiology 221 (2016) 759–764

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Comparing HEART, TIMI, and GRACE scores for prediction of 30-day major adverse cardiac events in high acuity chest pain patients in the emergency department☆

Jeffrey Tadashi Sakamoto [a], Nan Liu [b,c,*], Zhi Xiong Koh [b], Nicholas Xue Jin Fung [d], Micah Liam Arthur Heldeweg [e], Janson Cheng Ji Ng [b], Marcus Eng Hock Ong [b,f]

[a] Duke University School of Medicine, USA
[b] Department of Emergency Medicine, Singapore General Hospital, Singapore
[c] Centre for Quantitative Medicine, Duke-NUS Medical School, Singapore
[d] Yong Loo Lin School of Medicine, National University of Singapore, Singapore
[e] Faculty of Medical Sciences, University of Groningen, The Netherlands
[f] Health Services and Systems Research, Duke-NUS Medical School, Singapore

Table 5
Sensitivities, specificities, positive predictive values (PPV), and negative predictive values (NPV) at different cut-off values for the HEART score, TIMI score, and GRACE score.

	HEART ≤ 3	HEART ≤ 4	TIMI = 0	TIMI ≤ 1	GRACE ≤ 75	GRACE ≤ 110
Sensitivity (%)	99.1	91.6	97.2	87.0	93.5	60.0
Specificity (%)	24.9	42.2	15.9	37.5	20.3	54.5
PPV (%)	42.2	46.7	39.0	43.5	39.3	42.2
NPV (%)	98.0	90.1	91.2	83.9	85.0	71.1
Total, n (%)	99 (16.4)	182 (30.1)	68 (11.3)	174 (28.8)	93 (15.5)	298 (49.3)

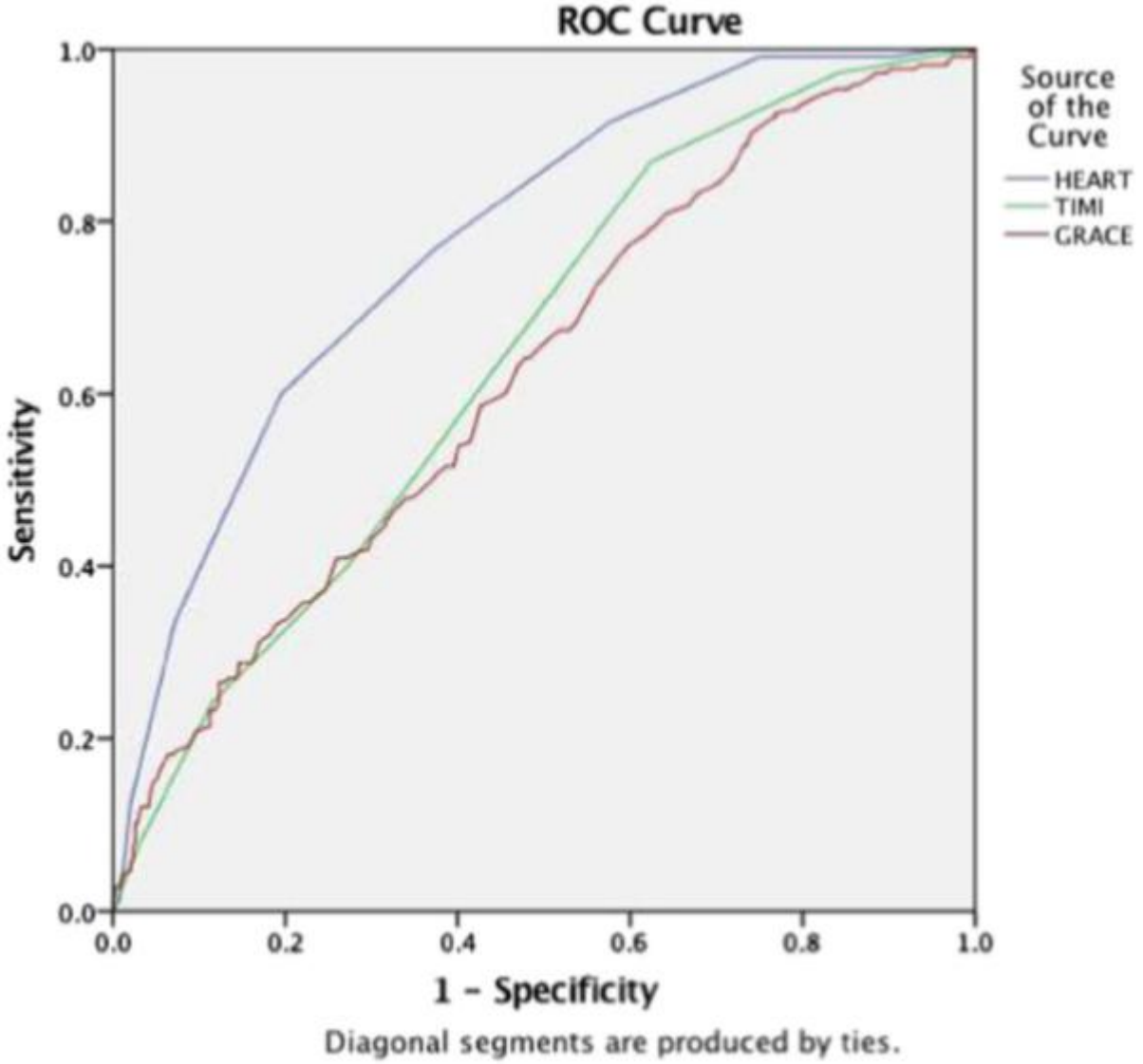


Fig. 2. Receiver operating characteristic (ROC) curve for the HEART score, TIMI score, and GRACE score in predicting 30-day major adverse cardiac events (MACE).

Original Article

The HEART Pathway Randomized Trial

Identifying Emergency Department Patients With Acute Chest Pain for Early Discharge

Simon A. Mahler, MD, MS; Robert F. Riley, MD; Brian C. Hiestand, MD, MPH; Gregory B. Russell, MS; James W. Hoekstra, MD; Cedric W. Lefebvre, MD; Bret A. Nicks, MD; David M. Cline, MD; Kim L. Askew, MD; Stephanie B. Elliott, BS; David M. Herrington MD, MHS; Gregory L. Burke, MD; Chadwick D. Miller, MD, MS

Circ Cardiovasc Qual Outcomes is available at http://circoutcomes.ahajournals.org DOI: 10.1161/CIRCOUTCOMES.114.001384

Clinical Trial Registration—URL: http://www.clinicaltrials.gov. Unique Identifier: NCT01665521.
(*Circ Cardiovasc Qual Outcomes*. 2015;8:195-203. DOI: 10.1161/CIRCOUTCOMES.114.001384.)

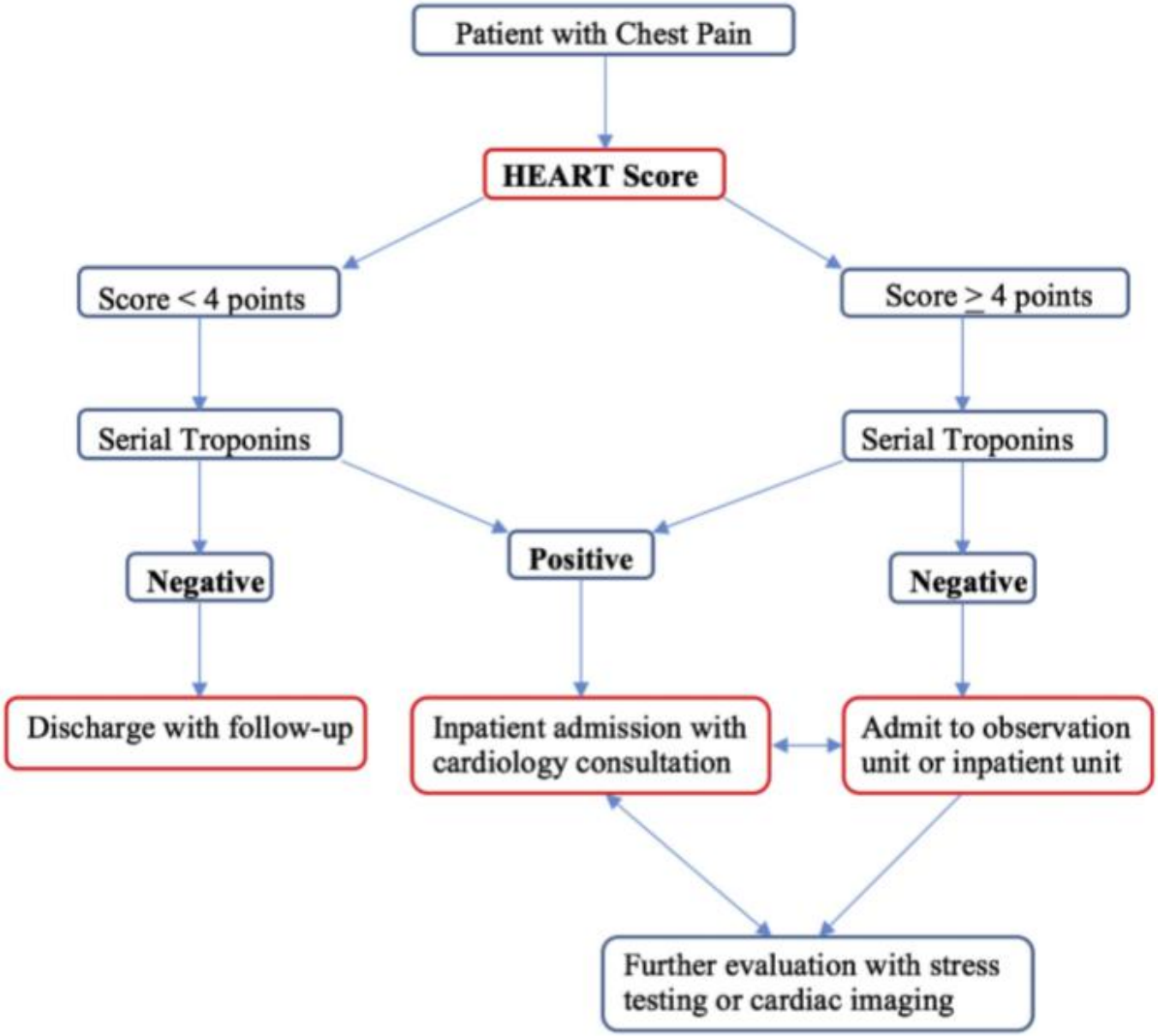


Fig. 1. HEART Pathway [26].

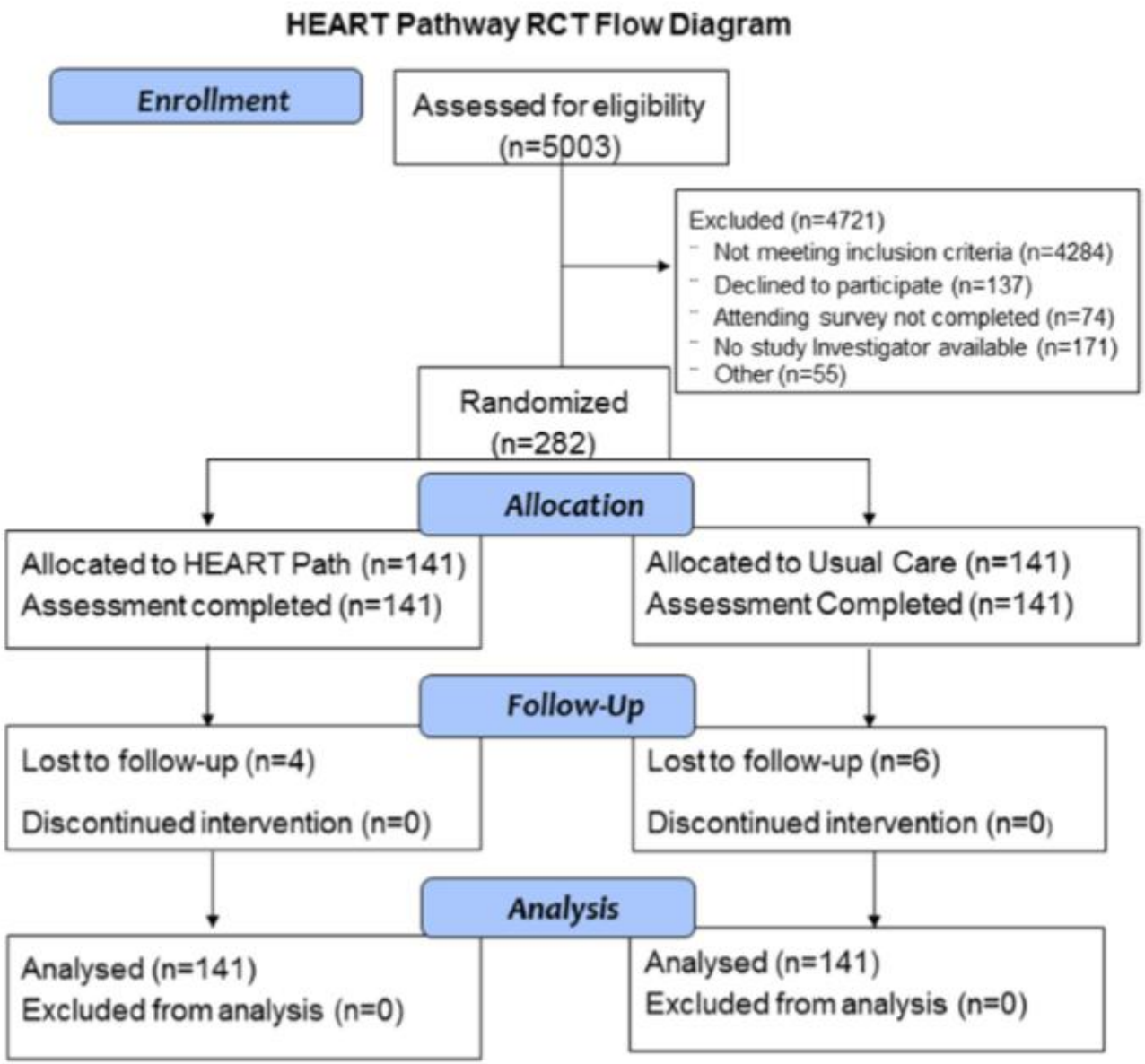


Figure 2. Enrollment flow dia

Table 4. Safety Events and Healthcare Utilization Outcomes

	HEART Pathway								
	Low-Risk Patients		High-Risk Patients		Total		Usual Care		
Outcomes	Number, n=66	Percent	Number n=75	Percent	Number, n=141	Percent.	Number, n=141	Percent	*P* Value*
Index length of stay, h; median (IQR)	6.4 (5.6–8.8)	…	25.9 (11.4–46.7)	…	9.9 (6.3–26.4)	…	21.9 (8.4–28.2)	…	0.013
Index visit disposition									
Hospitalization	19	28.8	66	88.0	85	60.3	110	78.1	0.002
Observation unit	18	27.3	25	33.3	43	30.5	62	44.0	0.31
Inpatient ward (admission)	1	1.5	41	54.7	42	29.8	48	34.0	0.52
Discharge	47	71.2	8	10.7	55	39.0	31	22.0	0.003
AMA	0	0	1	1.3	1	0.7	0	0	>0.999
Early discharge	47	71.2	9	12.0	56	39.7	26	18.4	0.0001
Recurrent hospital care at 30 days									
Repeat ED visit	2	3.0	8	10.7	10	7.1	18	12.8	0.16
Cardiac related	0	0	4	5.3	4	2.8	6	4.3	0.75
Nonindex hospitalization	1	1.5	8	10.7	9	6.4	9	6.4	>0.999
Cardiac related	0	0	5	6.7	5	3.6	4	2.8	>0.999
MACE at 30 days									
Cardiovascular death	0	0	0	0	0	0	0	0	…
MI	0	0	7	9.3	7	5.0	9	6.4	0.80
With revascularization	0	0	1	1.3	1	0.7	5	3.6	0.21
PCI	0	0	1	1.3	1	0.7	4	2.8	0.37
CABG	0	0	0	0	0	0	1	0.7	>0.999
Without revascularization	0	0	1	1.3	1	0.7	0	0	>0.999
PCI	0	0	1	1.3	1	0.7	0	0	>0.999
CABG	0	0	0	0	0	0	0	0	…

AMA indicates against medical advice; CABG, coronary artery bypass graft; ED, emergency department; IQR, interquartile range; MACE, major adverse cardiac event; MI, myocardial infarction; and PCI, percutaneous coronary intervention.

Table 5. Test Characteristics of the HEART Pathway and Serial Troponins

Risk Stratification Strategy	Early Discharge (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
Serial troponins	92.2% (87.8–96.6)	87.5% (47.4–99.6)	97.0% (92.5–99.2)	63.6% (30.8–89.1)	99.2% (95.8–100)
HEART Pathway	39.7% (31.6–48.3)	100% (63.1–100)	49.6% (40.8–58.4)	10.7% (4.7–19.9)	100% (94.6–100)

NPV indicates negative predictive values; and PPV, negative predictive values.

Clinical Biochemistry 50 (2017) 401–407

Contents lists available at ScienceDirect

Clinical Biochemistry

journal homepage: www.elsevier.com/locate/clinbiochem

Use of the HEART Pathway with high sensitivity cardiac troponins: A secondary analysis

Simon A. Mahler [a,*], Jason P. Stopyra [a], Fred S. Apple [b], Robert F. Riley [c], Gregory B. Russell [d], Brian C. Hiestand [a], James W. Hoekstra [a], Cedric W. Lefebvre [a], Bret A. Nicks [a], David M. Cline [a], Kim L. Askew [a], David M. Herrington [e], Gregory L. Burke [d], Chadwick D. Miller [a]

[a] Department of Emergency Medicine, Wake Forest School of Medicine, Winston-Salem, NC, USA
[b] Department Laboratory Medicine and Pathology, Hennepin County Medical Center and University of Minnesota Medical School, Minneapolis, MN, USA
[c] Division of Cardiology, University of Washington, Seattle, WA, USA
[d] Division of Public Health Sciences, Wake Forest School of Medicine, Winston-Salem, NC, USA
[e] Department of Internal Medicine, Division of Cardiology, Wake Forest School of Medicine, Winston-Salem, NC, USA

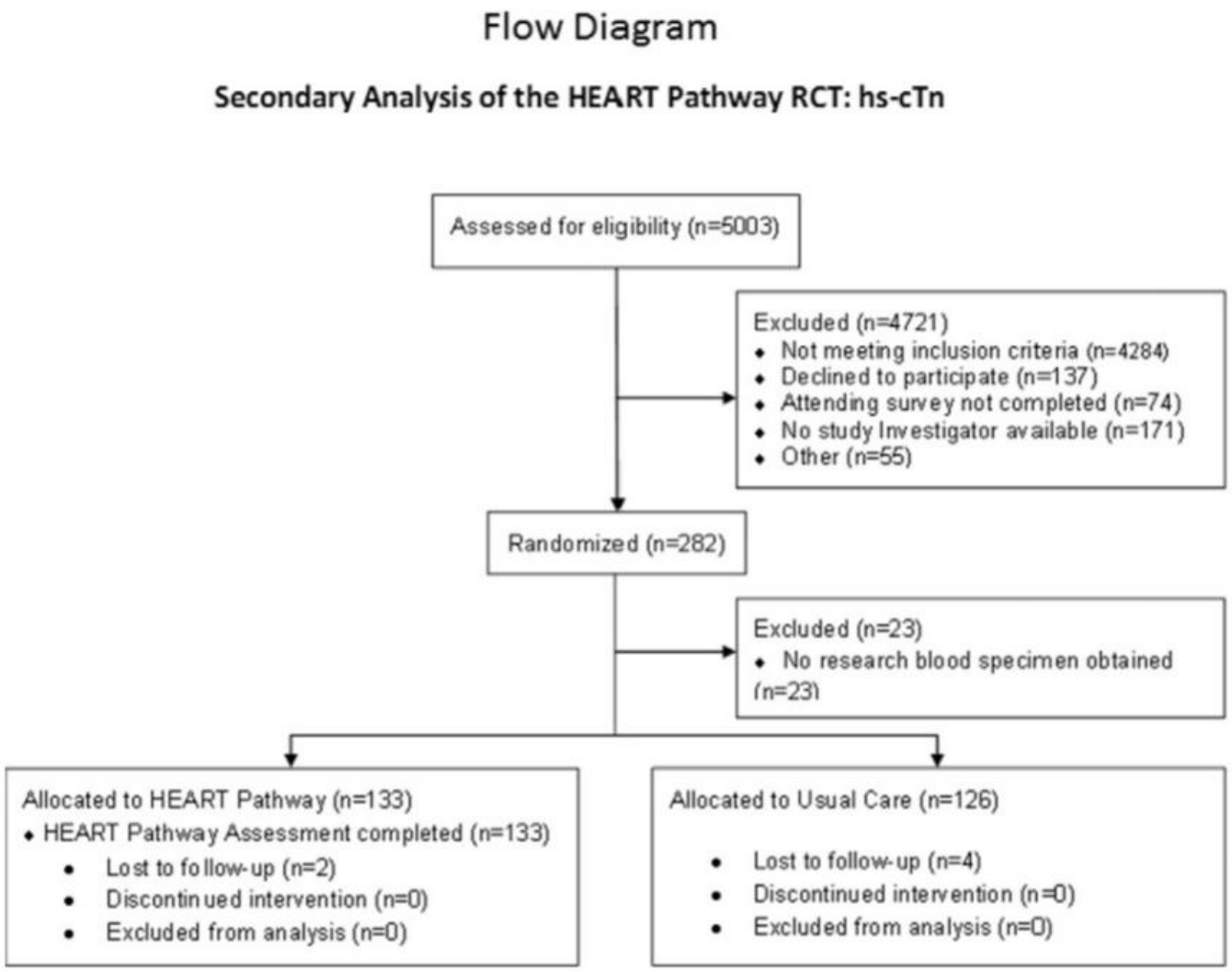


Fig. 2. Enrollment flow diagram.

Table 3
Performance characteristics of the HEART Pathway using cTnI, hs-cTnI, and hs-cTnT.

Risk stratification strategy	% low-risk (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
HEART Pathway cTnI	45.1% (36.5–54.0%)	100% (71.5–100%)	49.2% (40.0–58.4%)	15.1% (7.8–25.4%)	100% (94.0–10
HEART Pathway hs-cTnI	45.1% (36.5–54.0%)	100% (71.5–100%)	49.2% (40.0–58.4%)	15.1% (7.8–25.4%)	100% (94.0–10
HEART Pathway hs-cTnT	45.1% (36.5–54.0%)	90.9% (58.7–99.8%)	48.4% (39.2–57.6%)	13.7% (6.8–23.8%)	98.3% (91.1–1

Published in final edited form as:

Am J Emerg Med. 2017 January ; 35(1): 77–81. doi:10.1016/j.ajem.2016.10.005.

Cost Analysis of the HEART Pathway Randomized Control Trial

Robert F. Riley, MD, MS, **Chadwick D. Miller, MD, MS**, **Gregory B. Russell, MS**, **Erin N. Harper, MS**, **Brian C. Hiestand, MD**, **James W. Hoekstra, MD**, **Cedric W. Lefebvre, MD**, **Bret A. Nicks, MD**, **David M. Cline, MD**, **Kim L. Askew, MD**, and **Simon A. Mahler, MD, MS**

Cardiology, University of Washington (RFR), Department of Emergency Medicine, Wake Forest Baptist Health (CDM, ENH, BCH, JWH, CWL, BAN, DMC, KLA, SAM), and Department of Biostatistical Sciences, Wake Forest University (GBR)

Table 3

Cost Comparison Between Usual Care and the HEART Pathway

Cost	Usual Care (N= 136)	HEART Pathway (N=134)	p-value
Index visit median cost (Q1, Q3); mean cost (SD)	$1,412 ($993, $2,493), $,3194 ($6,064)	$1,260 ($692, $2,348); $2,512 ($3,803)	0.05
30-day median cost (Q1, Q3); mean cost (SD)	$1,523 ($1,065, $2,693); $3323 ($6,064)	$1,307 ($729, $2,457); $2,605 ($3,860)	0.04
30-day median cardiac-related cost (Q1, Q3); mean cost (SD)	$1,550 ($1,012, $2,780); $3,309 ($6,083)	$1,375 ($727, $2,383); $2,764 ($4,166)	0.10

one

Troponin level I-II

Pathway

Segreteria Nazionale:

Via Valprato, 68 - 10155 Torino
c.f. 91206690371
p.i. 02272091204

Contatti:

tel +39 02 67077483
fax +39 02 89959799
segreteria@simeu.it

Grazie per l'attenzione

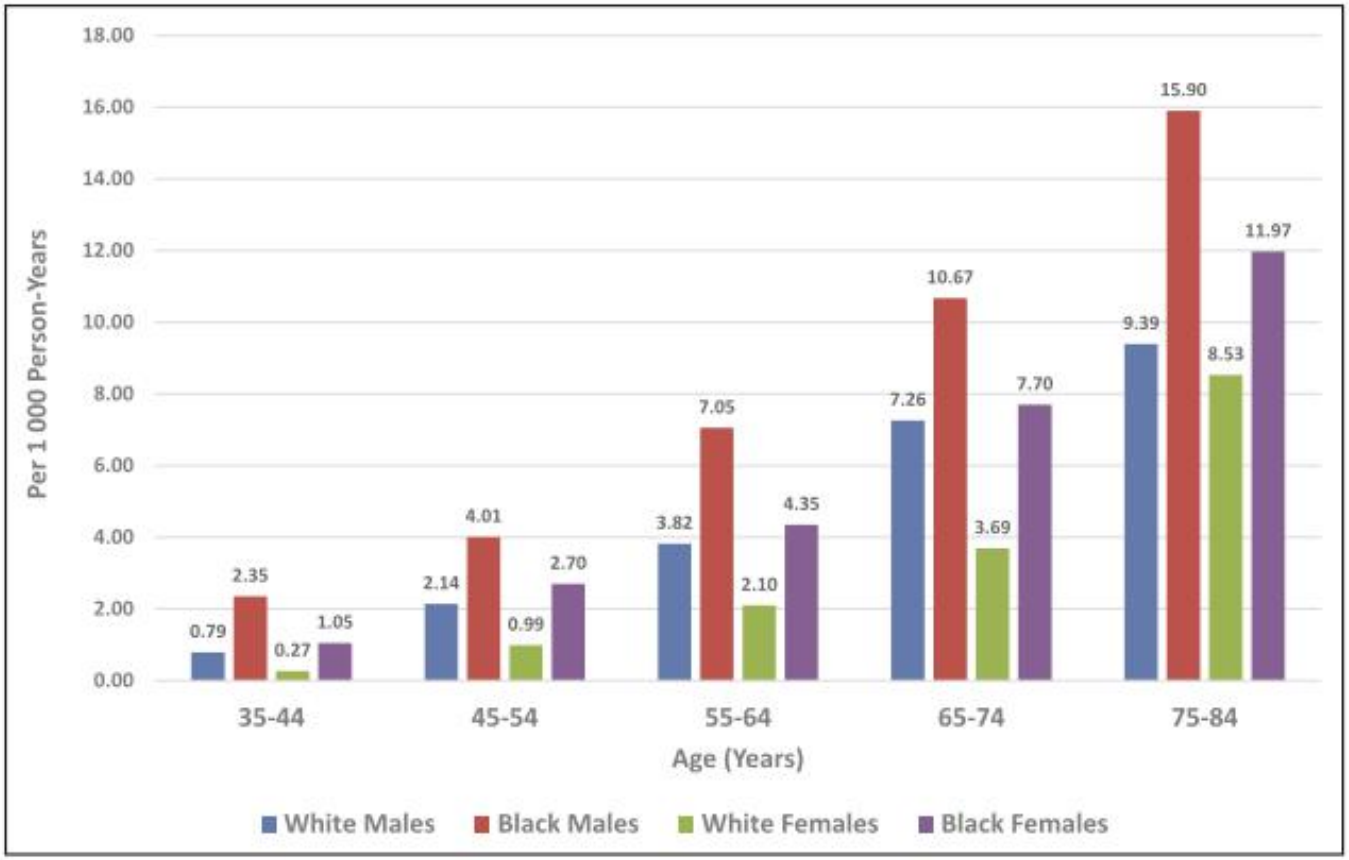


Chart 18-7. Incidence of myocardial infarction by age, sex, and race (ARIC Surveillance: 2005–2014).
ARIC indicates Atherosclerosis Risk in Communities.
Source: Unpublished data from ARIC, National Heart, Lung, and Blood Institute.

Table 2
Baseline characteristics.

	All patients ($n = 1748$)	Patients with MACE ($n = 326$)	Patients without MACE ($n = 1422$)
Demographics			
Male	937 (54%)	227 (70%)	710 (50%)
Mean age (SD)	62 (14)	67 (11)	60 (15)
Vital signs at presentation			
Mean systolic blood pressure in mm Hg (SD)	144 (23)	147 (23)	143 (23)
Mean diastolic blood pressure in mm Hg (SD)	81 (13)	82 (13)	81 (13)
Mean heart frequency per minute (SD)	73 (15)	75 (17)	73 (15)
Killip class I	1723 (99%)	317 (97%)	1406 (99%)
Cardiac risk factors			
Diabetes Mellitus	271 (16%)	68 (21%)	203 (14%)
Obesity (BMI >30 kg/m^2)	319 (18%)	58 (18%)	261 (18%)
Hypercholesterolemia	559 (32%)	117 (36%)	442 (31%)
Hypertension	846 (48%)	209 (64%)	637 (48%)
Positive family history	629 (36%)	117 (36%)	512 (36%)
Current smoking	441 (25%)	81 (25%)	360 (25%)
History of cardiovascular disease	576 (33%)	154 (47%)	422 (30%)
History of AMI	277 (16%)	65 (20%)	212 (15%)
History of PCI	331 (19%)	91 (28%)	240 (17%)
History of CABG	128 (7%)	36 (11%)	92 (6%)
History of CVA/TIA	98 (6%)	27 (8%)	71 (5%)
History of peripheral artery disease	69 (4%)	25 (8%)	44 (3%)
Laboratory results at presentation			
Mean creatinin in µmol/l (SD)	80 (33)	85 (22)	78 (35)
Medication at presentation			
Aspirin	597 (34%)	153 (47%)	444 (31%)
P2Y12-inhibitor (clopidogrel)	107 (6%)	40 (12%)	67 (5%)
Vitamin K antagonists (coumarin)	162 (9%)	33 (10%)	129 (9%)
Other (Dipyridamol, Ticagrelor, DOAC)	62 (4%)	14 (4%)	48 (3%)

SD: standard deviation, mm Hg: millimetres of mercury, BMI: Body Mass Index, AMI: acute myocardial infarction, PCI: percutaneous coronary intervention, CABG: coronary arterial bypass grafting, CVA: cerebrovascular attack, TIA: transient ischemic attack, DOAC: direct oral anticoagulant.

Titolo del capitolo

CAPITOLO 1

Table 3
Comparison of performance of GRACE score, HEART score and TIMI score in terms of safety and efficiency.

Scenario 1: at least 95% sensitivity	GRACE score	HEART score	TIMI score
Corresponding cut-off for "low risk"	≤72 points	≤3 points	0 points
Number of patients classified "low risk" / total number of patients	334/1748 (19.1%)	708/1748 (40.5%)	439/1748 (25.1%)
Percentage of MACE in "low risk" group	3.6% (12/334)	2.0% (14/708)	3.2% (14/439)
MACE, of which AMI	5	3	0
MACE, of which death	0	1	0
Negative predictive value (NPV)	96% (94%–98%)	98% (97–99%)	97% (95–98%)
Scenario 2: at least 98% sensitivity	**GRACE score**	**HEART score**	**TIMI score**
Corresponding cut-off for "low risk"	≤66 points	≤2 points	–*
Number of patients classified "low risk" / total number of patients	231/1748 (13.2%)	381/1748 (21.8%)	–
Percentage of MACE in "low risk" group	2.2% (5/231)	0.8% (3/381)	–
MACE, of which AMI	1	1	–
MACE, of which death	0	0	–
Negative predictive value (NPV)	98% (95–99%)	99% (98–100%)	–

MACE: major adverse cardiac events, AMI: acute myocardial infarction.

* At the lowest TIMI score, this absolute safety level is not reached unless all patients are classified as high risk.

Table 3
Baseline characteristics and cardiac risk factors of patients with and without 30-day major adverse cardiac events (MACE).

	Total population (n = 604)	No 30-day MACE (n = 389)	30-day MACE (n = 215)	p-Value
Age, mean (SD)	60.8 (13.2)	60.0 (13.9)	62.2 (11.8)	0.05
Male gender, n (%)	418 (69.2)	256 (65.8)	162 (75.3)	0.02
Diabetes, n (%)	223 (36.9)	140 (36.0)	83 (38.6)	0.52
Active smoker, n (%)	89 (14.7)	51 (13.1)	38 (17.7)	0.13
Hypercholesterolemia, n (%)	369 (61.1)	237 (60.9)	132 (61.4)	0.91
Hypertension, n (%)	420 (69.5)	273 (70.2)	147 (68.4)	0.64
Family history of CAD, n (%)	71 (11.8)	46 (11.8)	25 (11.6)	0.94
History of AMI, n (%)	143 (23.7)	90 (23.1)	53 (24.7)	0.68
History of CABG, n (%)	64 (10.6)	37 (9.5)	27 (12.6)	0.24
History of PCI, n (%)	169 (28.0)	110 (28.3)	59 (27.4)	0.83
History of IHD, n (%)	289 (47.8)	185 (47.6)	104 (48.4)	0.85

CAD: coronary artery disease; AMI: acute myocardial infarction; CABG: coronary artery bypass graft; PCI: percutaneous coronary intervention; IHD: ischemic heart disease.

International Journal of Cardiology 227 (2017) 656–661

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Comparison of the GRACE, HEART and TIMI score to predict major adverse cardiac events in chest pain patients at the emergency department

J.M. Poldervaart [a,*,1], M. Langedijk [b,1], B.E. Backus [c,1], I.M.C. Dekker [d,1], A.J. Six [e,1], P.A. Doevendans [f,1], A.W. Hoes [a,1], J.B. Reitsma [a,1]

[a] Julius Center for Health Sciences and Primary care, University Medical Center Utrecht, Utrecht, The Netherlands
[b] Department of Internal Medicine, Gelderse vallei hospital, Ede, The Netherlands
[c] Department of Emergency Medicine, Medical Center Haaglanden, Den Haag, The Netherlands
[d] Department of Emergency Medicine, Atrium Medical Center, Heerlen, The Netherlands
[e] Department of Cardiology, Zuwe Hofpoort Hospital, Woerden, The Netherlands
[f] Department of Cardiology, University Medical Center Utrecht, Utrecht, The Netherlands

CARDIOLOGY/ORIGINAL RESEARCH

Identifying Patients Suitable for Discharge After a Single-Presentation High-Sensitivity Troponin Result: A Comparison of Five Established Risk Scores and Two High-Sensitivity Assays

Edward W. Carlton, MBChB*; Ahmed Khattab, PhD; Kim Greaves, MD

*Corresponding Author. E-mail: eddcarlton@gmail.com, Twitter: @eddcarlton.

0196-0644/$-see front matter

http://dx.doi.org/10.1016/j.annemergmed.2015.07.006

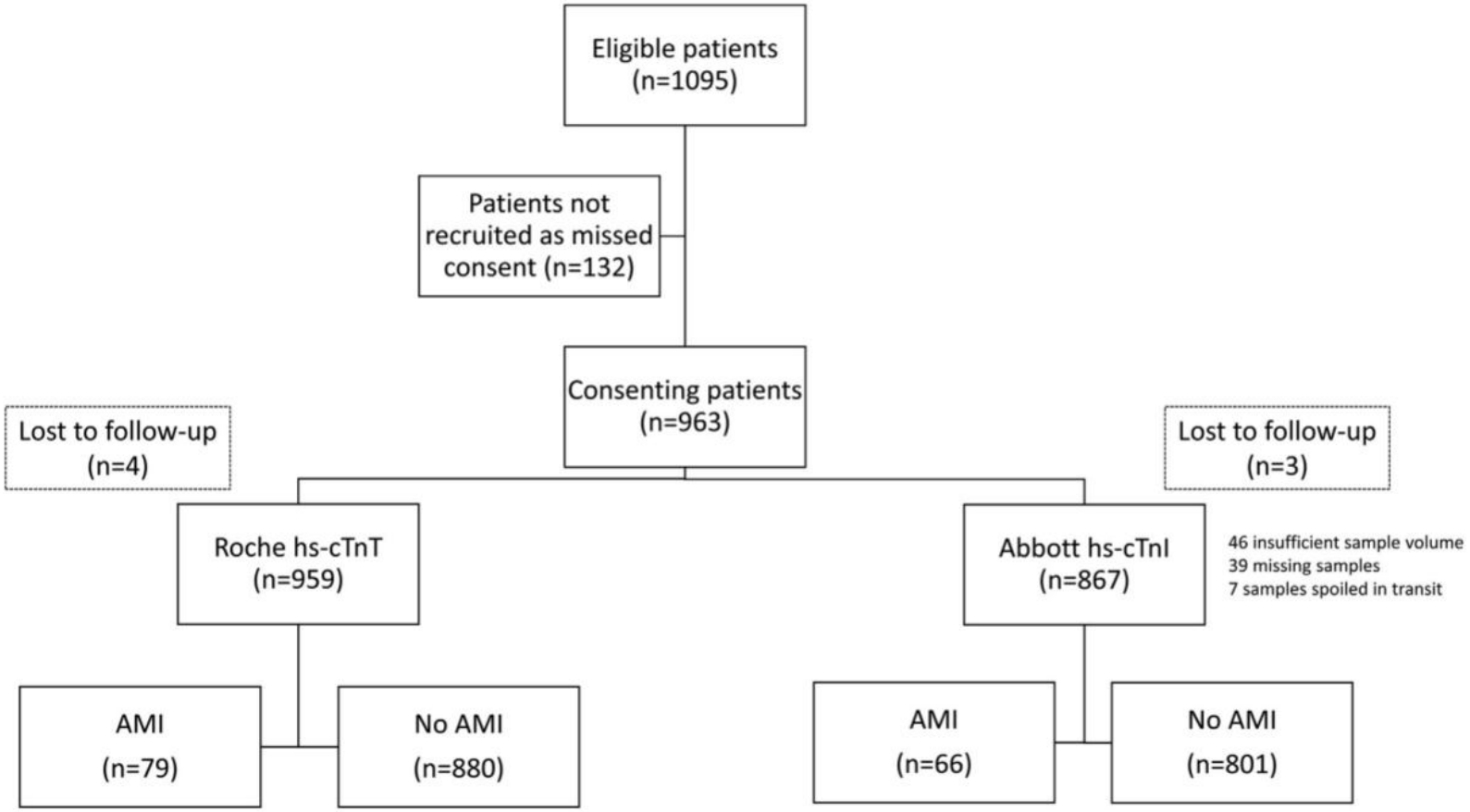


Figure 2. Recruitment flow chart. *AMI*, Acute myocardial infarction.

Table 2. Test performance of each risk score with high-sensitivity troponin T.

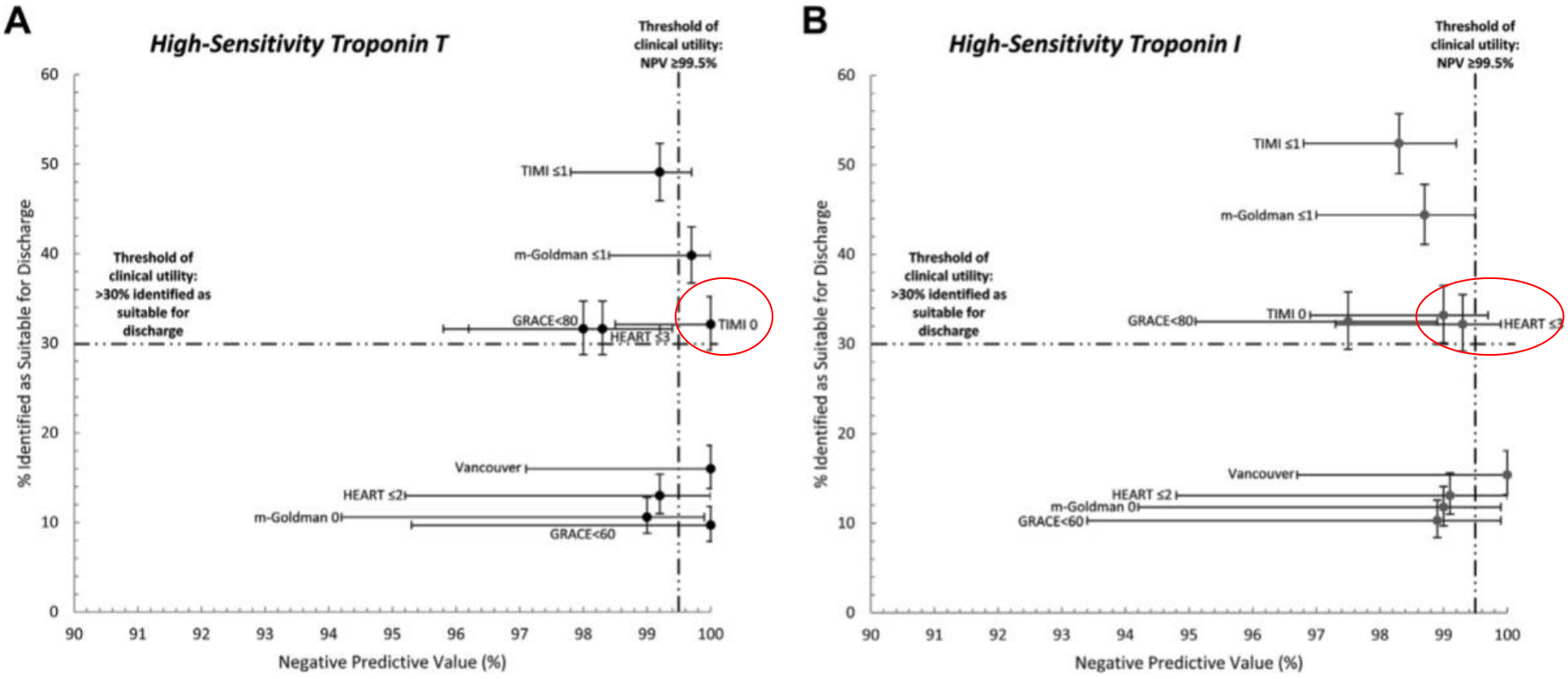
	hs-cTnT ≤14 ng/L Alone (99th Percentile)	m-Goldman Score 0 and hs-cTnT ≤14 ng/L	m-Goldman Score ≤1 and hs-cTnT ≤14 ng/L	TIMI Score 0 and hs-cTnT ≤14 ng/L	TIMI Score ≤1 and hs-cTnT ≤14 ng/L	GRACE Score <60 (Incorporates hs-cTnT)*	GRACE Score <80 (Incorporates hs-cTnT)*	HEART Score ≤2 (Incorporates hs-cTnT)	HEART Score ≤ 3 (Incorporates hs-cTnT)	Vancouver Chest Pain Rule (Incorporates hs-cTnT)
Sensitivity (95% CI)	83.5 (73.8–90.5)	98.7 (92.5–99.9)	98.7 (92.3–99.9)	100 (94.3–100)	94.9 (87.0–98.4)	100 (94.4–100)	92.3 (83.7–96.8)	98.7 (92.4–99.9)	93.7 (85.5–97.6)	100 (94.4–100)
Negative predictive value (95% CI)	98.3 (97.3–99.0)	99.0 (94.2–99.9)	99.7 (98.4–100)	100 (98.5–100)	99.2 (97.8–99.7)	100 (95.3–100)	98.0 (95.8–99.2)	99.2 (95.2–100)	98.3 (96.2–99.4)	100 (97.1–100)
Specificity (95% CI)	85.6 (84.7–86.2)	11.5 (10.9–11.6)	43.3 (42.7–43.4)	35.0 (34.5–35.0)	53.5 (52.8–53.8)	10.6 (10.1–10.6)	33.8 (33.0–34.2)	14.1 (13.5–14.2)	33.9 (33.1–34.2)	17.5 (17.0–17.5)
Positive predictive value (95% CI)	34.2 (30.2–37.0)	9.1 (8.5–9.2)	13.5 (12.6–13.7)	12.1 (11.4–12.1)	15.5 (14.2–16.1)	9.1 (8.6–9.1)	11.1 (10.0–11.6)	9.4 (8.8–9.5)	11.3 (10.3–11.8)	9.8 (6.4–9.8)
Positive likelihood ratio (95% CI)	5.789 (4.822–6.549)	1.115 (1.038–1.130)	1.741 (1.611–1.766)	1.538 (1.440–1.538)	2.043 (1.845–2.130)	1.119 (1.050–1.119)	1.393 (1.249–1.470)	1.149 (1.069–1.165)	1.416 (1.278–1.484)	1.212 (1.137–1.212)
Negative likelihood ratio (95% CI)	0.192 (0.111–0.309)	0.110 (0.006–0.691)	0.029 (0.002–0.180)	0 (0–0.165)	0.095 (0.030–0.245)	0 (0–0.555)	0.228 (0.093–0.495)	0.090 (0.005–0.561)	0.187 (0.069–0.439)	0 (0–0.331)
% Identified as suitable for discharge (95% CI)	79.9 (77.2–82.3)	10.6 (8.8–12.8)	39.8 (36.7–43.0)	32.1 (29.2–35.2)	49.1 (45.9–52.3)	9.8 (8.0–11.9)	31.6 (28.7–34.7)	13.0 (11.0–15.4)	31.6 (28.7–34.7)	16.0 (13.8–18.6)
Number of AMIs in patients identified as suitable for discharge (%)	13/766 (1.7)	1/102 (1.0)	1/382 (0.3)	0/308	4/471 (0.9)	0/93	6/301 (2.0)	1/125 (0.8)	5/303 (1.7)	0/154

*Incomplete GRACE scores in 7 cases because of missing creatinine results.

Table 3. Test performance of each risk score with high-sensitivity troponin I.

	hs-cTnI ≤26.2 ng/L Alone (99th Percentile)	m-Goldman Score 0 and hs-cTnI ≤26.2 ng/L	m-Goldman Score ≤1 and hs-cTnI ≤26.2 ng/L	TIMI Score 0 and hs-cTnI ≤26.2 ng/L	TIMI Score ≤1 and hs-cTnI ≤26.2 ng/L	GRACE Score <60 (Incorporates hs-cTnI)*	GRACE Score <80 (Incorporates hs-cTnI)*	HEART Score ≤2 (Incorporates hs-cTnI)	HEART Score ≤ 3 (Incorporates hs-cTnI)	Vancouver Chest Pain Rule (Incorporates hs-cTnI)
Sensitivity (95% CI)	62.1 (51.9–70.8)	98.5 (91.0–99.9)	92.8 (82.8–97.2)	95.5 (86.7–98.8)	87.9 (77.3–94.2)	98.5 (91.1–99.9)	89.4 (79.1–95.2)	98.5 (91.0–99.9)	97.0 (88.7–99.5)	100 (93.3–100)
Negative predictive value (95% CI)	96.9 (96.1–97.6)	99.0 (94.2–99.9)	98.7 (97.0–99.5)	99.0 (96.9–99.7)	98.3 (96.8–99.2)	98.9 (93.4–99.9)	97.5 (95.1–98.9)	99.1 (94.8–100)	99.3 (97.3–99.9)	100 (96.7–100)
Specificity (95% CI)	97.2 (96.5–98.1)	12.6 (12.0–12.7)	47.4 (46.6–47.8)	35.6 (34.9–35.9)	56.7 (55.8–57.2)	11.1 (10.5–11.2)	34.3 (33.5–34.8)	14.1 (13.5–14.2)	34.7 (34.0–34.9)	16.7 (16.2–16.7)
Positive predictive value (95% CI)	66.1 (55.2–75.4)	8.5 (7.9–8.6)	12.7 (11.3–13.3)	10.9 (9.9–11.3)	14.3 (12.6–15.4)	8.4 (7.8–8.5)	10.2 (9.0–10.8)	8.6 (8.0–8.8)	10.9 (10.0–11.2)	9.0 (8.4–9.0)
Positive likelihood ratio (95% CI)	23.695 (14.969–37.161)	1.127 (1.035–1.145)	1.758 (1.551–1.863)	1.482 (1.330–1.541)	2.029 (1.749–2.201)	1.107 (1.017–1.125)	1.361 (1.190–1.461)	1.147 (1.052–1.165)	1.485 (1.345–1.528)	1.201 (1.114–1.201)
Negative likelihood ratio (95% CI)	0.389 (0.298–0.498)	0.120 (0.006–0.746)	0.160 (0.059–0.370)	0.128 (0.033–0.383)	0.214 (0.101–0.407)	0.137 (0.007–0.852)	0.309 (0.137–0.624)	0.107 (0.006–0.665)	0.087 (0.015–0.332)	0 (0–0.412)
% Identified as suitable for discharge (95% CI)	92.8 (90.9–94.4)	11.8 (9.7–14.1)	44.4 (41.1–47.8)	33.2 (30.1–36.5)	52.4 (49.0–55.7)	10.3 (8.4–12.6)	32.5 (29.4–35.8)	13.1 (11.0–15.6)	32.2 (29.2–35.5)	15.4 (13.2–18.1)
Number of AMIs in patients identified as suitable for discharge (%)	25/805 (3.1)	1/102 (1.0)	5/385 (1.3)	3/288 (1.0)	8/454 (1.8)	1/89 (1.1)	7/280 (2.5)	1/114 (0.9)	2/280 (0.7)	0/134

*Incomplete GRACE scores in 6 cases because of missing creatinine results.



Note: Full axes from 0 to 100 are not shown to allow better visualization of points of interest

igure 4. Clinical utility of risk scores in combination with presentation high-sensitivity troponin T (*A*) and high-sensitivity troponin I 3) results. Error bars: 95% CIs.

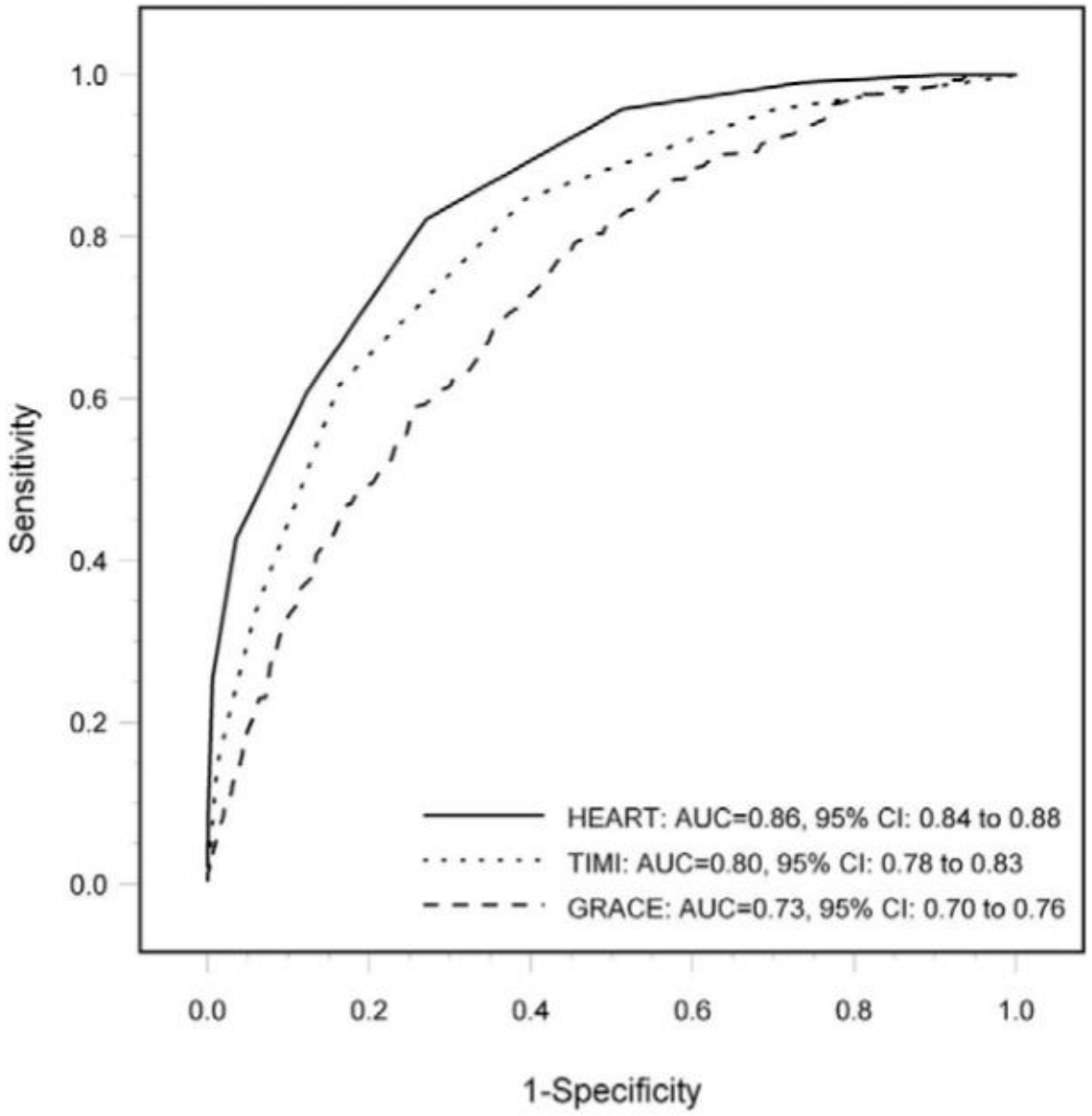


Fig. 2. Receiver-operating-characteristic (ROC) curves and corresponding Areas under the curve (AUCs) of the GRACE, HEART and TIMI score to predict major adverse cardiac events within 6 weeks.