



Cardiology Department, University of Foggia, Italy

Tele-cardiology for public emergency medical service:

5-year experience with 167.000 interventions

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ESC Meeting 2010, Stockholm, September 1

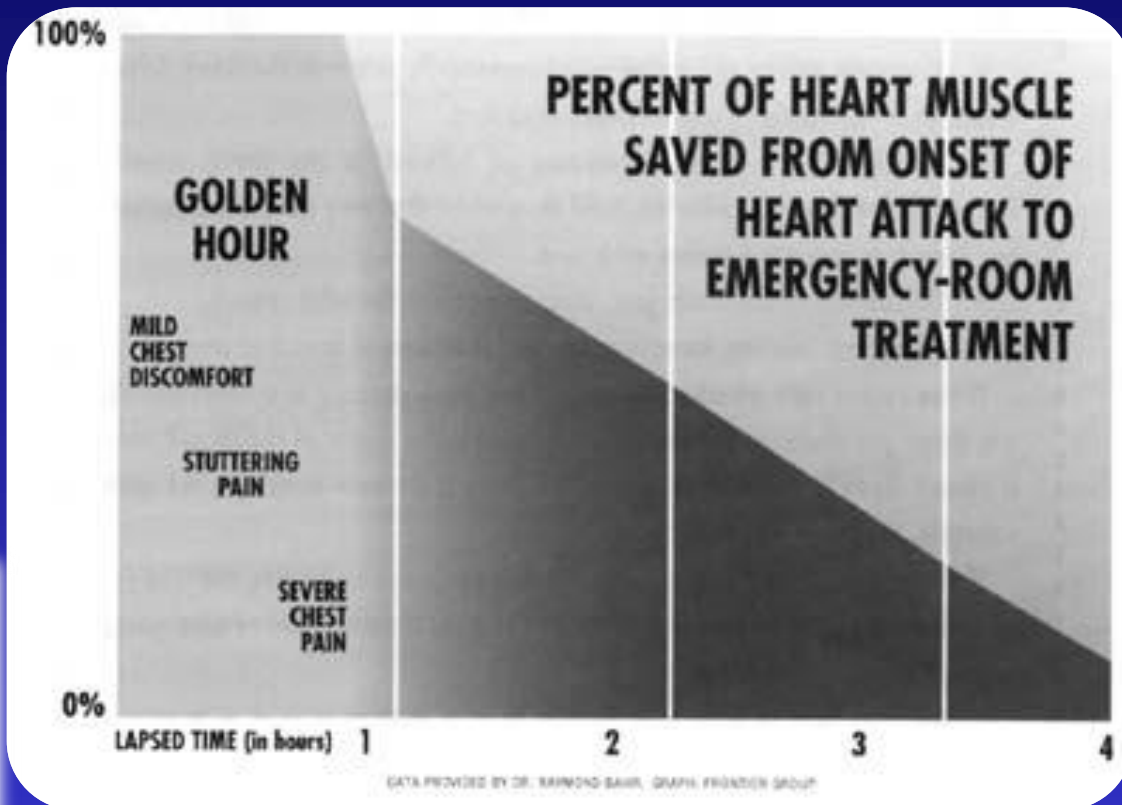
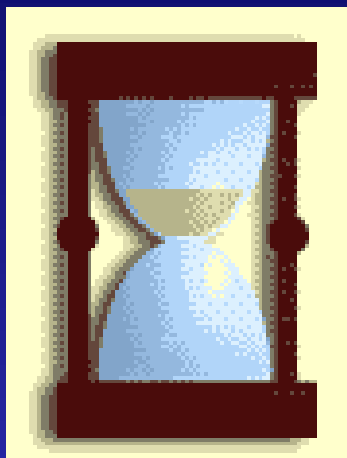


Conflict of interest disclosure

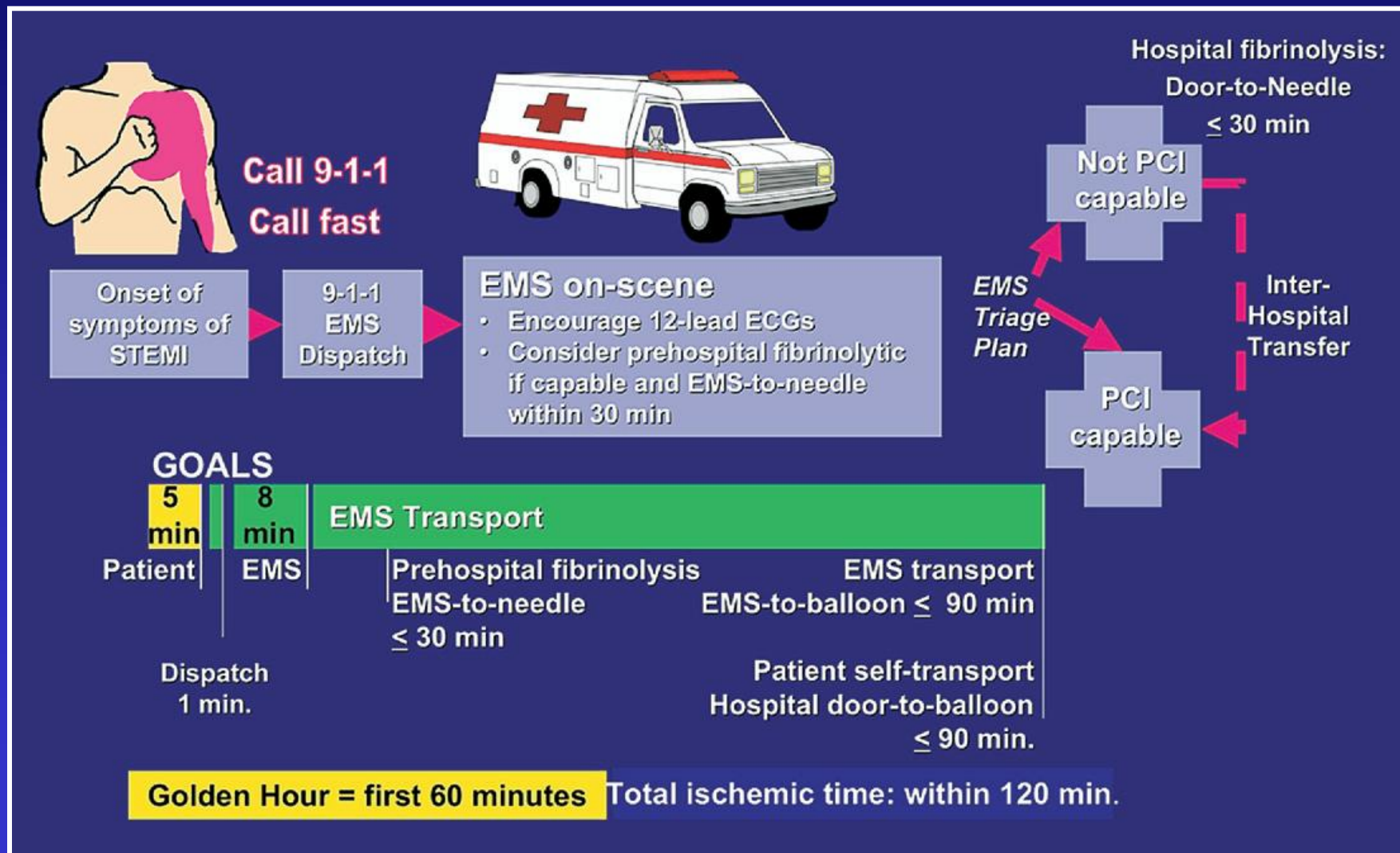


Dr Brunetti, dr De Gennaro and dr Pellegrino
received honoraria
from Cardio-on-Line Europe S.r.l.

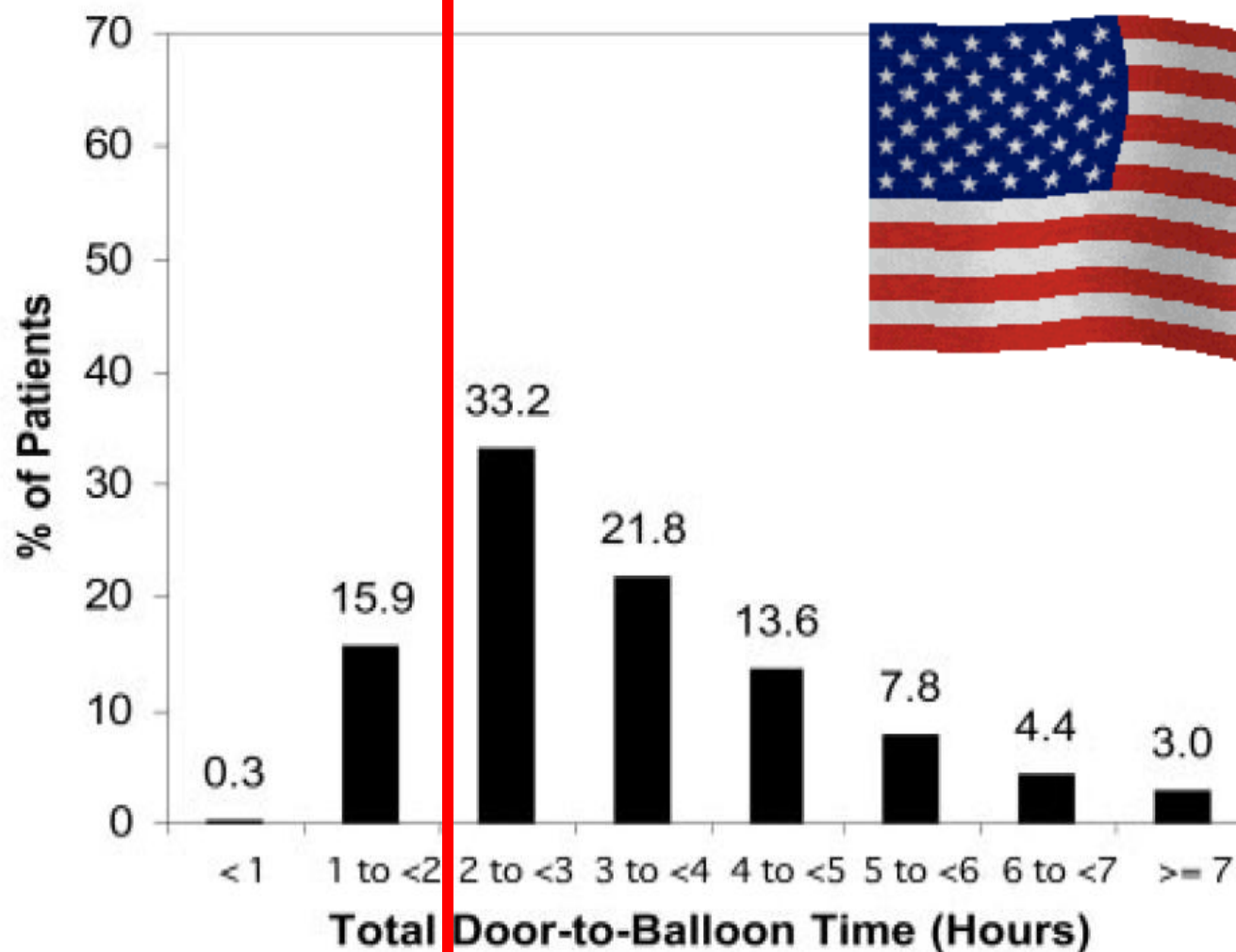
“Time is muscle!”



Acute myocardial infarction: treatment goals



AMI: treatment goals and real life





**Call 9-1-1
Call fast**



Onset of
symptoms of
STEMI

9-1-1
EMS
Dispatch

EMS on-scene

- Encourage 12-lead ECGs
- Consider prehospital fibrinolytic if capable and EMS-to-needle within 30 min

Hospital fibrinolysis:

Door-to-Needle

≤ 30 min

Not PCI
capable

EMS
Triage
Plan

PCI
capable

Inter-
Hospital
Transfer

GOALS

**5
min**

Patient

**8
min**

EMS

EMS Transport

Prehospital fibrinolysis
EMS-to-needle
≤ 30 min

EMS transport
EMS-to-balloon ≤ 90 min

Dispatch
1 min.

Patient self-transport
Hospital door-to-balloon
≤ 90 min.

Golden Hour = first 60 minutes

Total ischemic time: within 120 min.



Time to reperfusion with EMS



Without pre-hospital ECG

- Symptom onset to EMS arrival



- EMS arrival to hospital arrival



- Hospital arrival to ECG



- ECG to reperfusion

With pre-hospital ECG





Pre-hospital ECG: statement



Circulation

JOURNAL OF THE AMERICAN HEART ASSOCIATION

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**Implementation and Integration of Prehospital ECGs Into Systems of Care for
Acute Coronary Syndrome: A Scientific Statement From the American Heart
Association Interdisciplinary Council on Quality of Care and Outcomes
Research, Emergency Cardiovascular Care Committee, Council on
Cardiovascular Nursing, and Council on Clinical Cardiology**

Henry H. Ting, Harlan M. Krumholz, Elizabeth H. Bradley, David C. Cone, Jephtha P. Curtis, Barbara J. Drew, John M. Field, William J. French, W. Brian Gibler, David C. Goff, Alice K. Jacobs, Brahmajee K. Nallamothu, Robert E. O'Connor and Jeremiah D. Schuur

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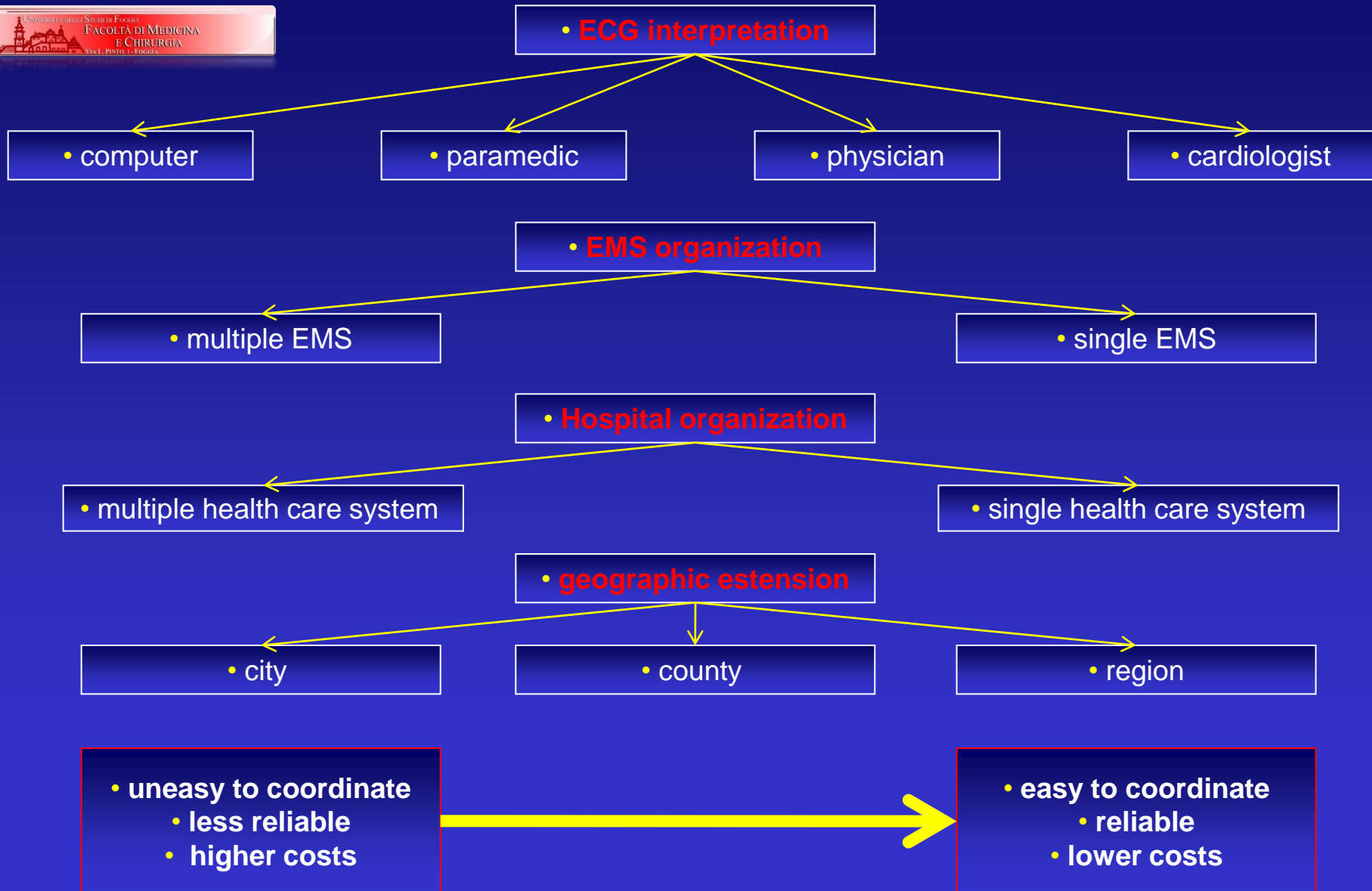
Table 1. Models for interpreting Prehospital ECGs

Method of Interpreting Prehospital ECG	Pros	Cons
Computer algorithm interpretation	Rapid, easy No wireless network or technology requirements	False-positive and false-negative rates higher than physician interpretation
Paramedic interpretation	Rapid, easy No wireless network or technology requirements	Requires intensive education and quality assurance program More complex in communities with multiple EMS providers and agencies
Wireless transmission and physician interpretation	Theoretically, lowest rate of false-positives and false-negatives Medical oversight can provide guidance on destination hospital and treatment en route	New technology requirement for EMS providers and hospital Reliable wireless network Transmission unit on ambulance Receiver station unit at hospital Smartphones for physicians Requires system to ensure immediate interpretation by physician Transmission failures

EMS indicates emergency medical services.



Variables conditioning time to ECG





- limited area (125 km²)
- paramedics interpretation, physician confirmation
- few EMS

Los Angeles County model



- wider area (10,000 km²)
- algorithm interpretation
- many different EMS, different hospital institutions



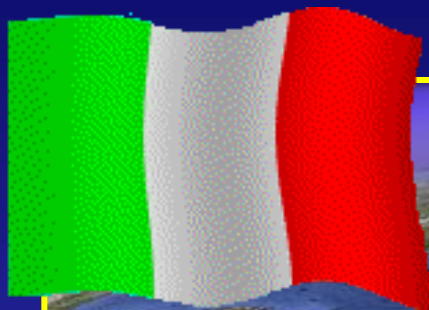
- no interpretation protocol (120,000 km², 9.5 million inhabitants)
- different EMS, hospitals: no standard protocol

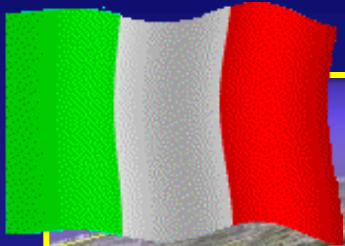


- physician interpretation
- limited areas (city, neighbourhood, district)



Apulia





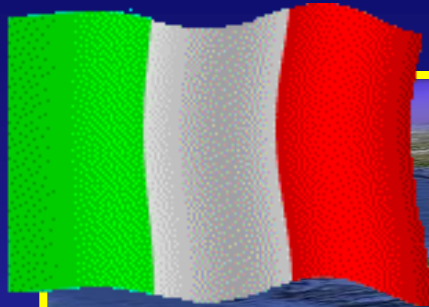


4 million inhabitants

20.000 km²

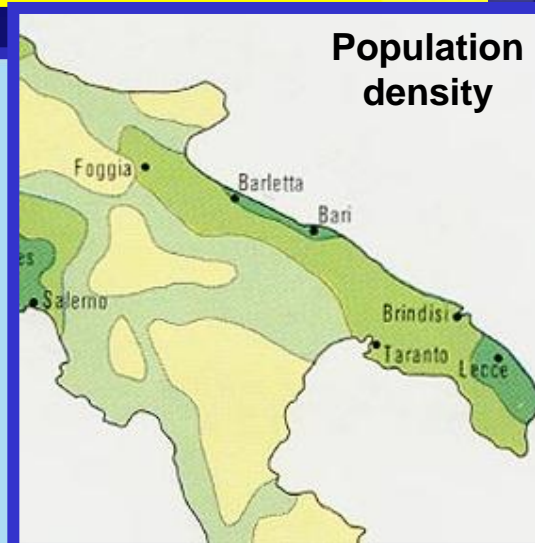
One single local government EMS

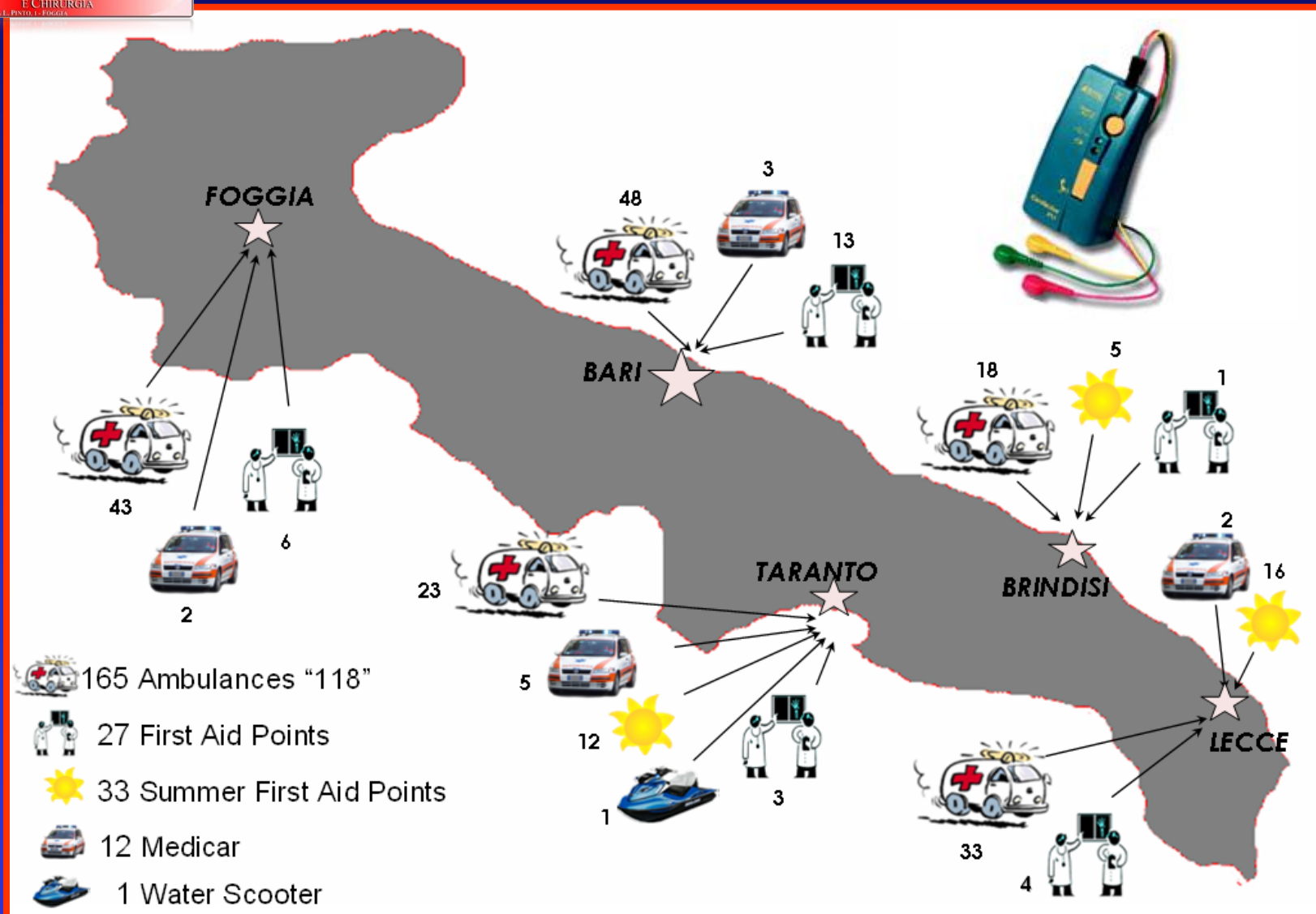
One single health care system coordinating all regional hospitals



- One regional telecardiology hub active 24/7
- Centralized medical (cardiologist) interpretation
- Pre-hospital ECG tele-cardiology support

Geographic characteristics





CardioVox P12 device for ECG recording



(mobile) telephone connection



Telecardiology hub center operative 24/7



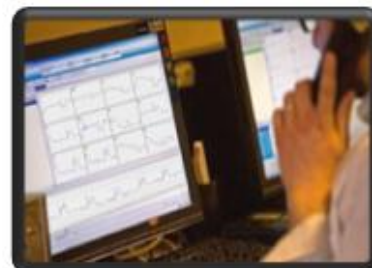
1

ECG recording
50 seconds



2

ECG transmission to
telecardiology HUB
50 seconds



3

ECG report by an-call cardiologist
at telecardiology HUB



4

ECG trasmission to 118 distric
operative room by fax or
internet

TELECARDIOLOGIA - CARDIO ON LINE Europe s.r.l.

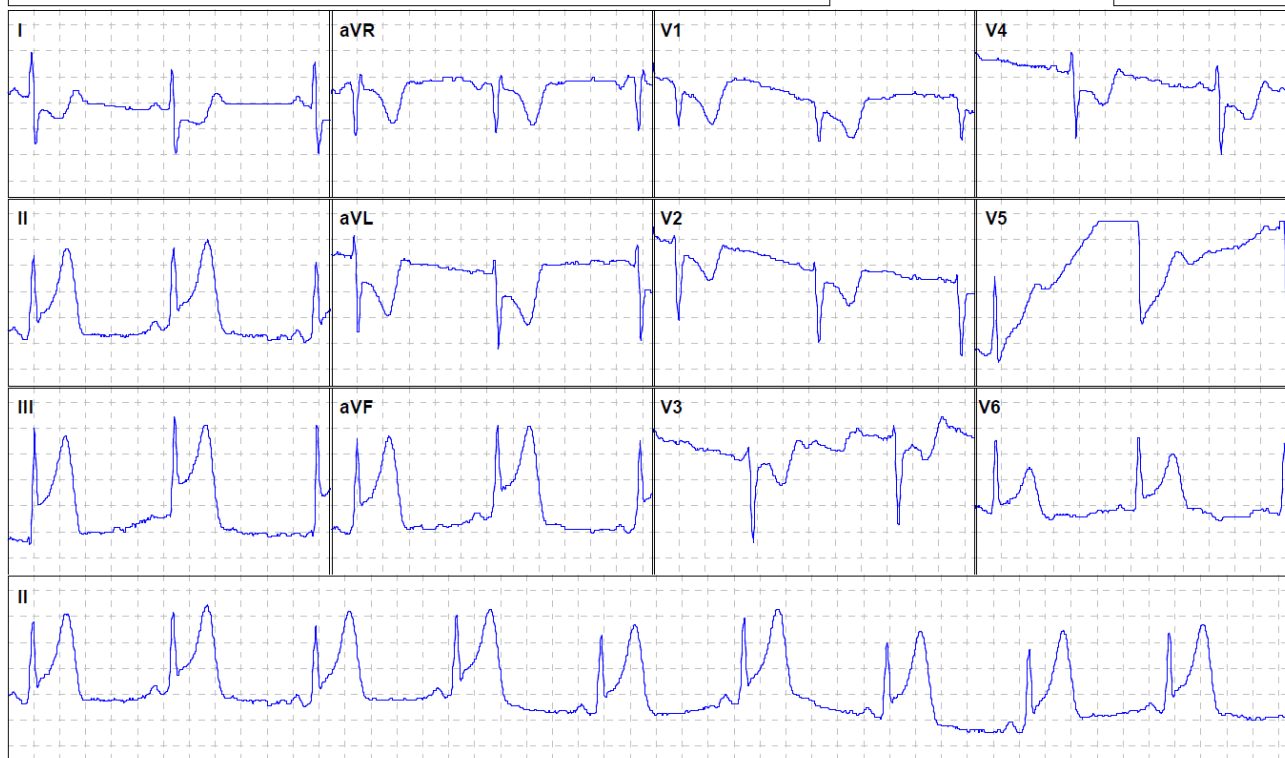
Pagina 1 of 1
Evento 1/1

Clinica/medico	Cod. clinica/medico	Nome	Cognome	Sesso	Età
118 TARANTO	PULSANO			Male	72

Referto

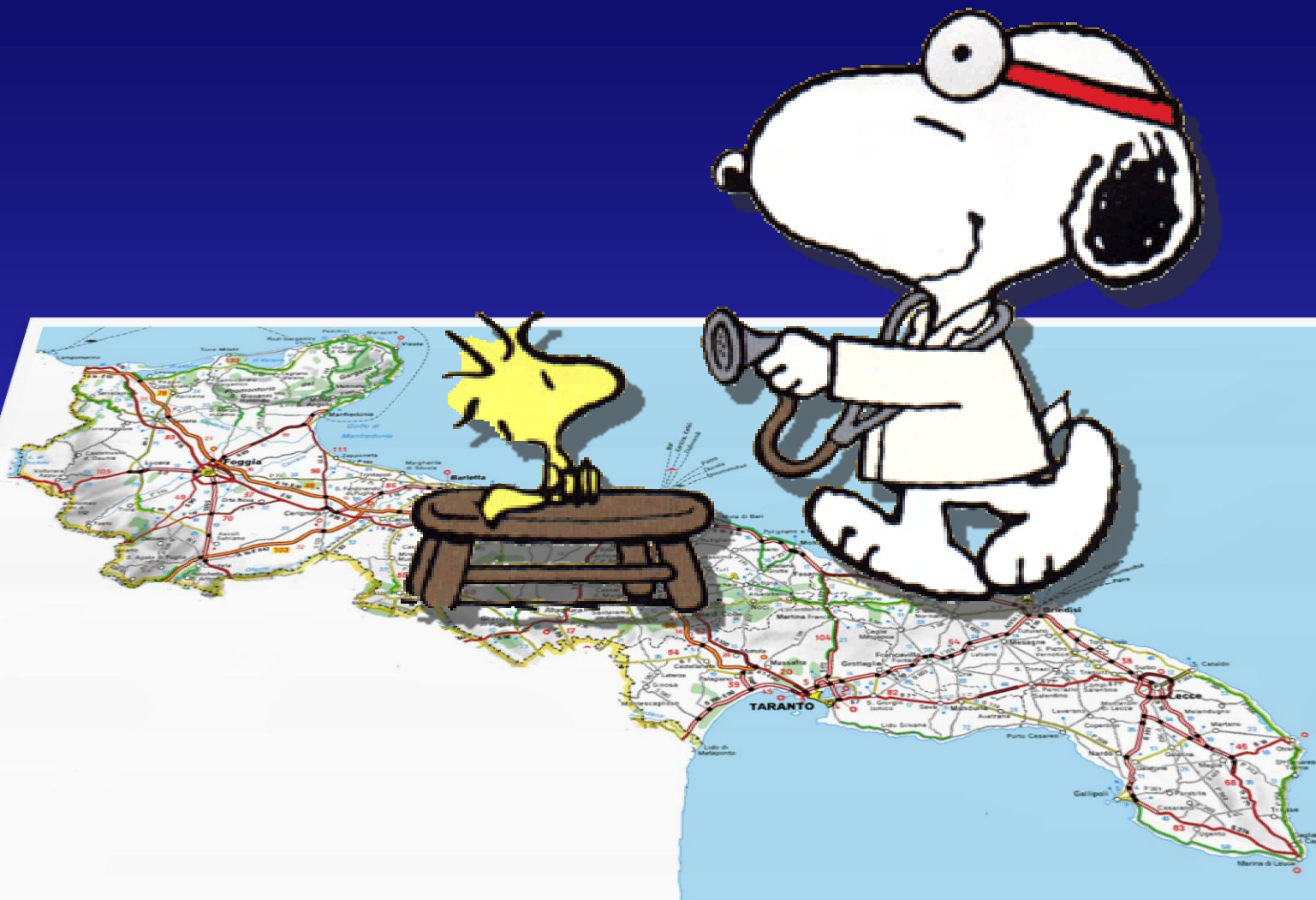
Cardiologo refertante:

Firma:



Risoluz.: 25mm/sec - 10mm/mV
[mm] 0 10 20 30 40
CHIAM. Apparato P12 P12-1
[sec] 0 1 2
Registrato da: 99 99
[mv] 0 1 2 3 4
Ricevuto il: 21/04/2009 20.48.23
Stampa: 11/05/2010
☐ ECG Invertito.

One region, one cardiologist!





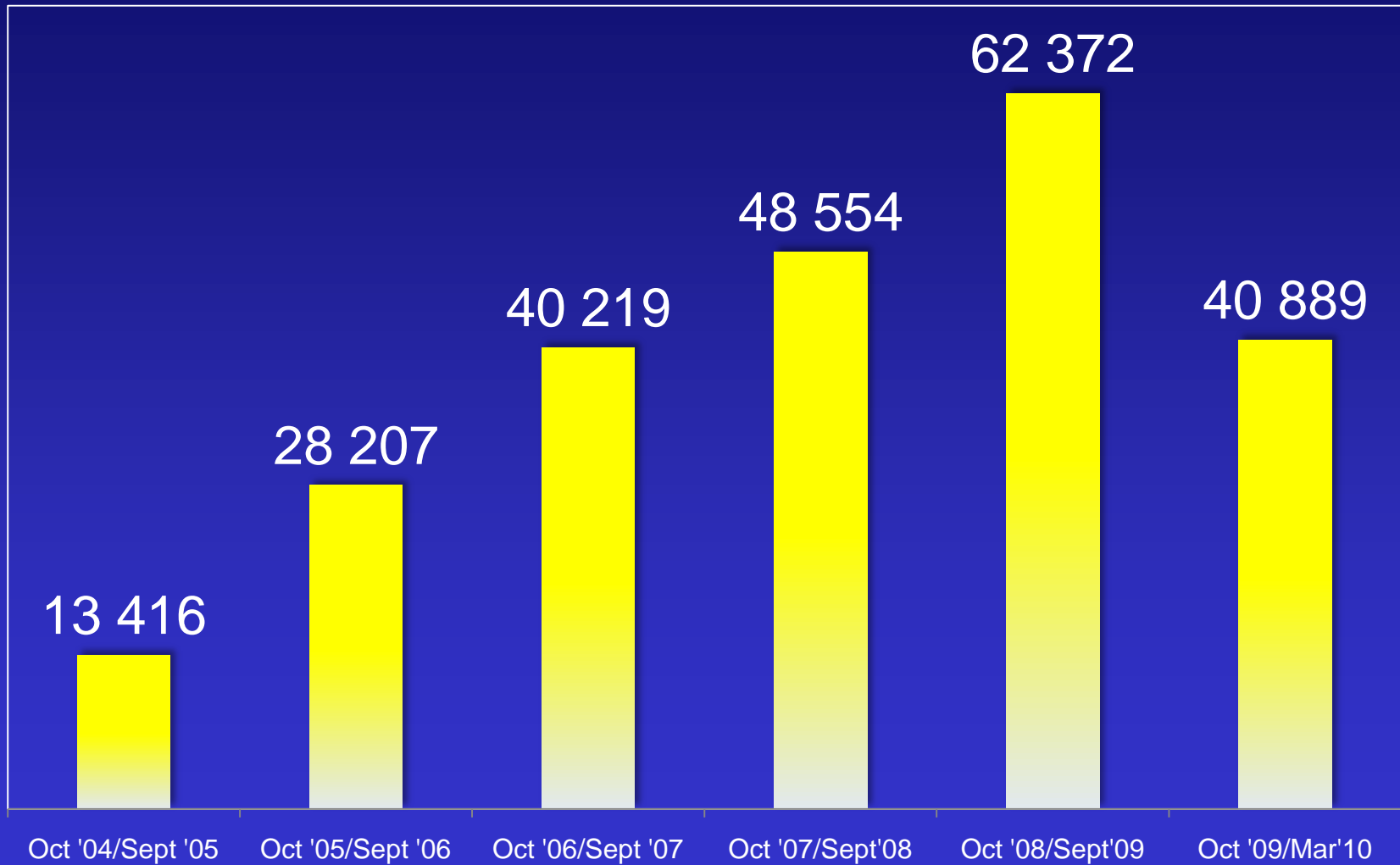
**233.000 patients screened with pre-hospital
tele-cardiology ECG**

October 2004 – April 2010



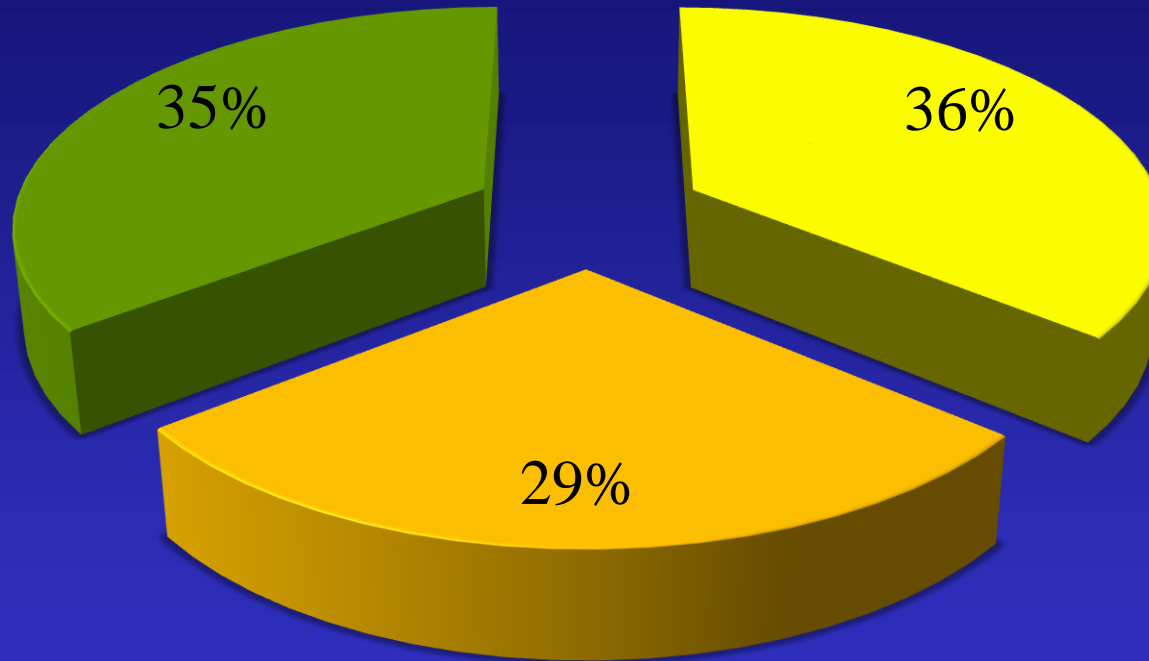


Results



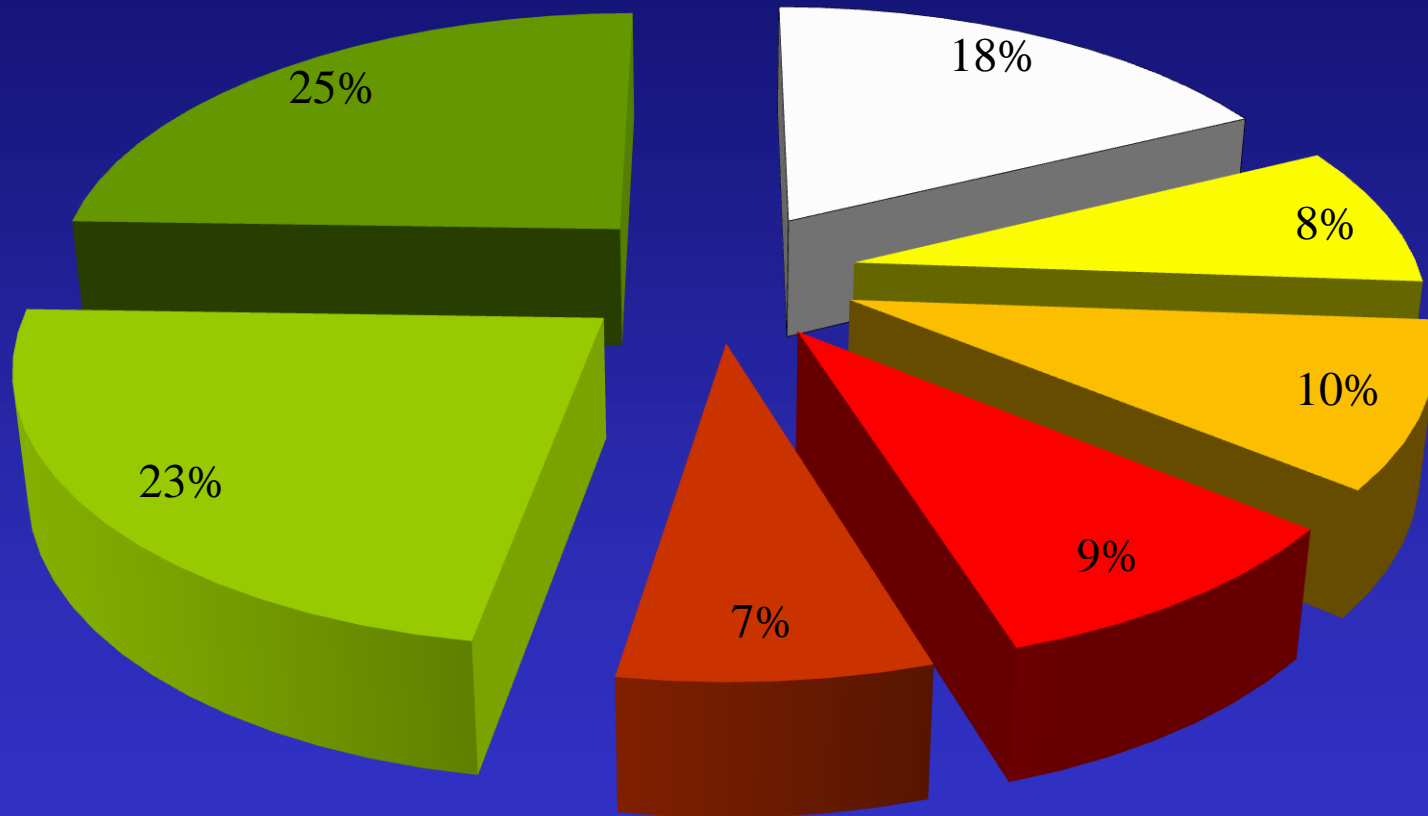
- chest pain
 - typical
 - atypical
 - epigastric pain
- palpitations
- dizziness / syncope
- breathlessness
- any suspected heart disease



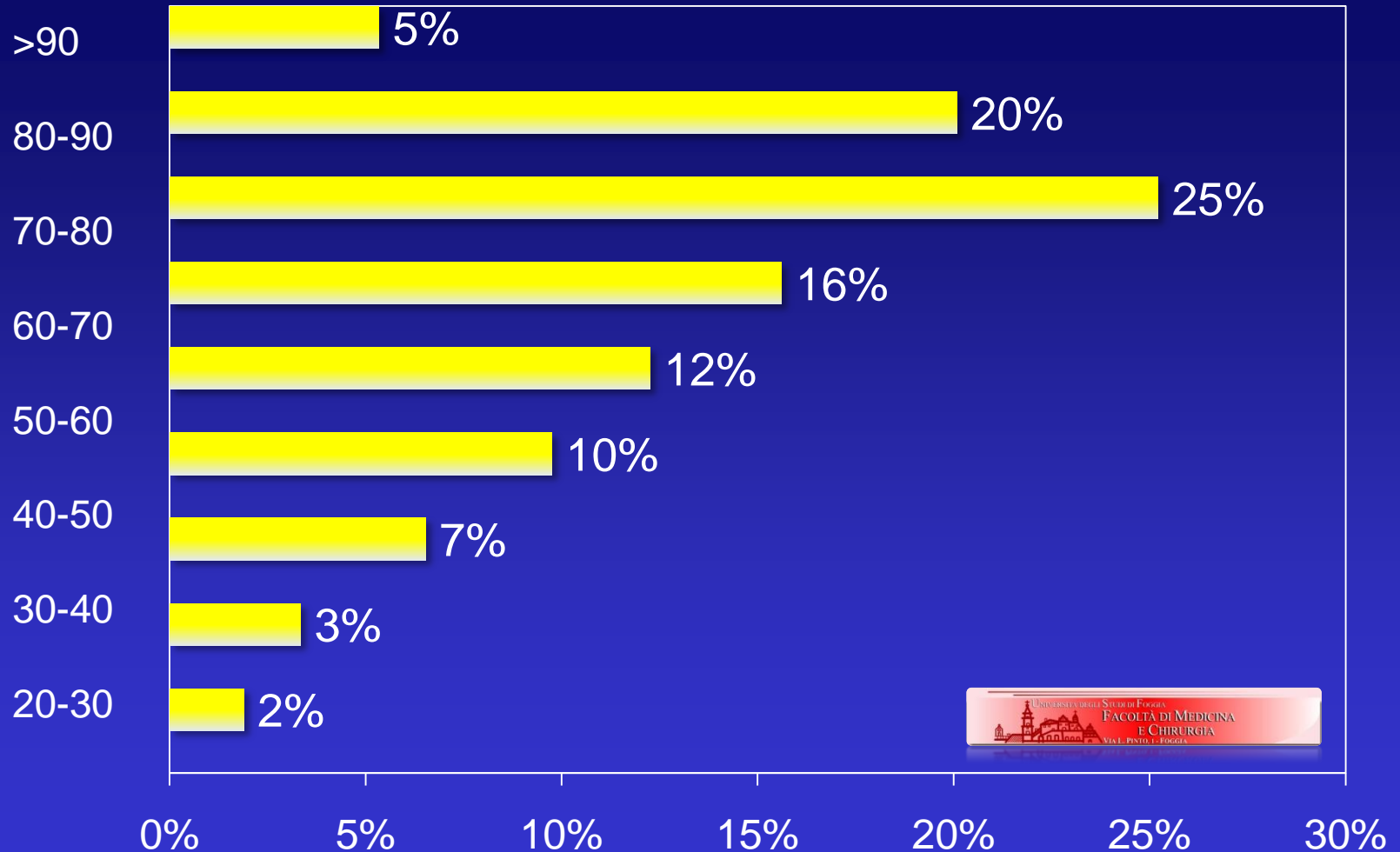


■ day (8 am - 2 pm) ■ afternoon (2 pm - 8 pm) ■ night (8 pm - 8 am)

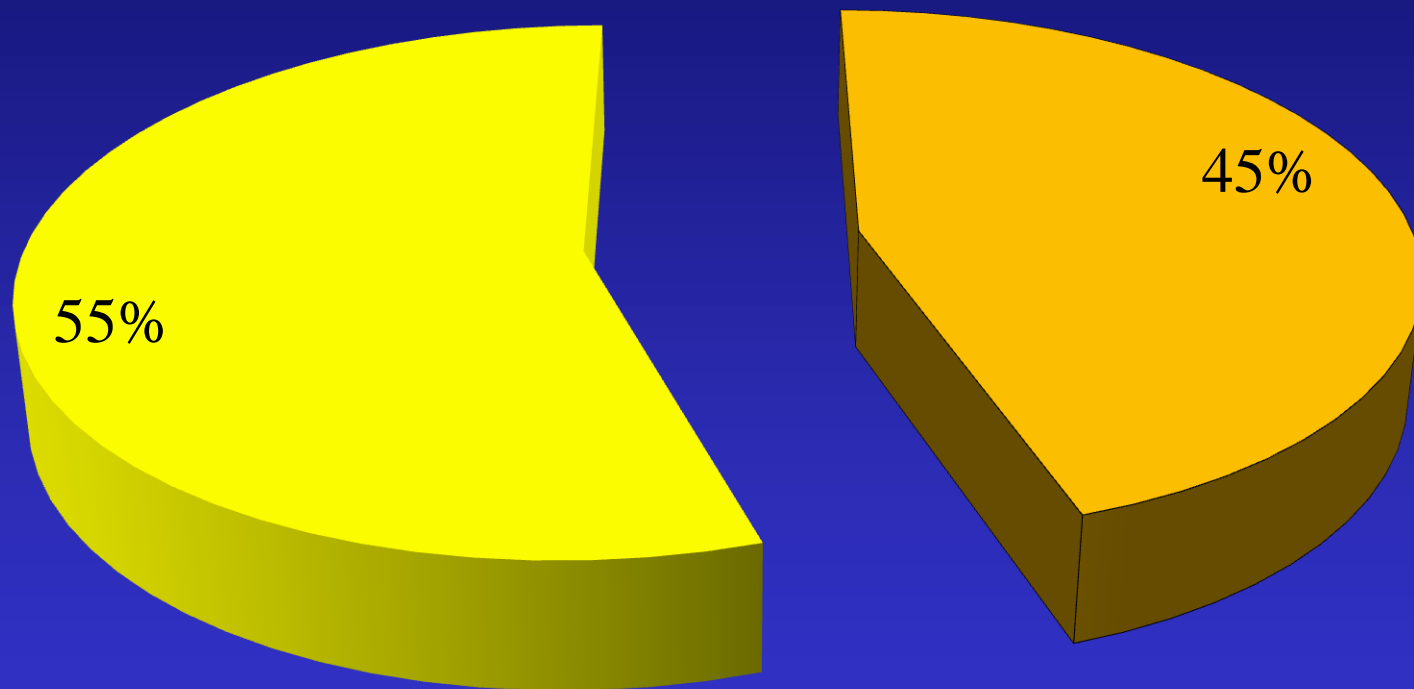
Symptoms reported



■ typical chest pain ■ atypical chest pain ■ breathlessness ■ epigastric pain
■ palpitations ■ dizziness/syncope ■ other

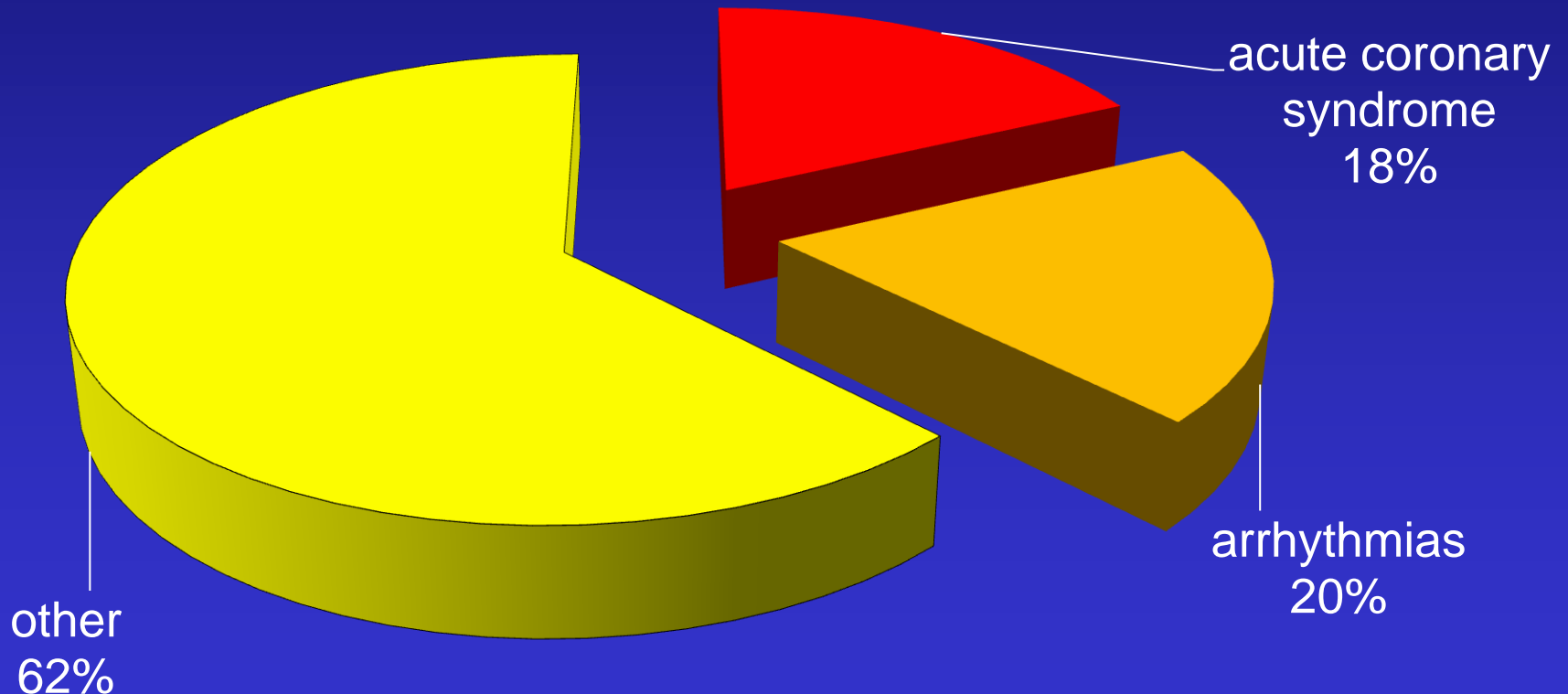


ECG finding in subjects with any suspected acute heart disease:
55% had a normal ECG

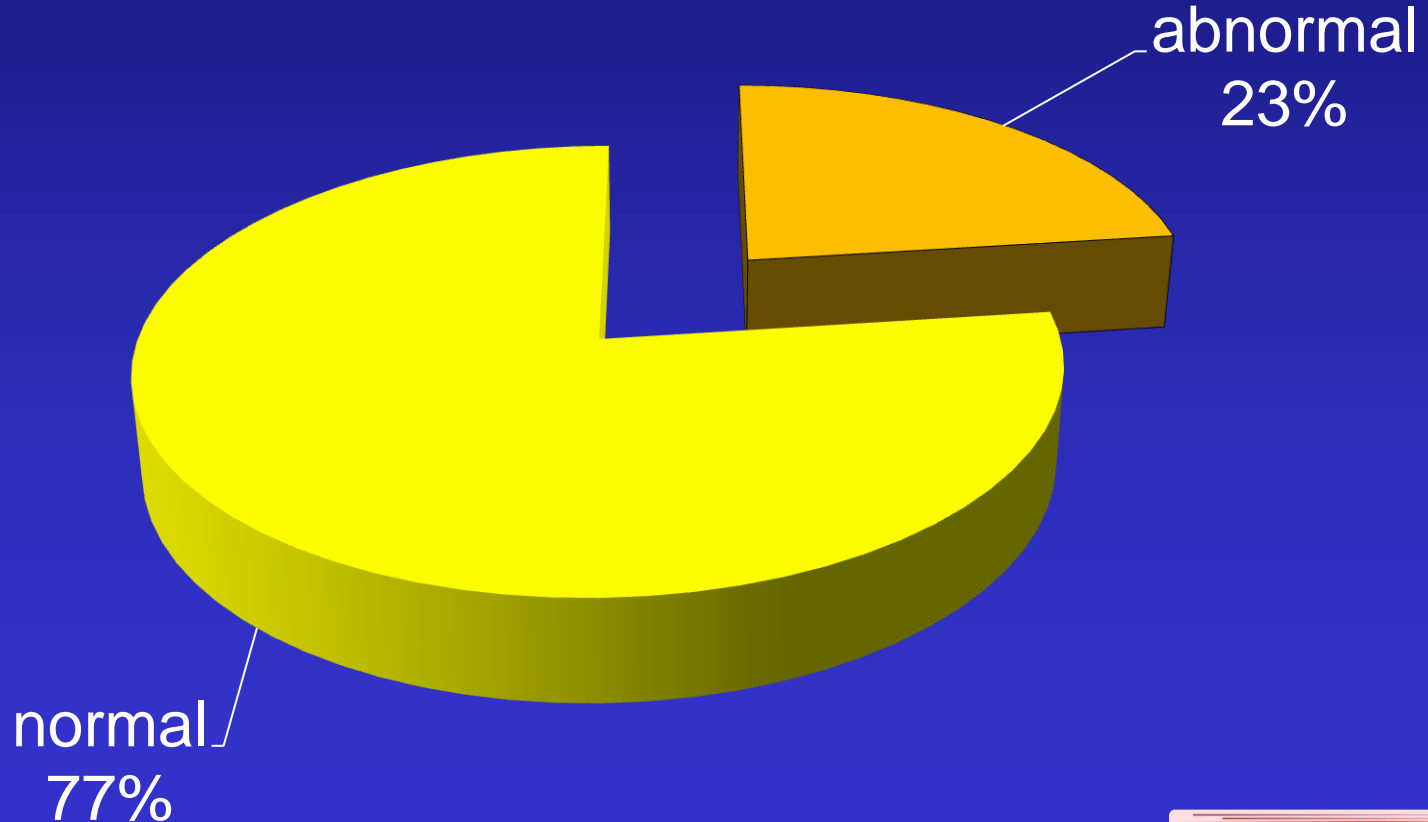


■ abnormal ■ normal

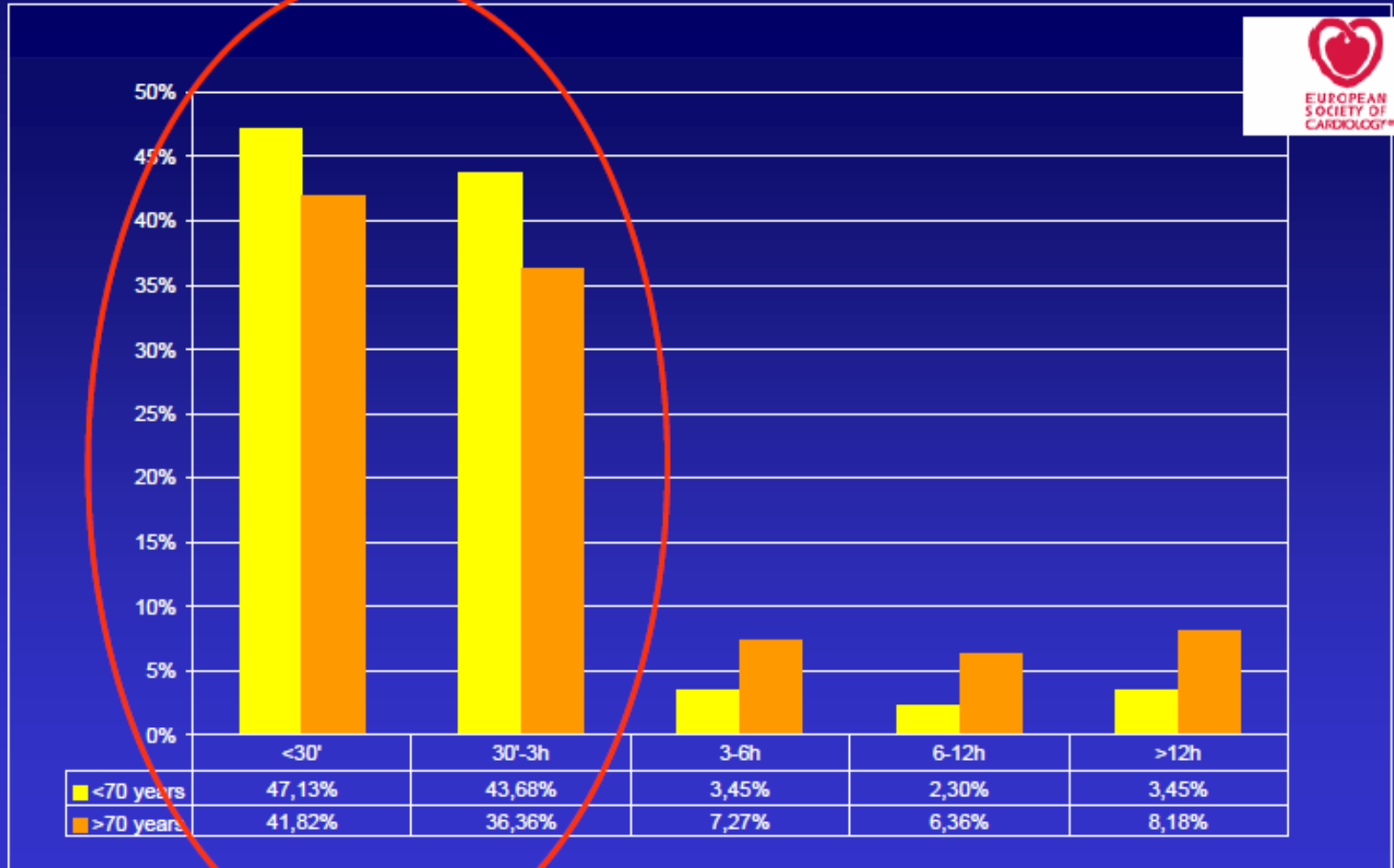
Suspected heart disease in subjects with a non normal pre-hospital ECG.



ECG findings in subject with symptoms suggestive for acute coronary syndrome (typical chest pain).

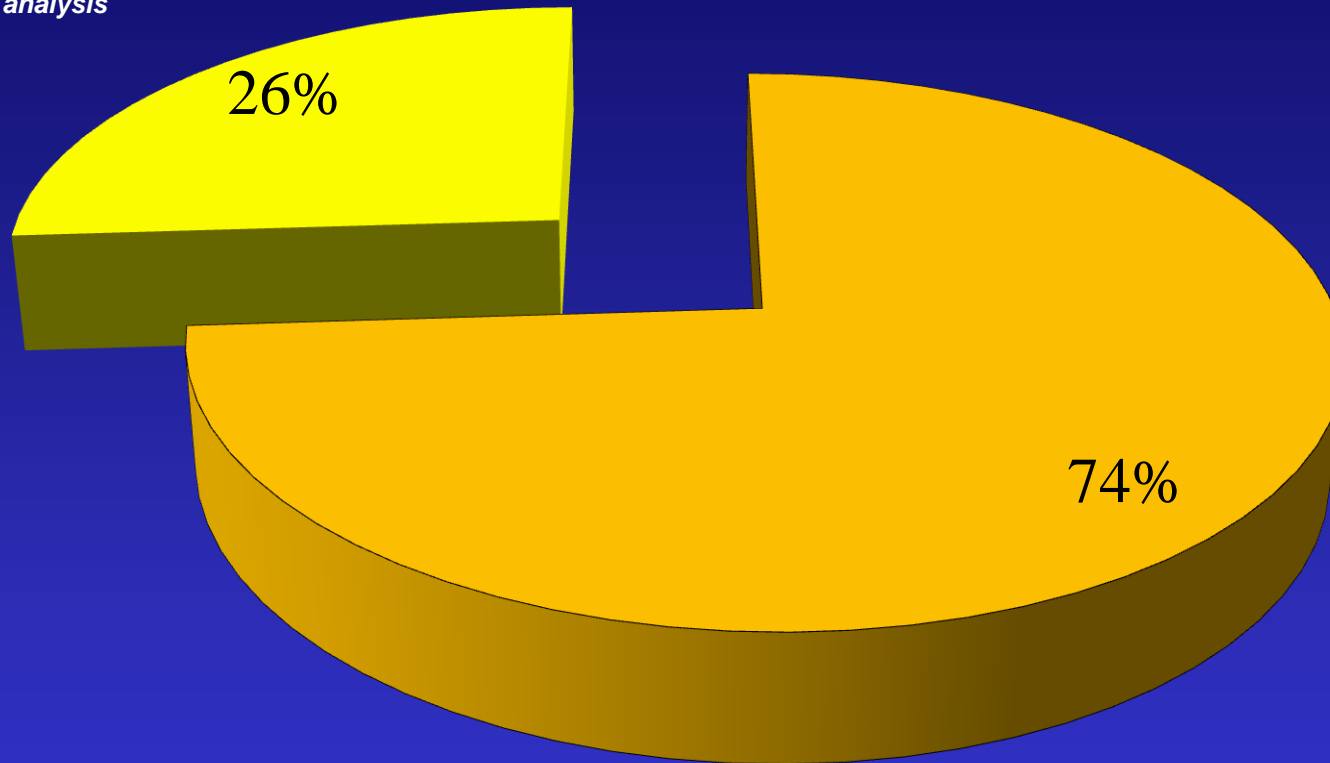


Time to ECG



Brunetti et al., J Thromb Thrombolysis 2009

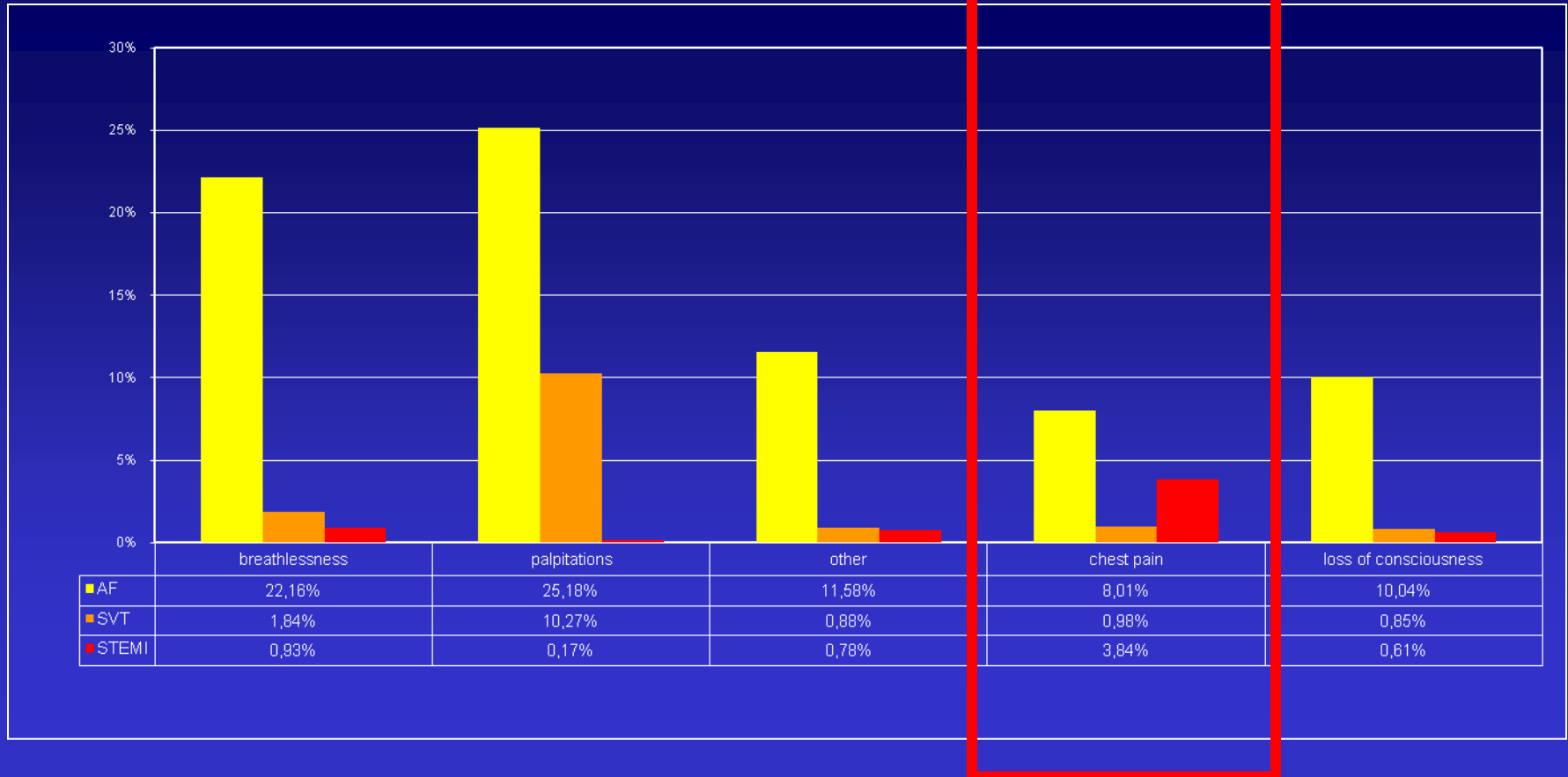
Preliminar analysis



■ within 30 minutes ■ over 30 minutes

since onset of chest pain

STEMI in subjects with chest pain



Symptoms in subjects with suspected STE-ACS

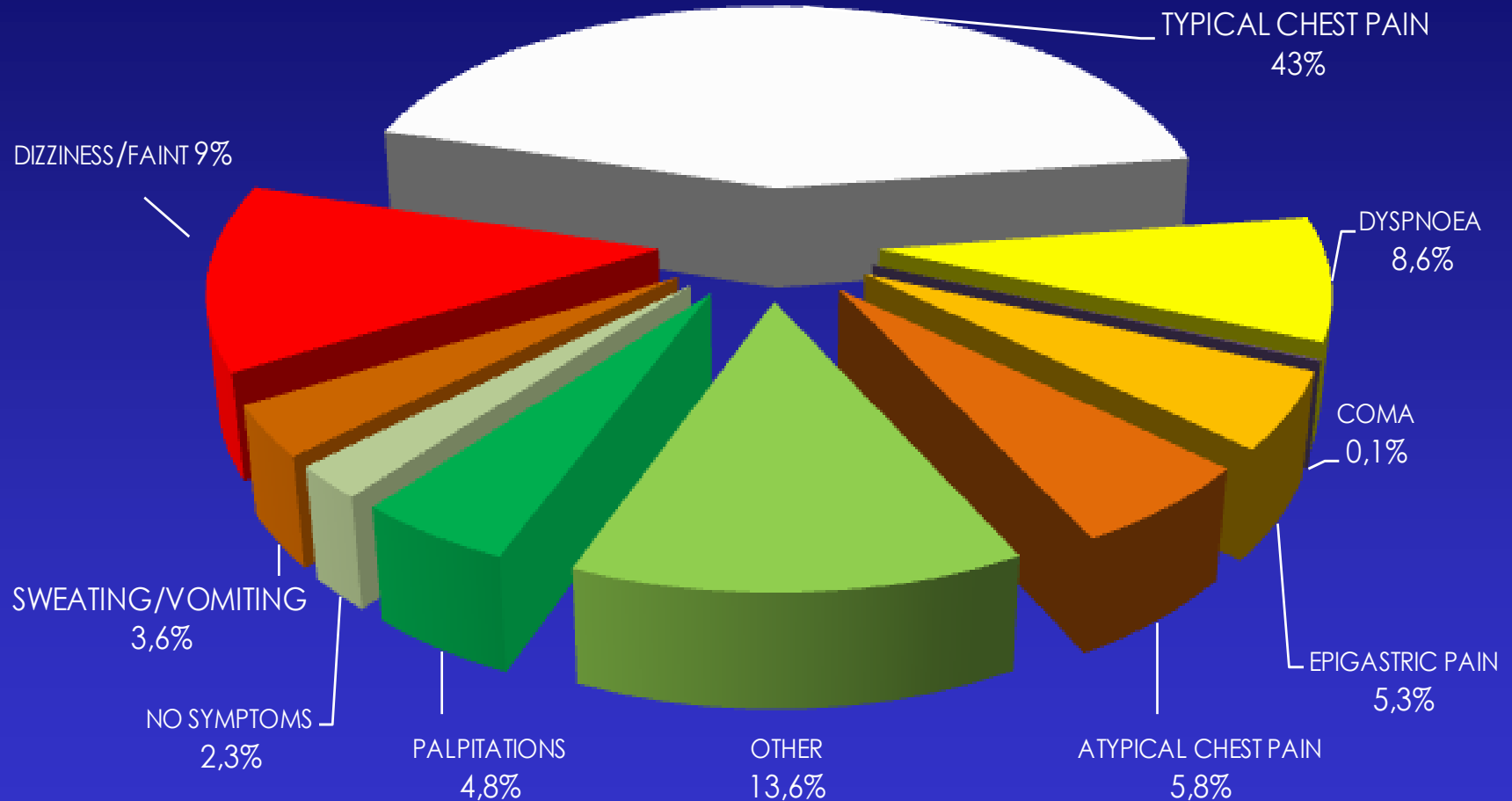
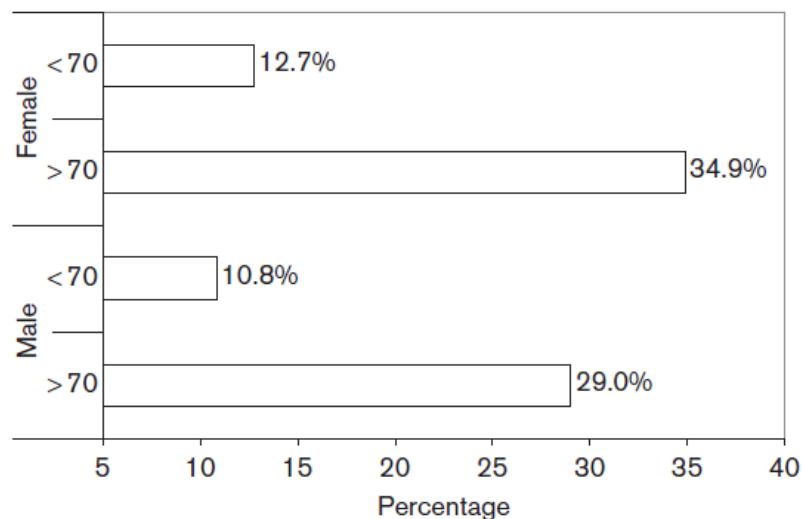
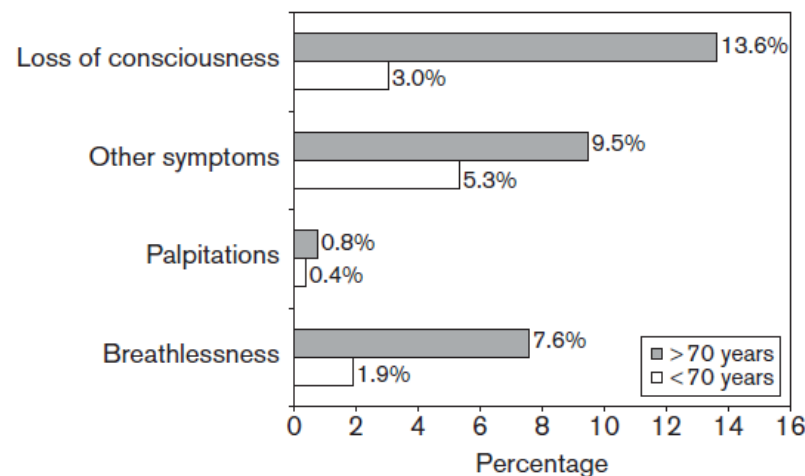


Fig. 4



Atypical presentation of ST-elevation acute myocardial infarction per age and gender.

Fig. 5



Symptom presentation of ST elevation acute myocardial infarction per age.



Pre-hospital ECG for elderly patients with STEMI



Wolters Kluwer | Lippincott
Health Williams & Wilkins



European Journal of Cardiovascular Prevention and Rehabilitation 2010

Original Scientific Paper

Telecardiology improves quality of diagnosis and reduces delay to treatment in elderly patients with acute myocardial infarction and atypical presentation

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Aim To assess whether telemedicine technology applied to public emergency healthcare system improves overall quality of home diagnosis in case of acute myocardial infarction among elderly patients, often characterized by higher rates of atypical presentation.

Methods About 27 841 patients from Apulia (Italy) who called public emergency healthcare number '118' underwent home ECG evaluation. Data were transmitted with a mobile telephone support to a telecardiology 'hub' active continuously (24/7). Data from elderly patients (>70 years) were compared with younger ones.

Results Thirty-nine percent of patients complained of chest (or epigastric) pain; ST elevation acute myocardial infarction (STEMI) was diagnosed in 1.9% of patients enrolled; 50.2% of patients with STEMI were above 70 years of age. Among STEMI patients older than 70 years, atypical presentation was detected in 32% [95% confidence interval (CI): 26.8–38.1] of patients (vs. 11% 95% CI: 7.8–15.5, $P<0.001$). Rate of atypical STEMI presentation, immediately diagnosed, thanks to telecardiology, rose up from 9.2% (95% CI: 5–17%) in the class of age 60–69 years to 25.6% (95% CI: 20–35%) in the class of age 70–79 years, to 35.2% (95% CI: 26–45%) in the class 80–89, and to 46.1% (95% CI: 26–67%) in the class greater than 89 years of age ($P<0.01$ in all cases). Number needed to treat (to avoid a single missed STEMI diagnosis) was 9.4 (95% CI: 6.4–12.9) for patients younger than 70 years versus 3.1 (95% CI: 2.6–3.7) among those older than 70 years ($P<0.001$).

Conclusion Telecardiology home ECG diagnosis could significantly help in avoiding errors and delay in STEMI diagnosis in elderly patients. *Eur J Cardiovasc Prev Rehabil* 00:000–000 © 2010 The European Society of Cardiology

Pre-hospital ECG for early rule out of patients with syncope

age class	sinus tachycardia	pvc	repetitive pvc	VT	VF	psvc	repetitive psvc	svt	atrial flutter	AF	high rate AF	sinus bradycardia	sinus arrest	sino atrial block	AV block I	AV block II	AV block II 2	advanced AV block	AV block III	junctional rhythm	Idio ventricular rhythm	low rate AF	PM failure
0 -10	0,11%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10 -20	0,91%	-	-	-	-	-	-	-	-	-	-	0,15%	-	-	-	-	-	-	-	-	-	-	-
20 -30	1,02%	0,08%	-	-	-	-	-	-	-	-	-	0,15%	-	-	-	-	-	-	-	-	-	-	-
30 -45	3,89%	0,23%	-	-	-	0,11%	0,04%	0,11%	-	0,26%	0,08%	1,70%	-	-	0,11%	-	0,08%	-	-	0,04%	-	-	-
45 -65	1,74%	0,26%	0,08%	0,08%	-	0,08%	-	0,08%	0,04%	0,42%	0,23%	1,02%	0,04%	0,04%	0,15%	0,04%	-	-	-	-	-	-	0,04%
65 -80	3,02%	0,98%	0,15%	0,08%	0,04%	0,02%	0,08%	0,15%	-	4,19%	1,13%	3,78%	0,08%	-	0,68%	0,00%	-	0,11%	0,11%	0,11%	0,23%	0,15%	-
>80	2,04%	1,13%	0,11%	0,04%	-	0,40%	0,30%	0,15%	0,34%	4,61%	0,98%	2,15%	-	0,04%	1,17%	0,08%	0,04%	-	0,08%	0,30%	0,04%	0,42%	0,08%
all	12,73%	2,68%	0,34%	0,19%	0,04%	0,61%	0,42%	0,49%	0,38%	9,48%	2,42%	8,95%	0,11%	0,08%	2,11%	0,11%	0,11%	0,11%	0,19%	0,45%	0,26%	0,57%	0,11%
p for trend	***	***				**	*		**	***	***				***					*		***	
gender																							
female	6,95%	1,28%	0,11%	-	0,04%	0,28%	0,30%	0,26%	0,34%	5,02%	1,25%	3,13%	0,08%	-	0,83%	0,04%	0,04%	0,08%	0,08%	0,15%	0,08%	0,30%	-
male	5,85%	1,40%	0,23%	0,19%	-	0,32%	0,11%	0,23%	0,04%	4,57%	1,21%	5,85%	0,04%	0,08%	1,28%	0,08%	0,08%	0,04%	0,11%	0,30%	0,19%	0,26%	0,11%
p												***											

Legend: pvc – premature ventricular contractions, psvc – premature supra-ventricular contractions, AF – atrial fibrillation, AV – atrio-ventricular, PM –pace-maker

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$



Conclusions



- A single regional tele-cardiology hub providing pre-hospital ECG may affordably support a region-wide public EMS
- Single tele-cardiology hub, lower costs of pre-hospital ECG implementation (cost analysis needed)
- Single EMS, single telecardiology hub, single hospital service: ideal scenario for reducing reperfusion times

Beam me up, Scotty!



TELE-MEDICINE + EMS/HOSPITAL NETWORK:

the fastest and easiest way to reduce time to ECG (treatment)