The Value of
Chest Pain Units (CPU)
in Cardiac Care

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Affiliation/Financial Relationship	**Company**
1. Honoraria for lectures	Abbott, AstraZeneca , Berlin Chemie, Boehringer Ingelheim, MSD, BMS, Brahms, Daiichi Sankyo, Essex, GSK, Medtronic, Lilly, SanofiAventis, Correvio, Pfizer, Roche, The Med. Comp., Boston Scientific, Gilead
2. Honoraria for advisory board activities	AstraZeneca, BRAHMS, Boehringer Ingelheim, Medtronic, SHS
3. Participation in clinical trials	AstraZeneca, MSD, Braun, Boston Scientific, Takeda, Terumo GSK, The Med. Comp., Gilead
4. Financial shares and options:	no

If you find a man
with cardiac discomfort,
with pain in his arms,
at the side of his heart,
death is near.

———————

The Ebers papyrus 2600 B.C.

Success Story of Short Term Mortality in Patients with an Acute MI

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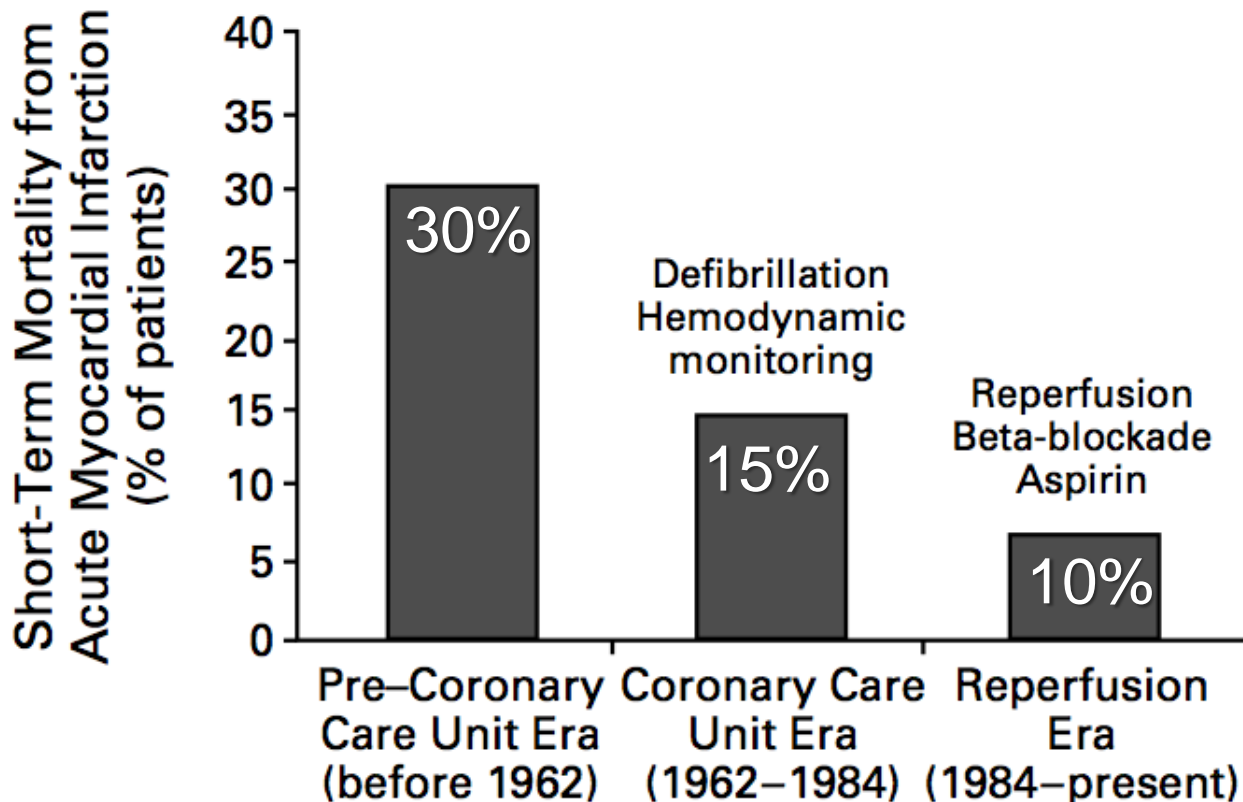
Why CPU?

What is CPU?

The work load:

- Chest pain is one of the most common chief complaints of patients presenting to EDs.

- 8-10% of the ED visits are for chest pain and related symptoms

WHY CPU ?

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The challenges:

- Patients presenting with chest pain who have life threatening underlying disease often not look critical on initial presentation

- It is estimated that 8-10% of patients presenting with ACS are discharged <u>mistakenly</u> from the ED

- These patients have 30 day mortality of 2%

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Challenges cont:

- Missed MI is the most common cause for litigation

- Medical malpractice lawsuits for missed MI recover the highest awards.

WHY CPU ?

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3 Objectives

I.   To rapidly and accurately assess a patient complaining of acute chest pain

II. To formulate an accurate differential diagnosis
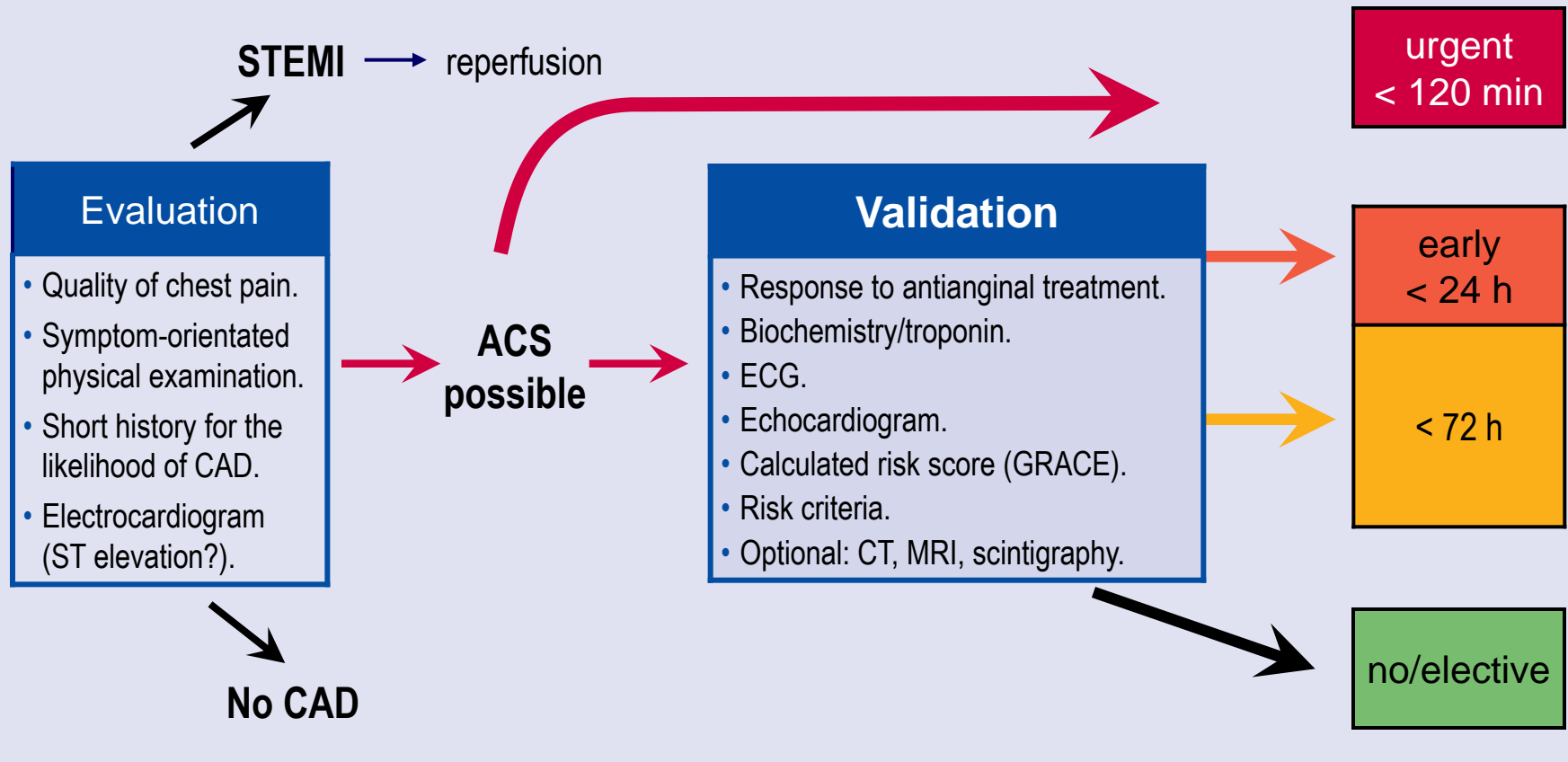
III. To initiate rapidly the appropriate basic therapy

European Heart Journal (2011) 32:2999–3054
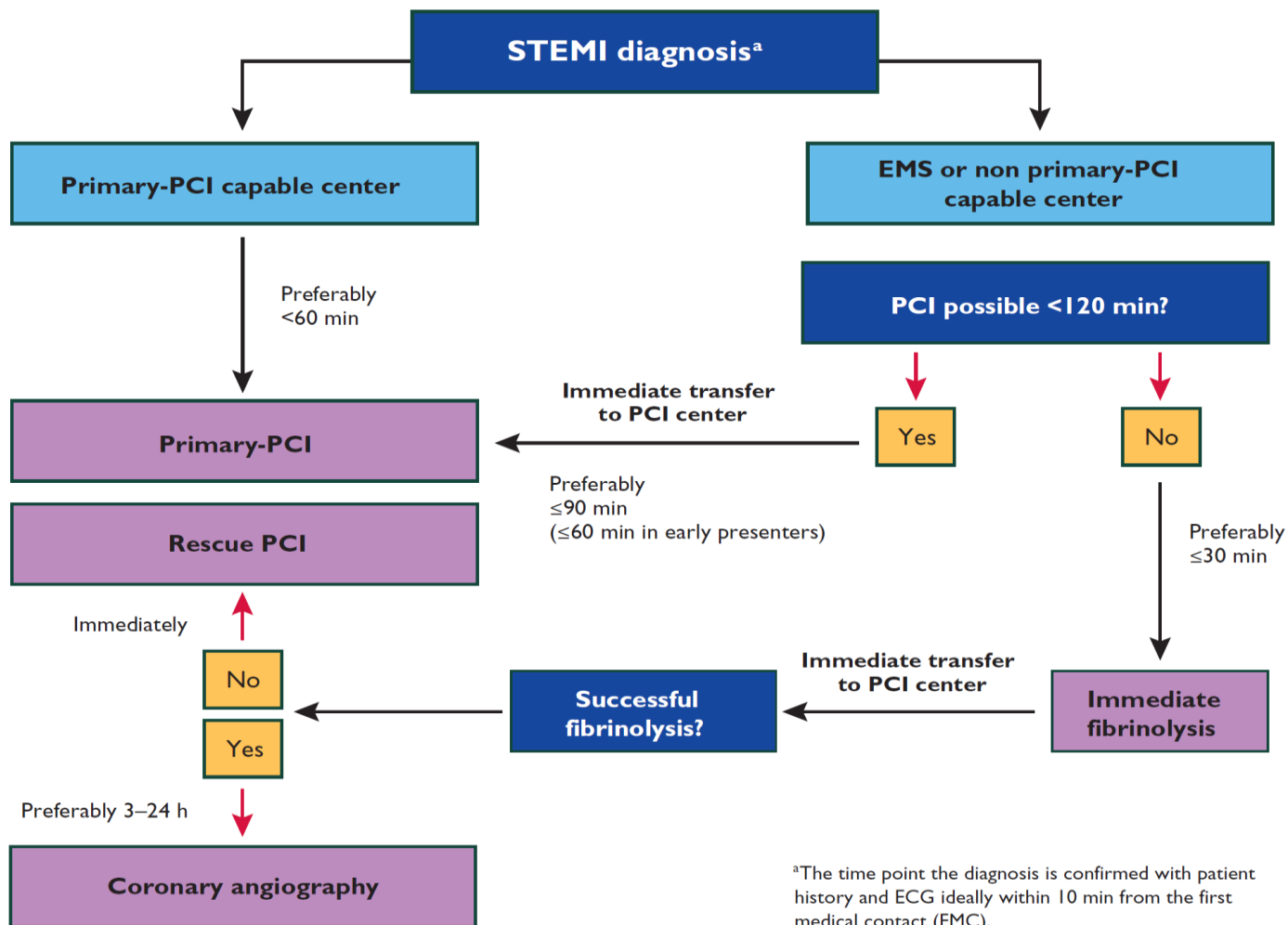doi:10.1093/eurheartj/ehr236
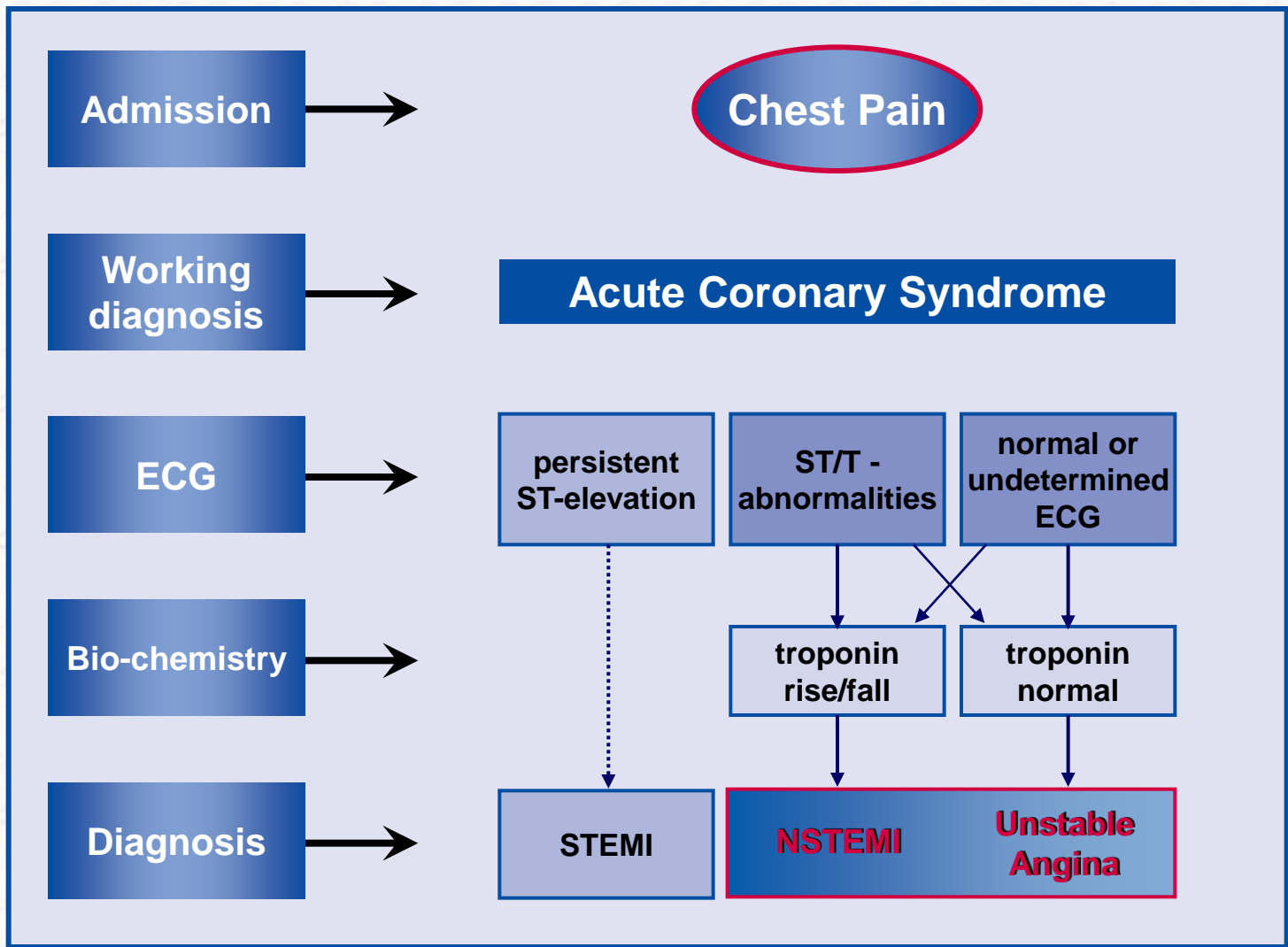
Decision-making algorithm in ACS

Prehospital and in-hospital management, and reperfusion strategies within 24 h of FMC

Cardiac and non cardiac conditions that can mimic NSTE-ACS

Cardiac	Pulmonary	Haematological	Vascular	Gastro-intestinal	Orthopedic
Myocarditis Pericarditis Myopericarditis Cardiomyopathy Valvular disease Apical ballooning (Tako-Tsubo syndrome)	Pulmonary embolism Pulmonary infarction Pneumonia Pleuritis Pneumothorax	Sickle cell anaemia	Aortic dissection Aortic aneurysm Aortic coarctation Cerebrovascular disease	Esophageal spasm Esophagitis Peptic ulcer Pancreatitis Cholescystitis	Cervical discopathy Rib fracture Muscle injury/ inflammation Costochondritis

Recommendations for diagnosis and risk stratification (1)

Recommendations	Class	Level
In patients with a suspected NSTE-ACS, diagnosis and short-term ischaemic/ bleeding risk stratification should be based on a combination of clinical history, symptoms, physical findings, ECG (repeated or continuous ST monitoring), and biomarkers.	I	A
ACS patients should be admitted preferably to dedicated **chest pain units or coronary care units.**	I	C
It is recommended to use established risk scores **for prognosis and bleeding (e.g. GRACE, CRUSADE).**	I	B

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US Experiences with Chest Pain Centers

- 1981: The first CPC was established in Baltimore

- In 2000 more than 1500 CPCs

- Society for CHEST PAIN CENTERS

Randomised controlled trial and economic evaluation of a chest pain observation unit compared with routine care

Steve Goodacre, Jon Nicholl, Simon Dixon, Elizabeth Cross, Karen Angelini, Jane Arnold, Sue Revill, Tom Locker, Simon J Capewell, Deborah Quinney, Stephen Campbell, Francis Morris

- Reduction of the proportion of patients admitted to the hospital from 54 to 37%

- Patients wrongly discharged with an ACS from 14% in the ED to 6% in the CPU

- Reduced costs (saving of 78 £/patient)

- More patient satisfaction

Development of acute chest pain services in the UK

Elizabeth Cross, Steven How, Steve Goodacre

Conclusion

Formal development of CPUs in the UK has been limited and mostly restricted to the research setting, yet there has been substantial informal and ad hoc development of acute chest pain services. Development of chest pain services in the UK is progressing in a disorganised way.

F. Breuckmann · F. Post · E. Giannitsis · H. Darius · R. Erbel · G. Görge · G. Heusch ·
W. Jung · H. Katus · S. Perings · J. Senges · N. Smetak · T. Münzel
Für die Task Force Chest Pain Unit

Kriterien der Deutschen Gesellschaft für Kardiologie – Herz- und Kreislaufforschung für „Chest-Pain-Units"

Spatial Requirements

Table I Spatial requirements

Criterion	Minimum requirement	Facultative
Room availability	Emergency department with constant availability of dedicated resources as described below, management of patients by cardiologists	Own spaces (rooms equipped with monitors, waiting room, treatment room, conference room)
Bed availability	Minimum 4 beds	One additional bed for every 50 000 inhabitants in the area
Availability	24 h/day, 365 days/year	
Heart Catheterization Laboratory	On the premises, available 24 h/day, 365 days/year	
Shock room		Integration in the CPU with pre-defined standard operating procedures and period (re-)training of staff

Equipment

Table 2 Equipment: minimum in the chest pain unit

Criteria	Minimum requirement	Encouraged by GSC
12-lead ECG	Constant availability	Additional devices
Blood pressure measurement	1 for each bed	NIBP in the waiting room, availability of invasive blood pressure monitors in emergencies
Transthoracic echocardiogram	Readily available within 30 min 24 h/day, 365 days/year	An ultrasound machine dedicated to CPU patients
Transoesophageal echocardiogram	Available on call within 30 min 24 h/day, 365 days/year	An ultrasound probe dedicated to CPU patients
Heart rhythm monitoring	1 for each bed	ST-segment monitoring
Cardiocirculatory resuscitation unit	Constant availability of resuscitation cart, including defibrillator	Additional devices
Transport with ECG monitoring	Available upon call (e.g. from ICU)	Devices dedicated to CPU patients
Transport with respiratory ventilator	Available upon call (e.g. from ICU)	Devices dedicated to CPU patients
Laboratory	Constantly available—turnaround time 50–60 min	POCT, turnaround time <20 min
Blood gas analysis	Constantly available—turnaround time <15 min	Integration in the CPU
External pacemaker	Available upon call (e.g. from ICU)	One device dedicated to CPU patients
Further diagnostic, including stress tests (ergometry, stress echo, stress scintigraphy, stress-MRI, CT scan)	Available within 3 days, availability guaranteed by formal contracts, preferably by cooperation networks with walk-in clinics	In the CPU (ergometry, stress echo)

CPU, chest pain unit; GSC, German Society of Cardiology; NIBP, non-invasive blood pressure measurement; POCT, point-of-care testing; MRI, magnetic resonance imaging; CT, computed tomography.
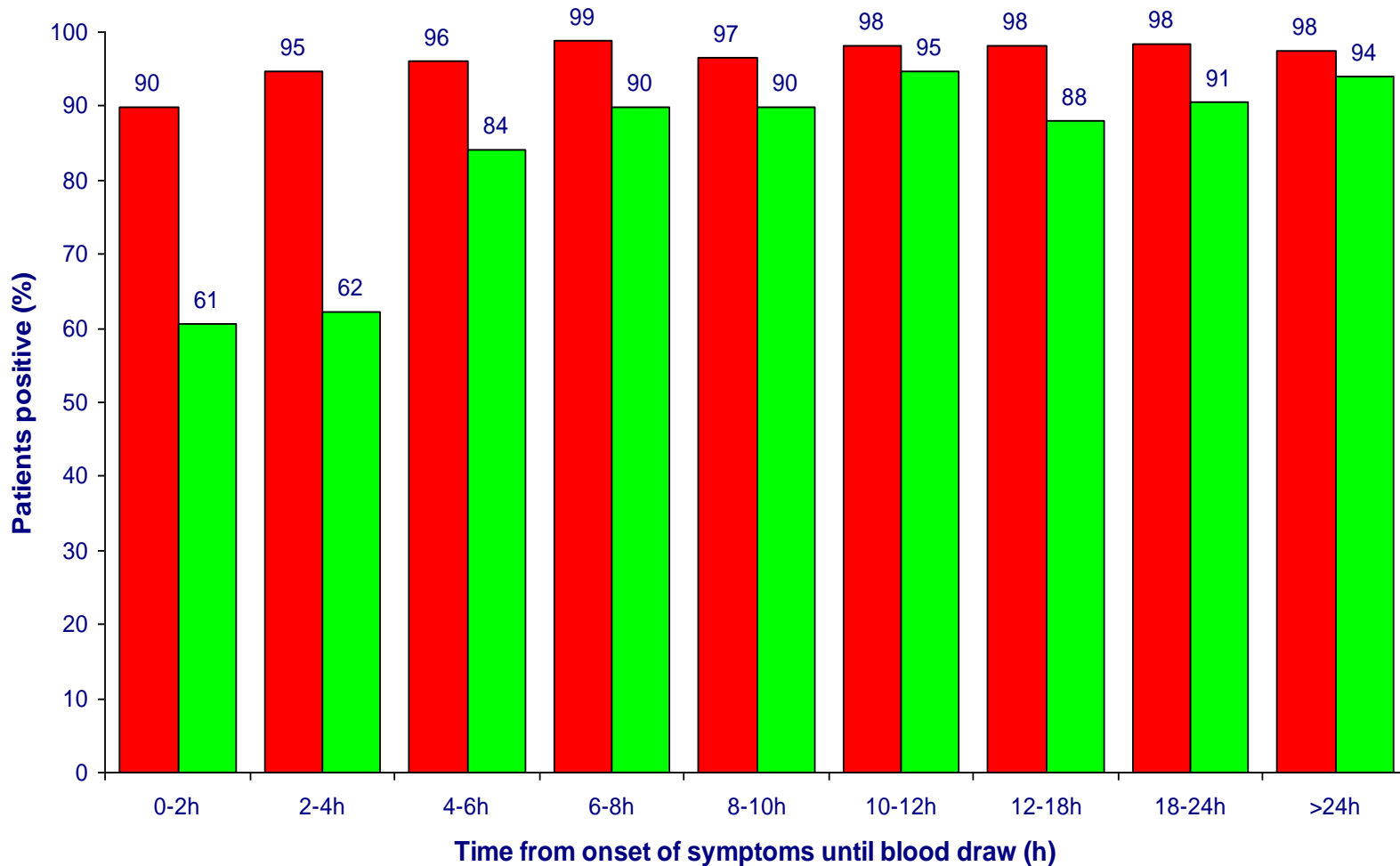
Minimum Diagnostics

Table 3 Minimum diagnostic standards for a chest pain unit

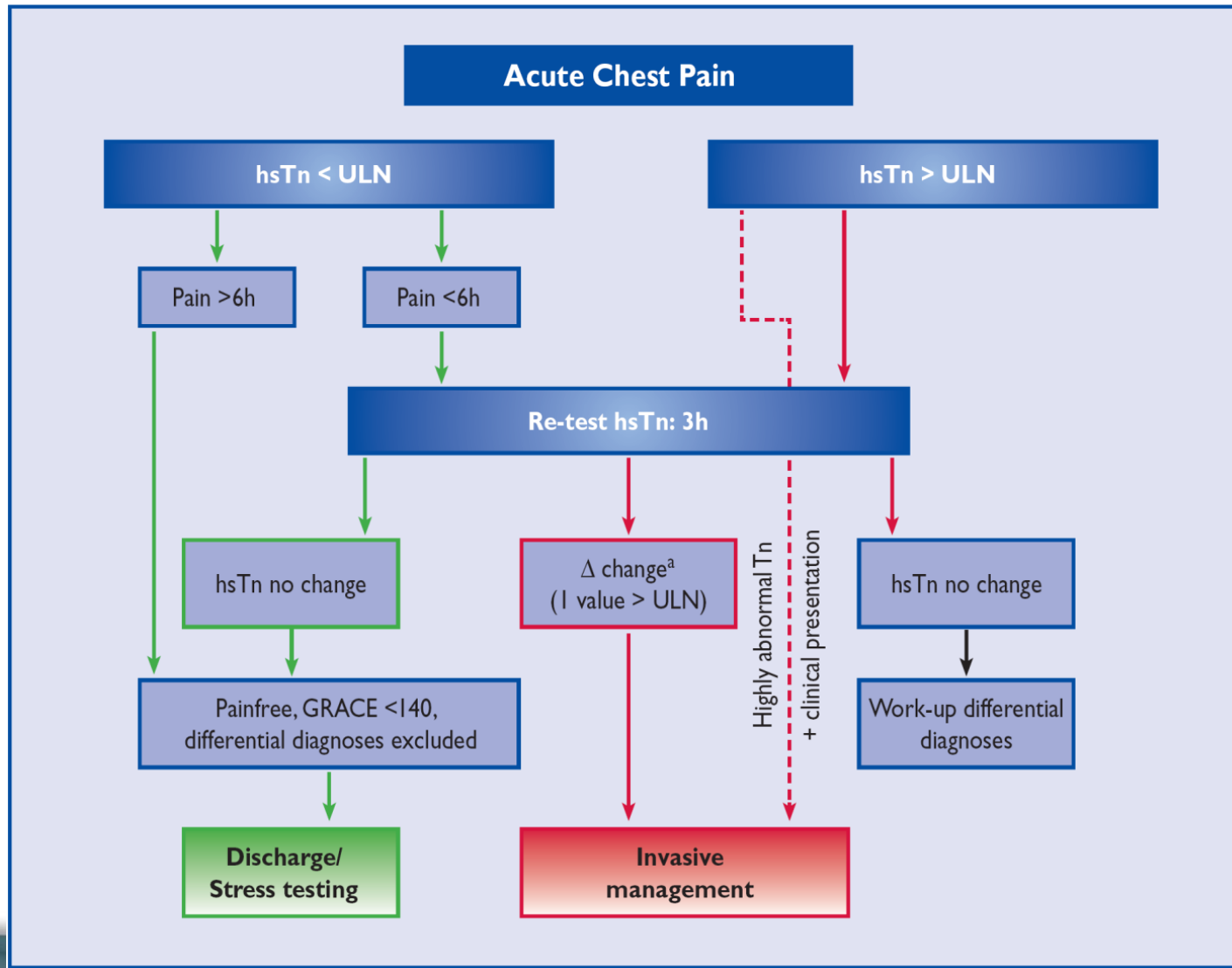| Criteria	Minimum requirement	Encouraged by GSC
Laboratory (cardiac markers)	Troponin T or I	CK, CK-MB, BNP, NT-proBNP, Multimarker Myoglobin
Time point of cardiac marker assessment	At admission + 6–12 h after admission	0, 3, and 6 h after admission and additional in case of symptoms
Laboratory (global)	Electrolytes, creatinine, blood counts, C-reactive protein, coagulation	Thyroid function (TSH), serial assessment of D-dimer and other markers when indicated
Time point of laboratory assays	At admission	Based on clinical indication
ECG	12 lead ECG, <10 min from first diagnosis	V3r, V4r, V7–9
Time point of ECG	At admission + 6 h later and if symptomatic	0, 3, and 6 h after admission and if symptomatic
Transthoracic echocardiography	All unstable patients with clinical indication. Availability 24/7	
Exercise test after exclusion of ACS	All patients, optionally in cooperation with walk-in clinics	
Abdominal ultrasound exams	24/7	In the CPU

ACS, acute coronary syndrome; BNP, brain natriuretic peptide; CK, creatine kinase; GSC, German Society of Cardiology; ECG, electrocardiogram; CPU, chest pain unit; TSH, thyroid-stimulating hormone.

hsTroponin T in AMI

hsTnT versus TnT in Patients with AMI (n=2501)

Weber, et al. Am Heart Journal 2011

Rapid rule-out of ACS with high-sensitivity troponin.

Diagnostics

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ECG & Risk

Diercks, et al. Am J. Cardiol. 2006

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Recommendations for diagnosis and risk stratification (2)

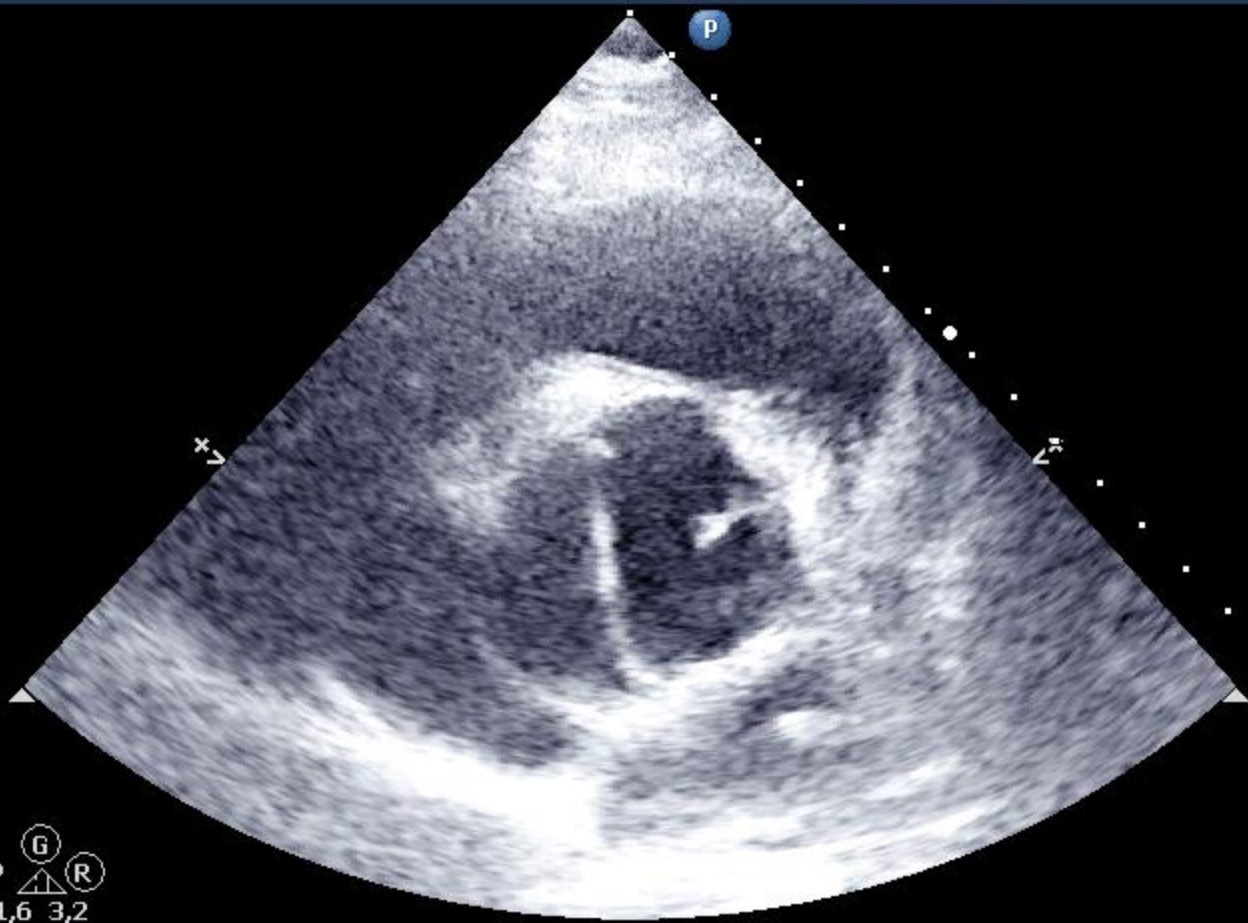| Recommendations	Class	Level
Blood has to be drawn promptly for troponin (cardiac troponin T or I) measurement.The result should be available within 60 min.The test should be repeated 6-9 h after initial assessment if the first measurement is not conclusive. Repeat testing after 12-24 h is advised if the clinical condition is still suggestive of ACS.	I	A
the culprit lesion has to be determined.	I	C
Coronary CT angiography should be considered as an alternative to invasive angiography to exclude ACS when there is a low to intermediate likelihood of CAD and when troponin and ECG are inconclusive.	IIa	B
In patients without recurrence of pain, normal ECG findings, negative troponins tests, and a low risk score, a non-invasive stress test for inducible ischaemia is recommended before deciding on an invasive strategy.	I	A

An echocardiogram is recommended for all patients to evaluate regional and global LV function and to rule in or rule out differential diagnoses.

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Recommendation for initial diagnosis

Recommendations	Class[a]	Level[b]
A 12-lead ECG must be obtained as soon as possible at the point of FMC, with a target delay of ≤10 min.	I	B
ECG monitoring must be initiated as soon as possible in all patients with suspected STEMI.	I	B
in patients with high suspicion of infero-basal myocardial infarction (circumflex occlusion) should be considered.	IIa	C
Echocardiography may assist in making the diagnosis in uncertain cases but should not delay transfer for angiography.	IIb	C

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Minimum Diagnostics

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Exercise testing in the CPU: safe and predictive?

BMC Emergency Medicine

Research article

Which diagnostic tests are most useful in a chest pain unit protocol?

Steve Goodacre*[1,2], Thomas Locker[1,2], Jane Arnold[1,2], Karen Angelini[1] and Francis Morris[1]

Results: Of the 706 patients, 30 (4.2%) were diagnosed as ACS with myocardial infarction, 30 (4.2%) as ACS with myocyte necrosis, and 32 (4.5%) suffered an adverse cardiac event. Sensitivities for ACS with myocardial infarction and myocyte necrosis respectively were: serial ECG / ST segment monitoring 33% and 23%; CK-MB(mass) 96% and 63%; troponin T (using 0.03 ng/ml threshold) 96% and 90%. The only test that added useful prognostic information was exercise treadmill testing (relative risk 6 for cardiac death, non-fatal myocardial infarction or arrhythmia over six months).

Conclusion: Serial ECG / ST monitoring, as used in our protocol, adds little diagnostic or prognostic value in patients with a normal or non-diagnostic initial ECG. CK-MB(mass) can rule out ACS with clinical myocardial infarction but not myocyte necrosis(defined as a troponin elevation without myocardial infarction). Using a low threshold for positivity for troponin T improves sensitivity of this test for myocardial infarction and myocardial necrosis. Exercise treadmill testing predicts subsequent adverse cardiac events.

Treadmill: Risk?

Equipment

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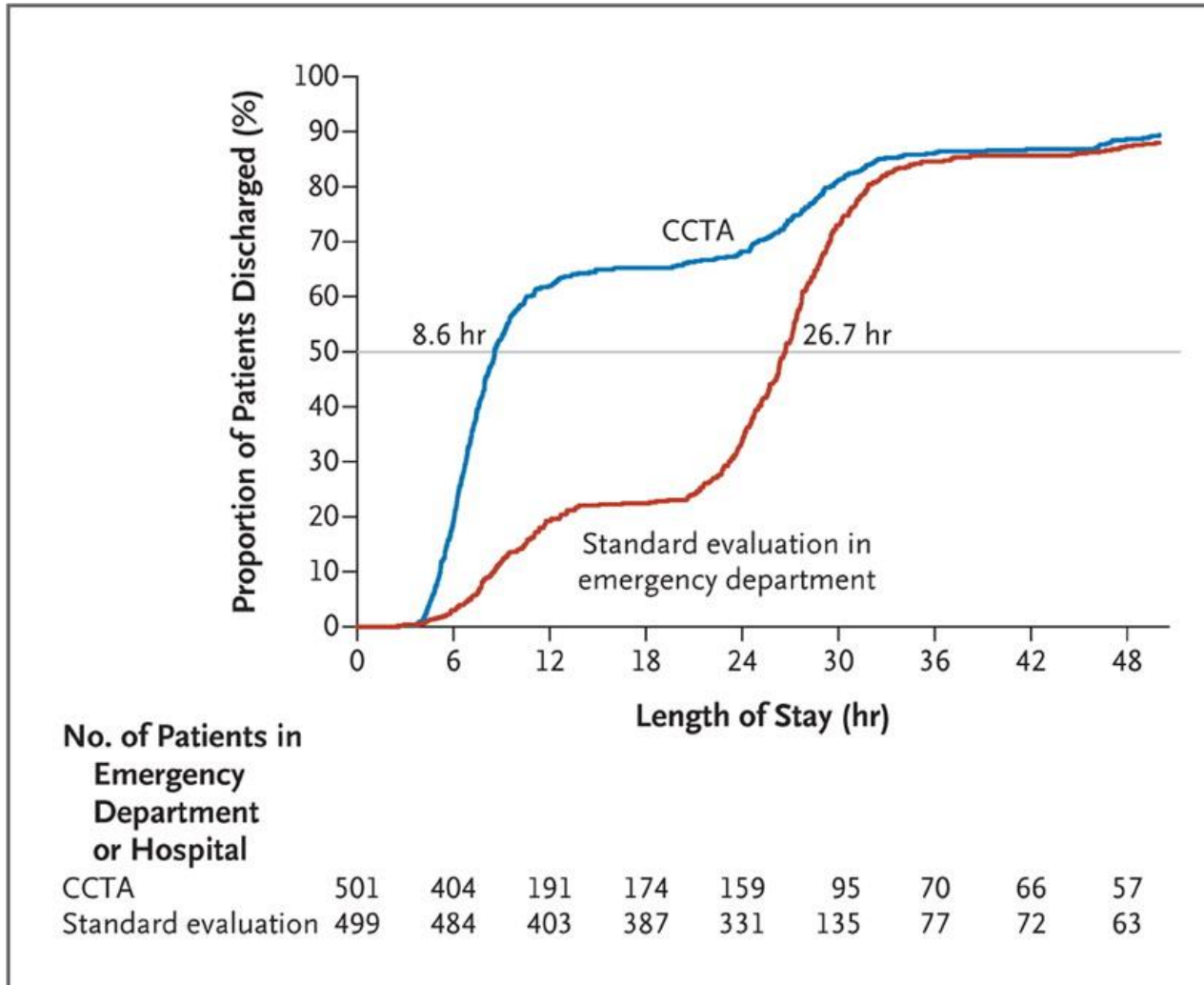
Coronary-CT
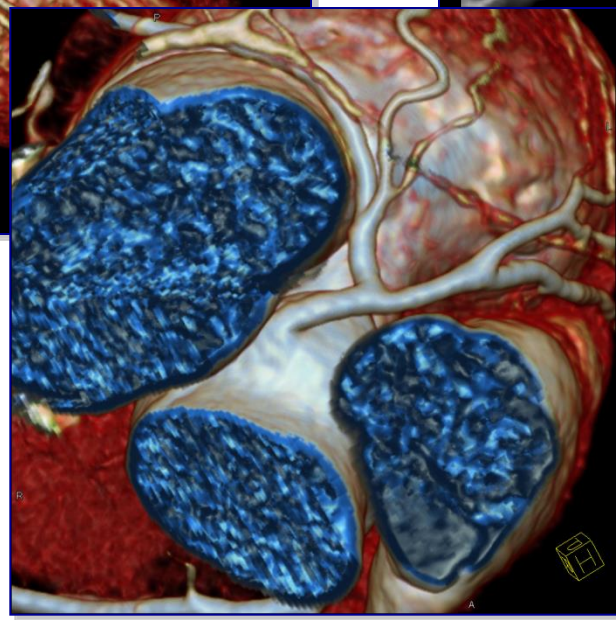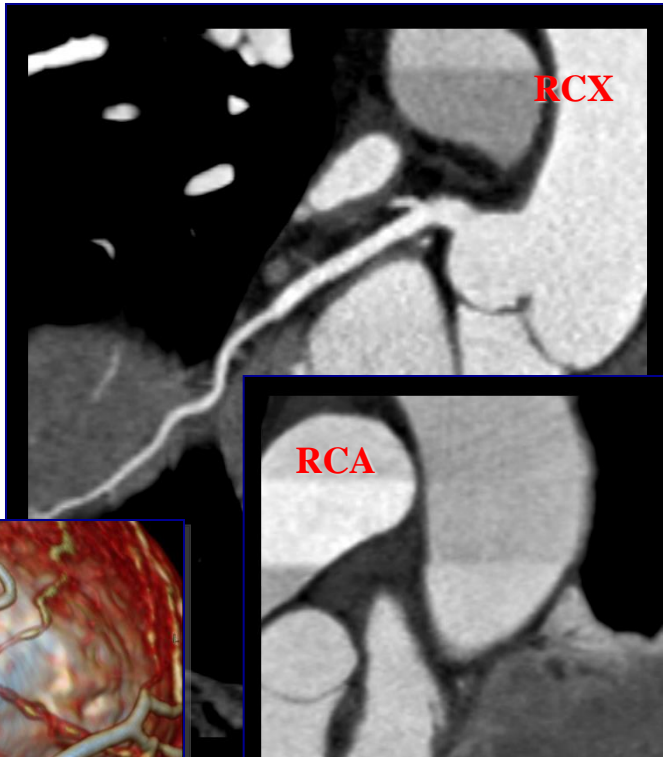
Computer Tomography

META-ANALYSES		Sens.	Spec.	NPV	PPV
Gopalakrishnan *Cardiol in Rev 2008*	*PER SEGMENT*	91%	96%	98%	78%
Mowatt *Heart 2008*	*PER SEGMENT*	90%	97%	99%	76%

Length of Stay in the Hospital and Proportion of Patients Discharged.

162 certified CPUs (60 CPUs already recertified) 39 in the certification process

Certified CPUs

CPUs in the Certification Process

Potential CPU sites (Heart Cath. Lab. available)
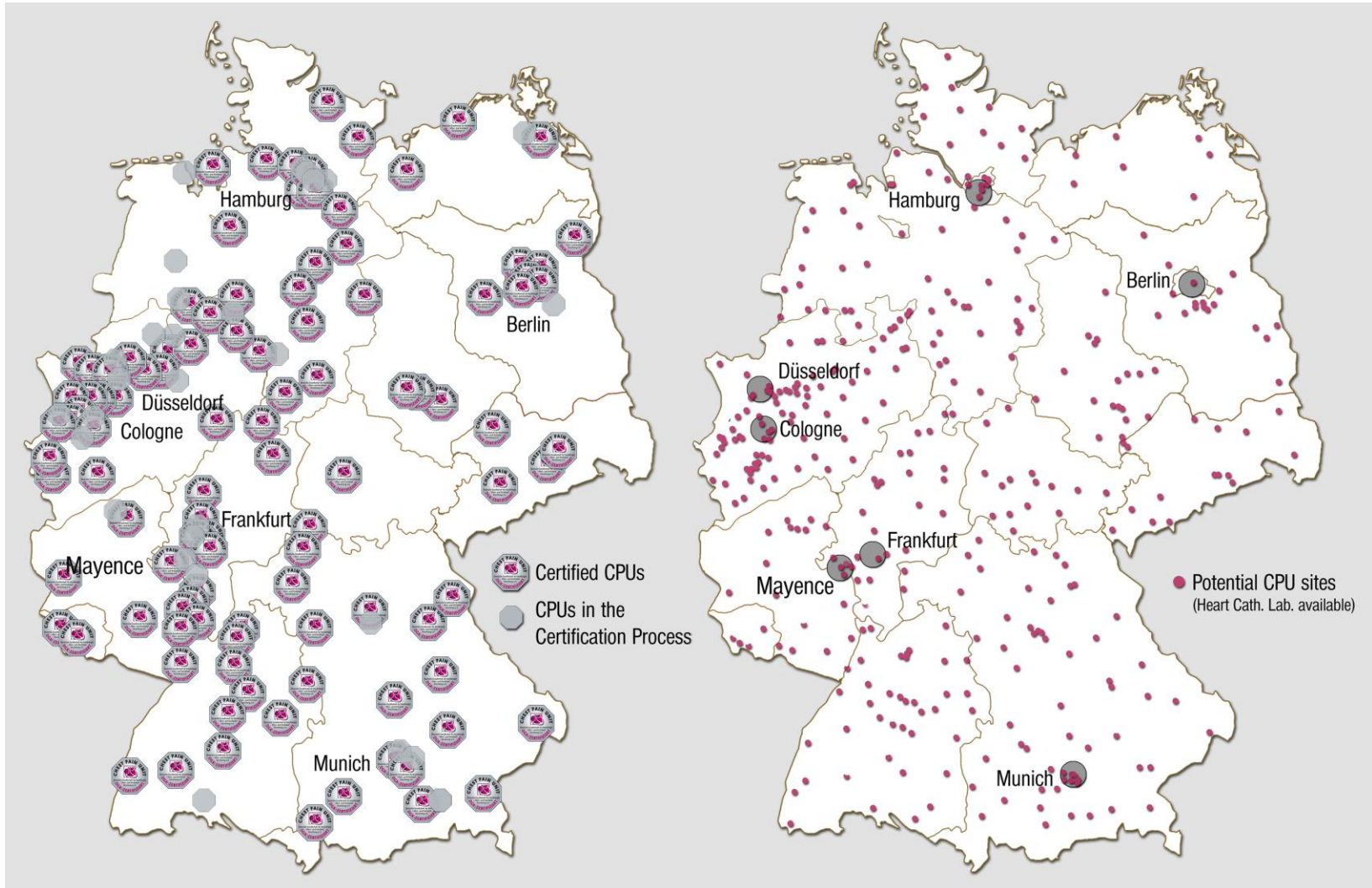
Erste Chest Pain Unit der Schweiz am UniversitätsSpital Zürich zertifiziert

22. April 2013

Die Deutsche und die Schweizerische Gesellschaft für Kardiologie haben am 17. April 2013 die Brustschmerzabteilung der Klinik für Kardiologie, an der Herzpatienten mit akuten Beschwerden behandelt werden, gemeinsam geprüft und ihr attestiert, dass sie qualitativ hochstehende Leistungen erbringt.

Das UniversitätsSpital Zürich ist schweizweit das erste Krankenhaus mit einer Chest Pain Unit (CPU). In dieser Abteilung werden Patientinnen und Patienten untersucht, die mit Verdacht auf ein akutes Koronarsyndrom (Herzinfarkt oder andere plötzlich auftretende Durchblutungsstörungen des Herzmuskels) ins Spital gebracht werden. In der CPU klären Kardiologen diesen Verdacht sehr schnell ab, wobei eng mit den Herzkatheterlaboratorien des Universitätsspitals zusammengearbeitet wird, wo akute Kathetereingriffe am Herzen durchgeführt werden können. Falls die Abklärungen den Verdacht auf einen Herzinfarkt bestätigen, wird der Patient der weiteren Behandlung im Spital zugeführt. Die Zeit bis zum Beginn einer Behandlung mit Medikamenten und einem Kathetereingriff mit Ballon oder Stent spielt gerade bei Herzinfarktpatienten eine grosse Rolle. Mit einer speziellen CPU ist sichergestellt, dass diese Zeit der Diagnosestellung so kurz wie möglich gehalten und damit das Überleben verbessert wird. Durch die CPU wird darüber hinaus der Notfall entlastet.

Die Zertifizierung der CPU durch die Experten der Deutschen und der Schweizerischen Gesellschaft für Kardiologie bestätigt, dass die Abteilung den Anforderungen für die Behandlung von Patienten in organisatorischer, medizinischer und pflegerischer Hinsicht optimal gerecht wird.

Ansprechpartner für Fragen:
Für weitere Auskünfte steht Ihnen die Medienstelle des UniversitätsSpitals Zürich über die Telefonnummer 044 255 86 20 zur Verfügung.

Link zur Deutschen Gesellschaft für Kardiologie, Seite zur Zertifizierung von Chest Pain Units:
http://cpu.dgk.org/index.php?id=158

Druckversion (PDF)

What has changed in Germany since the introduction of the Chest Pain Unit?

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- **German CPU Registry**
  - 25.102 ACS Patients
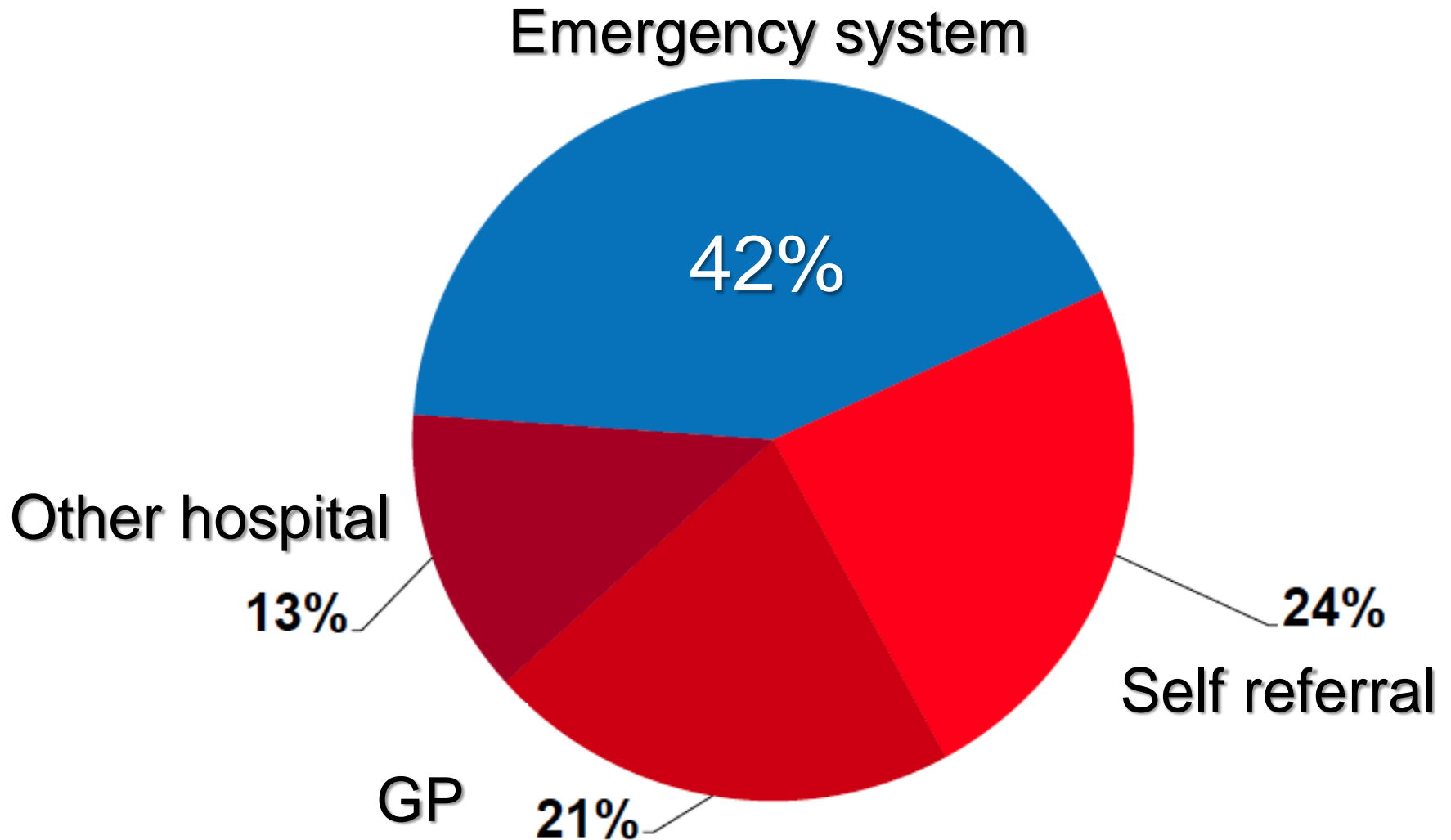 - Start: 2008
  - 38 Clinics (Certified CPU)
  - 3 Mo Follow Up

Institut für Herzinfarktforschung Ludwigshafen
an der Universität Heidelberg

Senges et al.

First Medical Contact

Original scientific paper
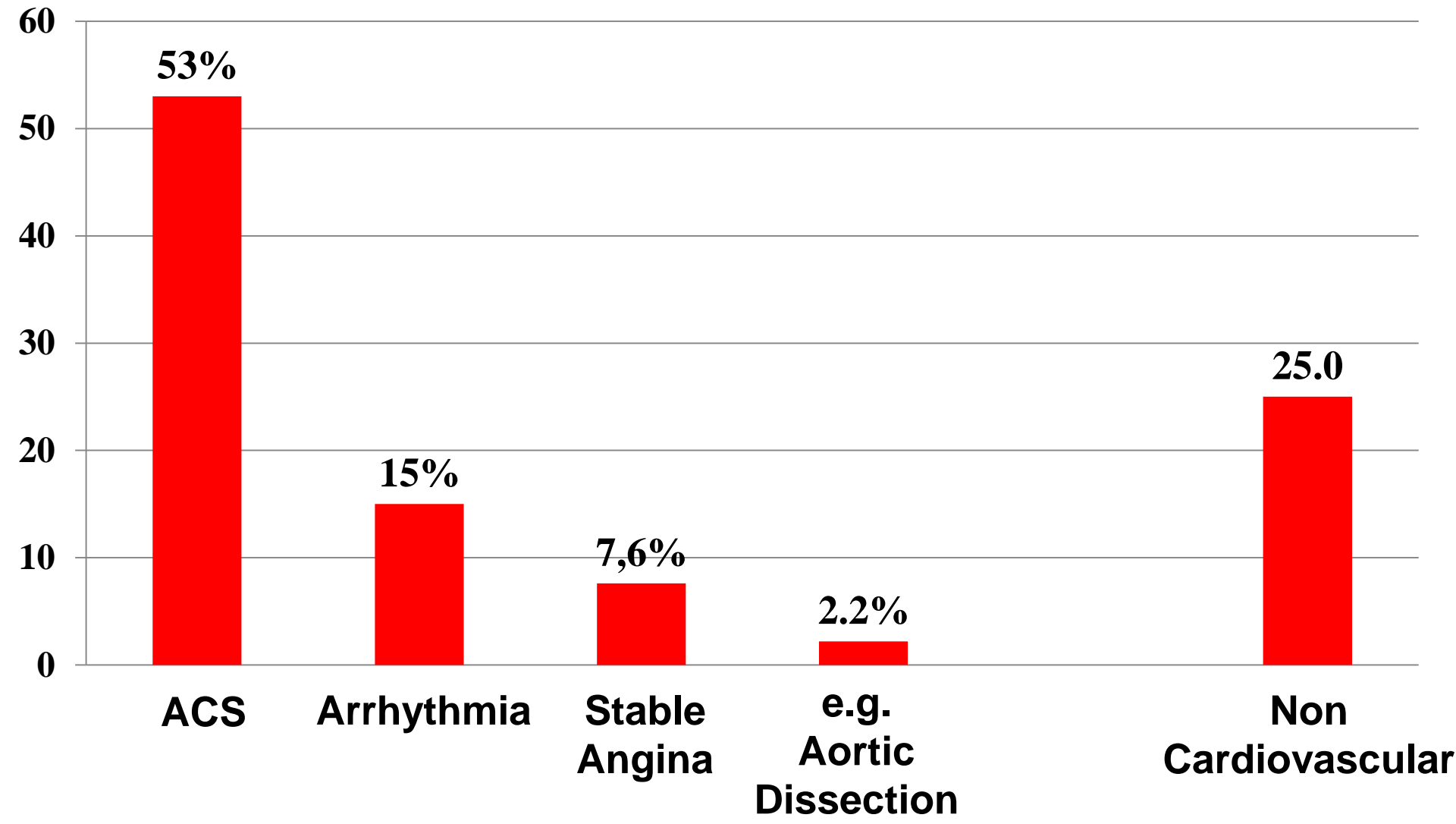
Self-referral to chest pain units: results of the German CPU-registry
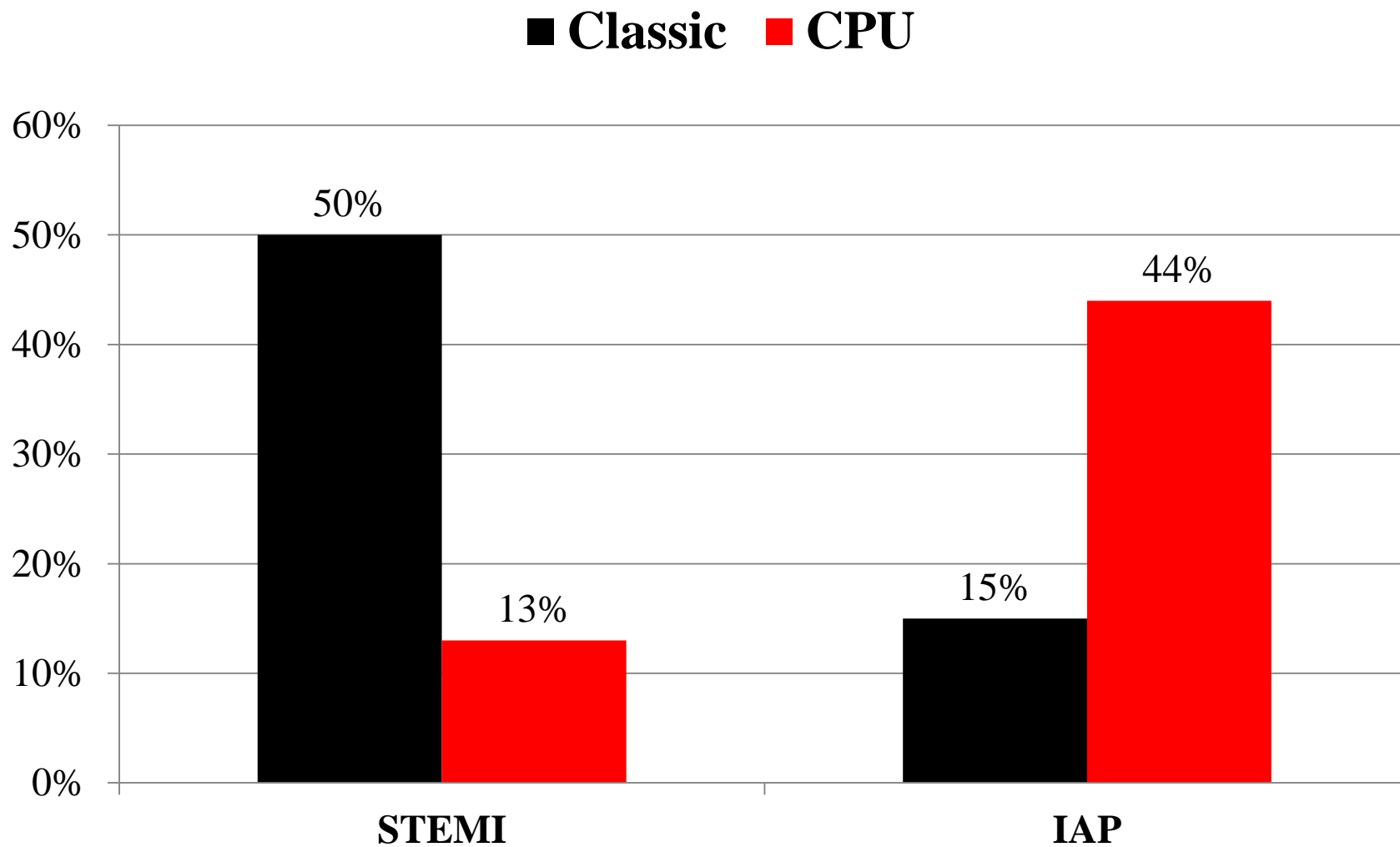
Bernd Nowak[1], Evangelos Giannitsis[2], Thomas Riemer[3], Thomas Münzel[4], Michael Haude[5], Lars S Maier[6], Claus Schmitt[7], Burghard Schumacher[8], Harald Mudra[9], Christian Hamm[10], Jochen Senges[3] and Thomas Voigtländer[1]

Methods and results: From 2008 until 2010, the prospective CPU-registry enrolled 11,581 consecutive patients. Of those 3789 (32.7%) were self-referrals (SRs), while 7792 (67.3%) were referred by EMS. SR-patients were significantly younger (63.6 *vs.* 70.1 years), had less prior myocardial infarction or coronary artery bypass surgery, but more previous percutaneous coronary interventions (PCIs). Acute coronary syndromes were diagnosed less frequently in the SR-patients (30.3 *vs.* 46.9%; *p*<0.0001). SR-patients showed ST-segment changes in their initial ECG in 19.6% of cases. EMS-patients underwent more coronary angiographies (60.0 *vs.* 47.5%; *p*<0.0001), while SR-patients underwent more stress tests (11.3 *vs.* 7.8%; *p*<0.001). PCI was performed in 32.6% of the EMS- and in 24.0% of the SR-group (*p*<0.0001).

Conclusion: These data demonstrate that patients who contact a CPU as a self-referral are younger, less severely ill and have more non-coronary problems than those calling an emergency medical service. Nevertheless, 30% of self-referral patients had an acute coronary syndrome.

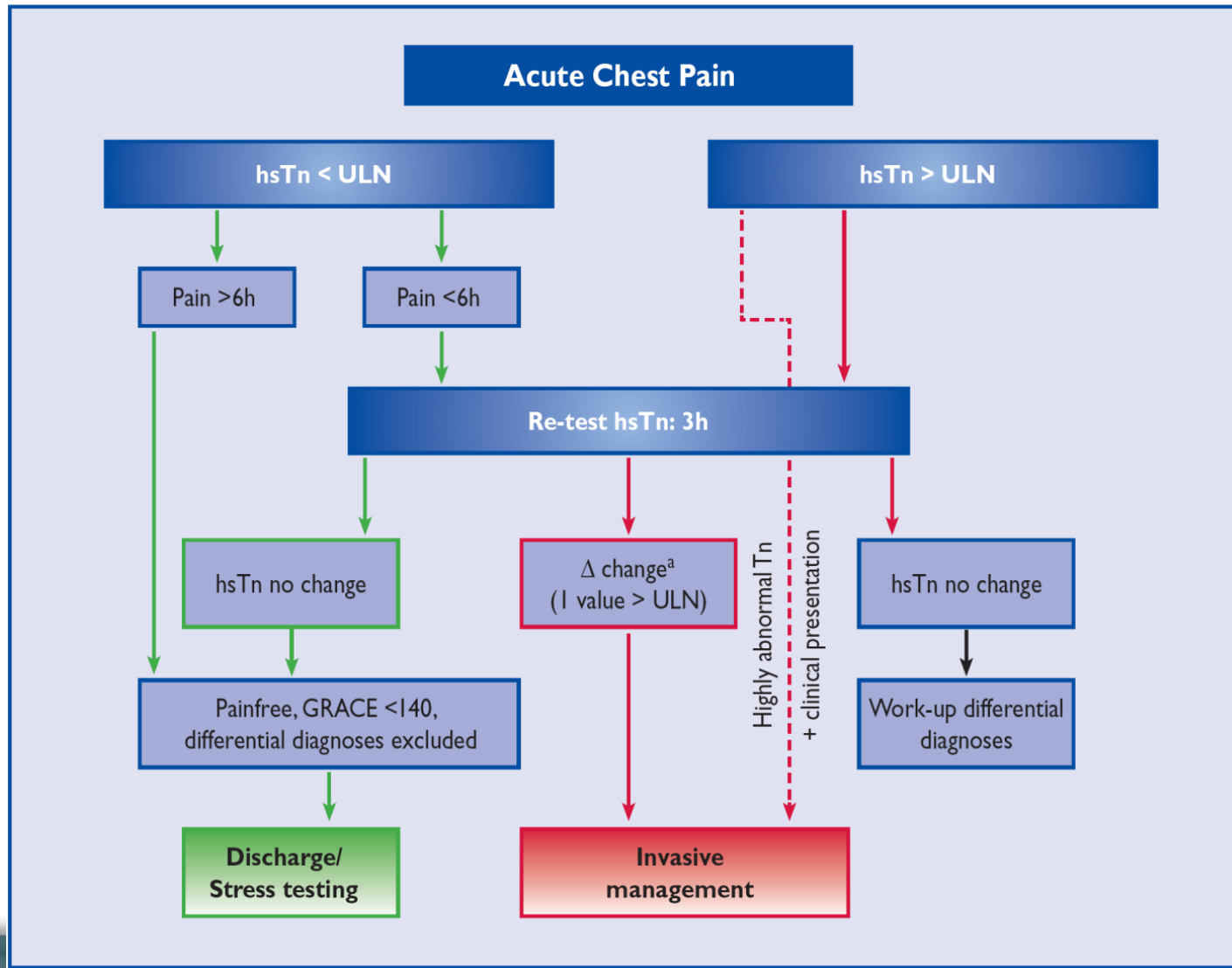# ACS: Classic vs CPU- Diagnosis

Thank you !

Recommendations for diagnosis and risk stratification (2)

Recommendations	Class	Level
Blood has to be drawn promptly for troponin (cardiac troponin T or I) measurement.The result should be available within 60 min.The test should be repeated 6-9 h after initial assessment if the first measurement is not conclusive. Repeat testing after 12-24 h is advised if the clinical condition is still suggestive of ACS.	I	A
An echocardiogram is recommended for all patients to evaluate regional and global LV function and to rule in or rule out differential diagnoses.		
the culprit lesion has to be determined.	I	
Coronary CT angiography should be considered as an alternative to invasive angiography to exclude ACS when there is a low to intermediate likelihood of CAD and when troponin and ECG are inconclusive.	IIa	B
In patients without recurrence of pain, normal ECG findings, negative troponins tests, and a low risk score, a non-invasive stress test for inducible ischaemia is recommended before deciding on an invasive strategy.	I	A

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Rapid rule-out of ACS with high-sensitivity troponin.

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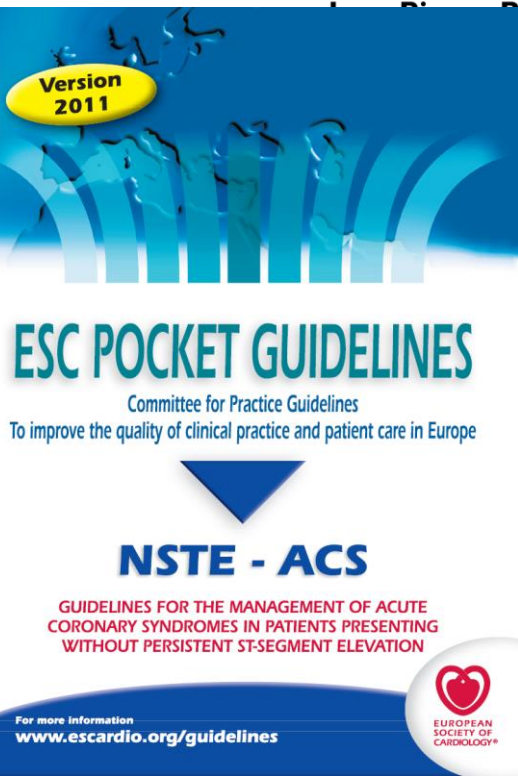# Coronary CT Angiography versus Standard Evaluation in Acute Chest Pain

Udo Hoffmann, M.D., M.P.H., Quynh A. Truong, M.D., M.P.H., David A. Schoenfeld, Ph.D., Eric T. Chou, M.D., Pamela K. Woodard, M.D., John T. Nagurney, M.D., M.P.H., J. Hector Pope, M.D., Thomas H. Hauser, M.D., M.P.H., Charles S. White, M.D., Scott G. Weiner, M.D., M.P.H., Shant Kalanjian, M.D., Michael E. Mullins, M.D., Issam Mikati, M.D., W. Frank Peacock, M.D., Pearl Zakroysky, B.A., Douglas Hayden, Ph.D., Alexander Goehler, M.D., Ph.D., Hang Lee, Ph.D., G. Scott Gazelle, M.D., M.P.H., Ph.D., Stephen D. Wiviott, M.D., Jerome L. Fleg, M.D., and James E. Udelson, M.D., for the ROMICAT-II Investigators

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

The Task Force for the management of acute coronary syndromes (ACS) in patients presenting without persistent ST-segment elevation of the European Society of Cardiology (ESC)

Authors/Task Force Members: Christian W. Hamm (Chairperson) (Germany)*, Jean-Pierre Bassand (Co-Chairperson)*, (France), Stefan Agewall (Norway), [The] Netherlands), Eric Boersma (The Netherlands), Hector Bueno [...]aso (Italy), Dariusz Dudek (Poland), Stephan Gielen (Germany), [...]Austria), Magnus Ohman (USA), Mark C. Petrie (UK), Frank Sonntag [...]iguel Sousa Uva (Portugal), Robert F. Storey (UK), William Wijns [...]oron Zahger (Israel).

[...]or Practice Guidelines: Jeroen J. Bax (Chairperson) (The Netherlands), Angelo Auricchio [...]mut Baumgartner (Germany), Claudio Ceconi (Italy), Veronica Dean (France), Christi Deaton [...]rd (Belgium), Christian Funck-Brentano (France), David Hasdai (Israel), Arno Hoes (The [...]ni Knuuti (Finland), Philippe Kolh (Belgium), Theresa McDonagh (UK), Cyril Moulin (France), [...]The Netherlands), Bogdan A. Popescu (Romania), Željko Reiner (Croatia), Udo Sechtem [...]nton Sirnes (Norway), Adam Torbicki (Poland), Alec Vahanian (France), Stephan Windecker

Version 2011

ESC POCKET GUIDELINES

Committee for Practice Guidelines
To improve the quality of clinical practice and patient care in Europe

NSTE - ACS

GUIDELINES FOR THE MANAGEMENT OF ACUTE CORONARY SYNDROMES IN PATIENTS PRESENTING WITHOUT PERSISTENT ST-SEGMENT ELEVATION

For more information
www.escardio.org/guidelines

Krankenhaus Mortalität
typisch vs. atypische Symptome

Brieger et al., GRACE Investigators CHEST 2003
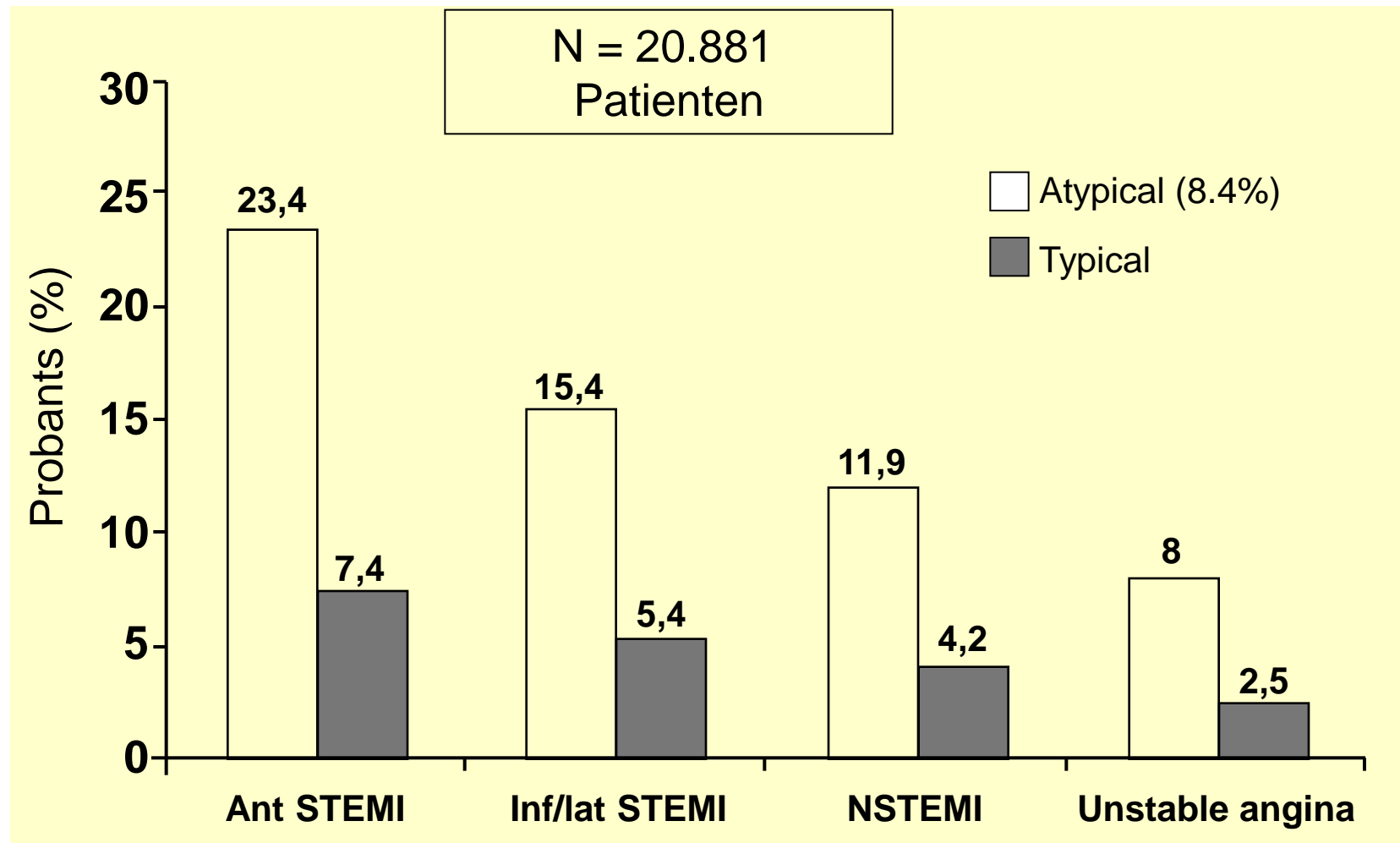
Criteria for high risk with indication for invasive management

Primary
• Relevant rise or fall in troponin.
• Dynamic ST- or T-wave changes (symptomatic or silent).

Secondary
• Diabetes mellitus.
• Renal insufficiency (eGFR < 60 mL/min/1.73 m^2).
• Reduced LV function (ejection fraction < 40%).
• Early post infarction angina.
• Recent PCI.
• Prior CABG.
• Intermediate to high GRACE risk score.

Deutsches CPU Register Update 2013

- **Patientencharakteristik:**
  - Änderungen CPU vs CCU

- **Umsetzung der Leitlinien**
  - Kritische Zeitintervalle
  - Akute Revaskularisation
  - Optimierte medikamentöse Therapie

- **Outcome:** CPU und Follow Up 3 Mo

Recommendations for diagnosis and risk stratification

Recommendations	Class	Level
Blood has to be drawn promptly for troponin (cardiac troponin T or I) measurement.The result should be available within 60 min.The test should be repeated 6-9 h after initial assessment if the first measurement is not conclusive. Repeat testing after 12-24 h is advised if the clinical condition is still suggestive	I	A
An echocardiogram is recommended for all patients to evaluate regional and global LV function and to rule in or rule out differential diagnoses.	I	C
Coronary angiography is indicated in patients in whom the extent of CAD or the culprit lesion has to be determined.	I	C
Coronary CT angiography should be considered as an alternative to invasive angiography to exclude ACS when there is a low to intermediate likelihood of CAD and when troponin and ECG are inconclusive.	IIa	B
In patients without recurrence of pain, normal ECG findings, negative troponins tests, and a low risk score, a non-invasive stress test for inducible ischaemia is recommended before deciding on an invasive strategy.	I	A

A rapid rule-out protocol (0 and 3 h) is recommended when highly sensitive troponin tests are available.

Deutsches CPU Register
Update 2013

- **Beginn: 12/2008**
- **Zentren: 41/81**
- **Patienten: 25.102**
- **3-Mo-Follow-Up**
- **Sponsor: DGK/IHF**

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