

# **STEMI Transfer: Wheels or Blades**

## **Insight from the Copenhagen PCI Center**

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# Potential conflicts of interest

**Peter Clemmensen**

I have the following potential conflicts of interest to report:

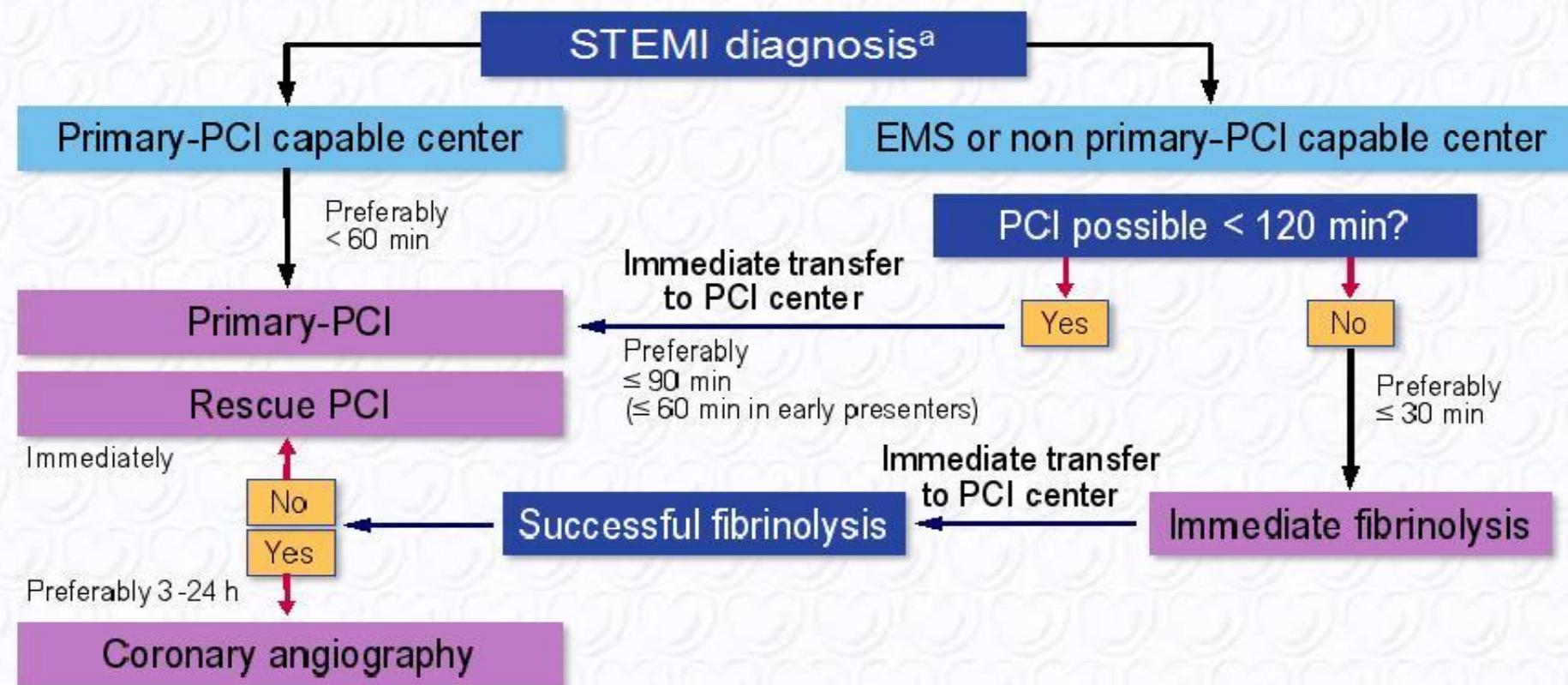
Research contracts

Consulting

Abbott, Acarix, AstraZeneca, Aventis, Bayer, Boehringer Ingelheim, Bristol Myers Squibb, Daiichi Sankyo, Eli-Lilly, Merck, Myogen, Medtronic, Mitsubishi Pharma, Nycomed, Organon, Pfizer, Pharmacia, Sanofi-Aventis, Sanofi-Synthelabo, Searle, The Medicines Company.

# Challenges and Guidelines

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



<sup>a</sup> The time point the diagnosis is confirmed with patient history and ECG ideally within 10 min from the first medical contact (FMC). All delays are related to FMC (first medical contact).

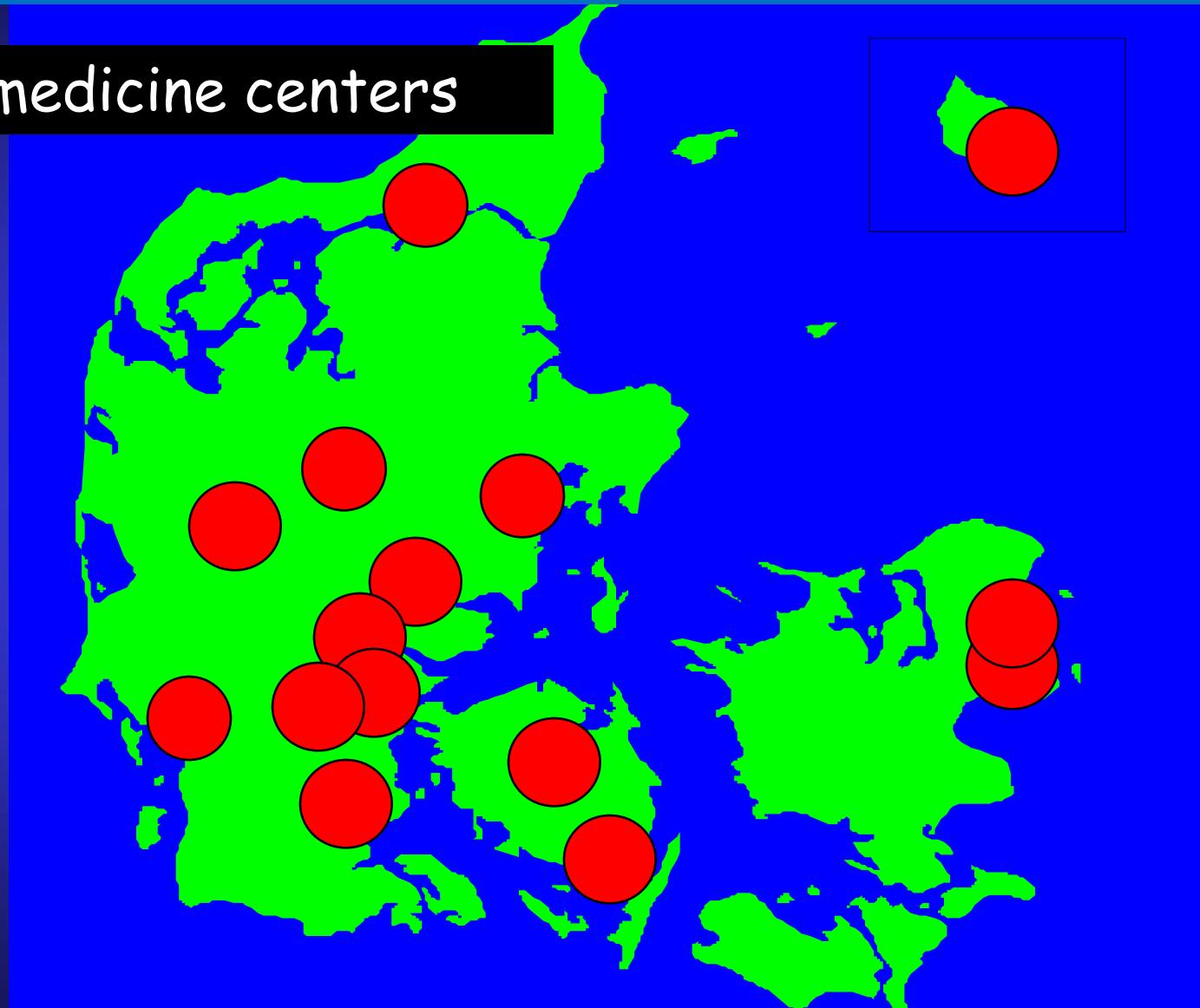
Cath = catheterization laboratory; EMS = emergency medical system; FMC = first medical contact; PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction.

# The Danish Solutions

**STEMI networks  
Prehospital Triage**

# Background:

15 Telemedicine centers



450 ambulance vehicles transmit ECGs

# Implementation of reperfusion therapy

## Danish law since 2008

### Ambulances

- Defibrillators 100% !
- 12 lead ECG 100%
- ECG Transmission 100%



# Paper vs. Fax vs. LCD



# Pre-hospital diagnosis & triage by tele-ECG



12 lead EKG  
LIFEPAK 12/15  
Medtronic



Attending Cardiologist



Oct.2003- Oct. 2005	Referred patients n=146	DANAMI-2 controls n=89	p value
Door-to-PCI	34 (19-46)	97 (80-124)	<0.001

$\Delta=63$  minutes

# The Danish Solutions

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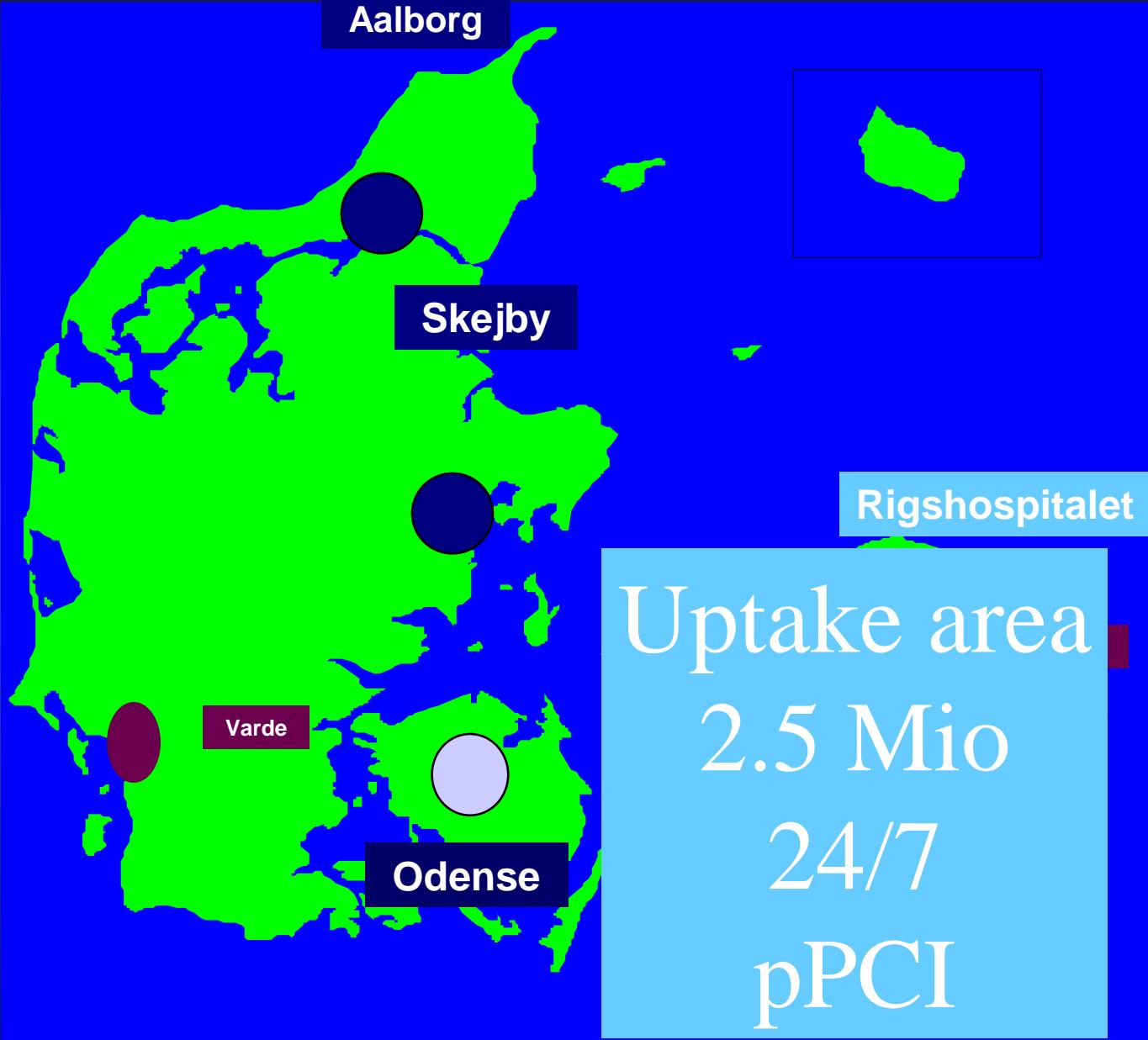
Real World Data

University of Copenhagen  
PCI Center

# Denmark 5.5 M Inhabitants

2010

Politicians  
Closed  
1/5  
pPCI  
Center



# Treatment delays when doubling the cathment area for pPCI in STEMI

	1/6-2010 - 31/5- 2011 (n = 472)	1/6-2011 - 31/5- 2012 (n = 936)	↑ 98%
Symptom to ECG	75 (40-158)	76 (42-155)	→
Transport delay (ECG to arrival)	75 (47-105)	59 (38-89)	↓ 21%
Door-to-balloon	23 (18-33)	23 (19-30)	→
Symptom to balloon	196 (137-304)	175 (125-270)	↓ 11%
ECG to balloon	101 (77-134)	85 (64-115)	↓ 16%

*Median minutes (interquartile range)*

Telemedicine triage of STEMI 1/6-2011 - 31/5-2012: 68%



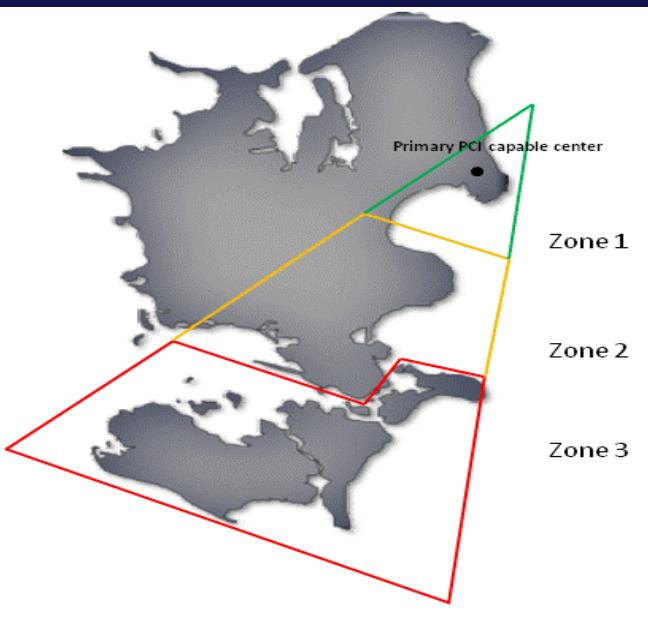
# Centralized Heart Station



# Teletransmitted ECG's visible on all Hospital Computers

The screenshot shows a Windows Internet Explorer window with the title "Liste - Windows Internet Explorer provided by RH". The address bar displays the URL "http://mta/ekg/". The menu bar includes "Filer", "Rediger", "Vig", "Favoritter", "Funktioner", and "Hjælp". The toolbar includes icons for Back, Forward, Stop, Refresh, and Search, along with links to "Gratis Hotmail" and "Google". The main content area is titled "Valg af LifeNet Data" and contains a table of 20 entries, each with a link labeled "Log af" followed by "Guider og dokumenter".

Position	Action	Date	Name
01.	<a href="#">PDF</a>	29-02-2012 14:27	POULSEN
02.	<a href="#">PDF</a>	29-02-2012 12:16	JØRGENSEN
03.	<a href="#">PDF</a>	29-02-2012 09:47	LAU
04.	<a href="#">PDF</a>	29-02-2012 09:30	ANDERSEN
05.	<a href="#">PDF</a>	29-02-2012 05:16	JOHANSSON
06.	<a href="#">PDF</a>	29-02-2012 04:11	JRGENSEN
07.	<a href="#">PDF</a>	29-02-2012 01:31	HANSEN
08.	<a href="#">PDF</a>	28-02-2012 20:28	PETERSEN
09.	<a href="#">PDF</a>	28-02-2012 19:16	WESTERGAARD
10.	<a href="#">PDF</a>	28-02-2012 17:50	JENSEN
11.	<a href="#">PDF</a>	28-02-2012 16:13	PEDERSEN
12.	<a href="#">PDF</a>	28-02-2012 15:26	EJSENHART
13.	<a href="#">PDF</a>	28-02-2012 10:51	ABRAHAMSEN
14.	<a href="#">PDF</a>	28-02-2012 10:48	
15.	<a href="#">PDF</a>	28-02-2012 10:18	LAURSEN
16.	<a href="#">PDF</a>	28-02-2012 10:15	HANSEN
17.	<a href="#">PDF</a>	28-02-2012 07:46	HOLTE
18.	<a href="#">PDF</a>	28-02-2012 07:07	HARTMANN
19.	<a href="#">PDF</a>	28-02-2012 07:06	KELDSEN
20.	<a href="#">PDF</a>	28-02-2012 05:15	MINOR



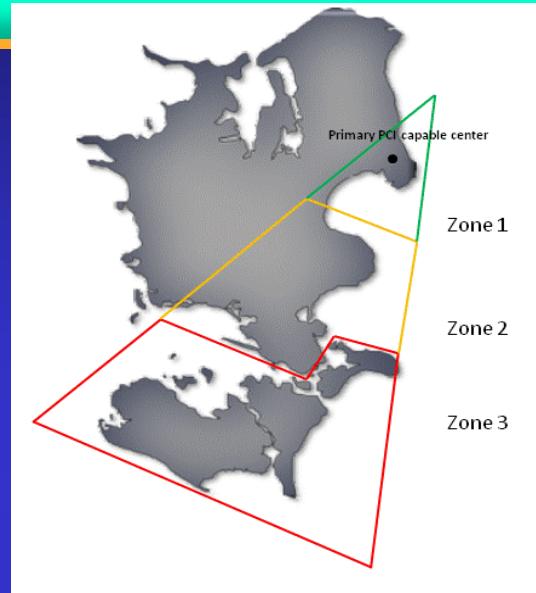
# Results: Reperfusion delays

	Median time intervals in minutes			P value
	Zone 1 (0-25 km)	Zone 2 (65-100 km)	Zone 3 (100-185 km)	
Patient delay	41 (15-85)	75 (29-170)	52 (26-99)	0.009
Call to scene	6 (4-7)	17 (10-22)	14 (10-19)	<0.001
Time at scene	20 (15-25)	16 (8-22)	18 (12-23)	0.002
Scene to PCI center	9 (7-12)	60 (50-70)	91 (75-125)	<0.001
Door to balloon	45 (33-70)	30 (20-39)	30 (23-45)	<0.001
Pre-hospital delay	35 (29-43)	98 (82-129)	135 (110-173)	<0.001
FMC to balloon	79 (65-100)	119 (102-168)	160 (128-210)	<0.001
System delay	86 (72-113)	133 (116-178)	173 (145-215)	<0.001
Treatment delay	135 (100-200)	235 (158-350)	235 (187-330)	<0.001

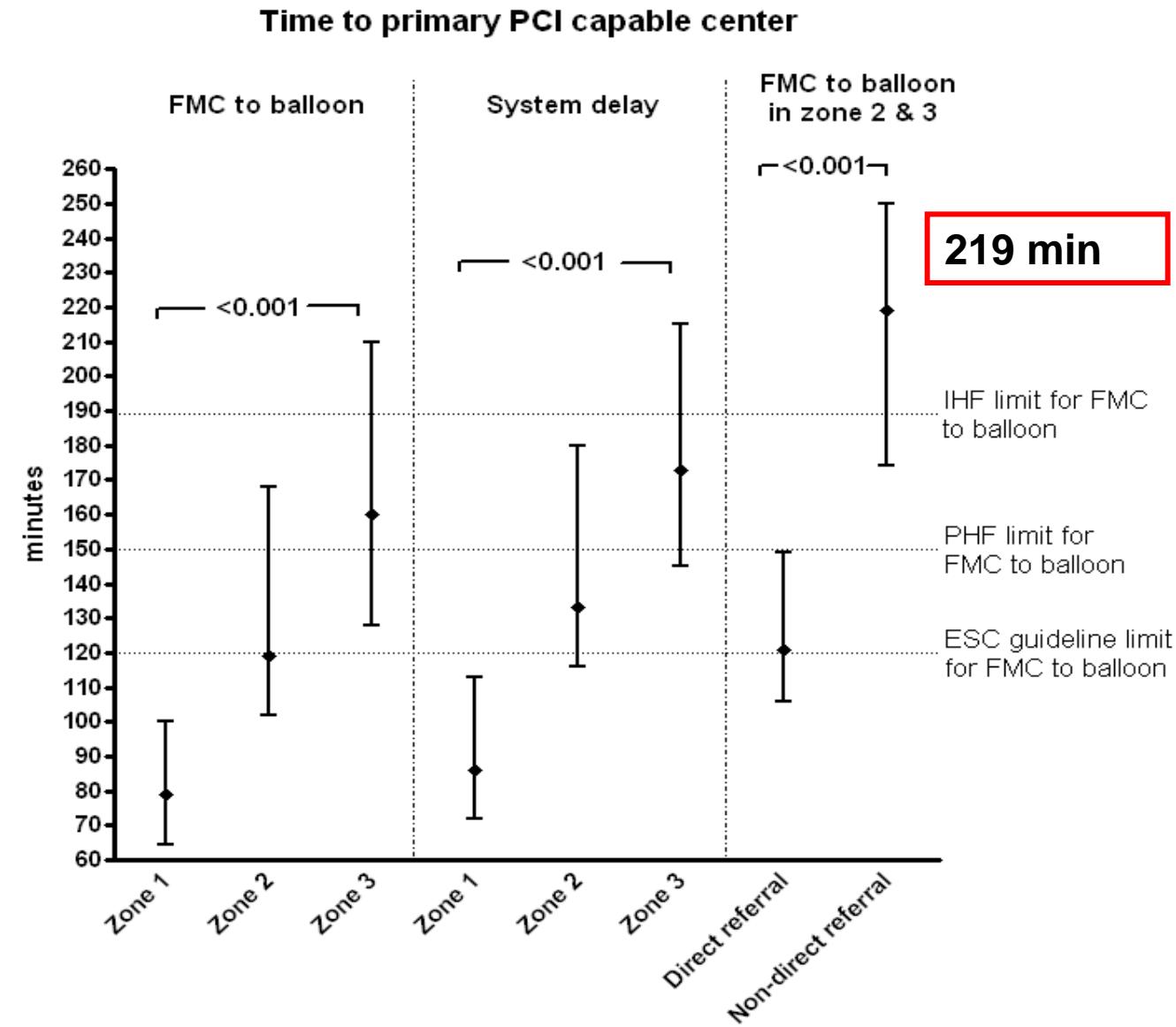
# Results: Complications during transfer and mortality

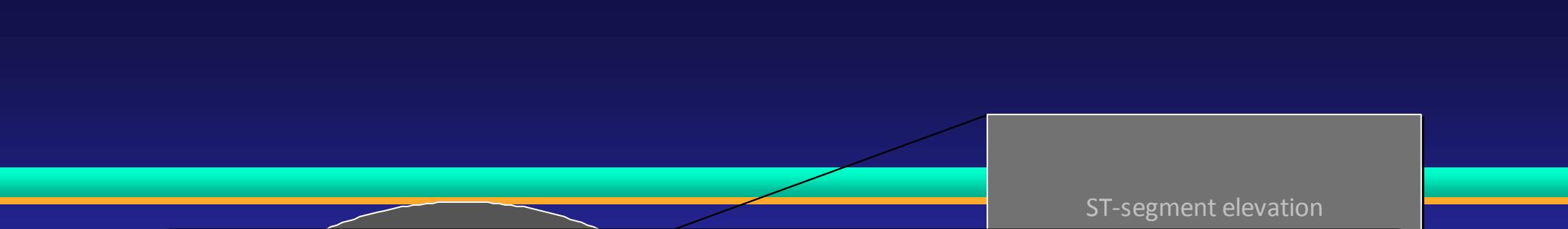
	Zone 1 (0-25 km)	Zone 2 (65-100 km)	Zone 3 (100-185 km)	P value
VF/VT/asystole	18 (7.6)	12 (10.4)	14 (11.8)	0.178
SBT <100	49 (20.6)	11 (9.6)	18 (15.1)	0.092
HR >100	33 (13.9)	21 (18.9)	14 (11.4)	0.736
AV block >2 <sup>nd</sup> degree	4 (1.7)	4 (3.5)	2 (1.7)	0.842
Killip class 2-4	26 (11.8)	13 (12.5)	8 (7.8)	0.731
Mortality 24 hours	10 (4.2)	1 (0.9)	1 (0.8)	0.036
Mortality 7 days	16 (6.8)	4 (3.5)	5 (4.2)	0.239
Mortality 30 days	19 (8.1)	7 (6.1)	8 (6.8)	0.501
Mortality Final follow-up	56 (23.8)	23 (20)	20 (16.9)	0.126

# Results: Reperfusion delays



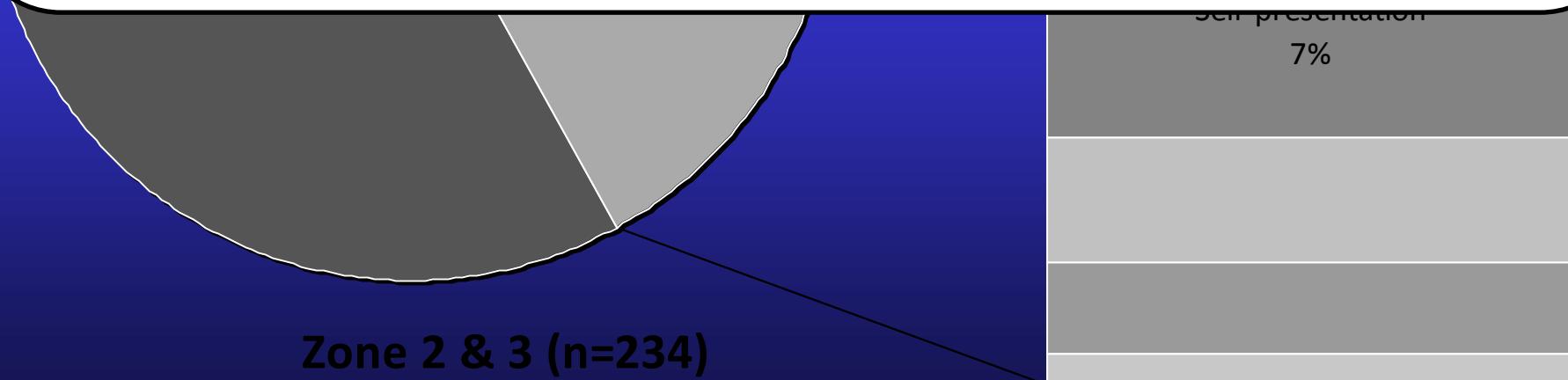
Direct referral FMC to balloon	
Zone 2	Zone 3
<b>109 min</b> (92-121)	<b>139 min</b> (121-160)





ST-segment elevation

# Pre-hospital triage feasible in 73% of STEMI patients (self-presenters excluded)



# 2011 Single Center Experience

RF

1282 Consecutive acute CAG  
(IHD, Chest pain, Cardiogenic shock, OHCA)

702 Tele-ECG Triage



P PCI 81%

580 Transferred from spo



P PCI 41%



# STEMI time delays when using Ambulances or Helicopters

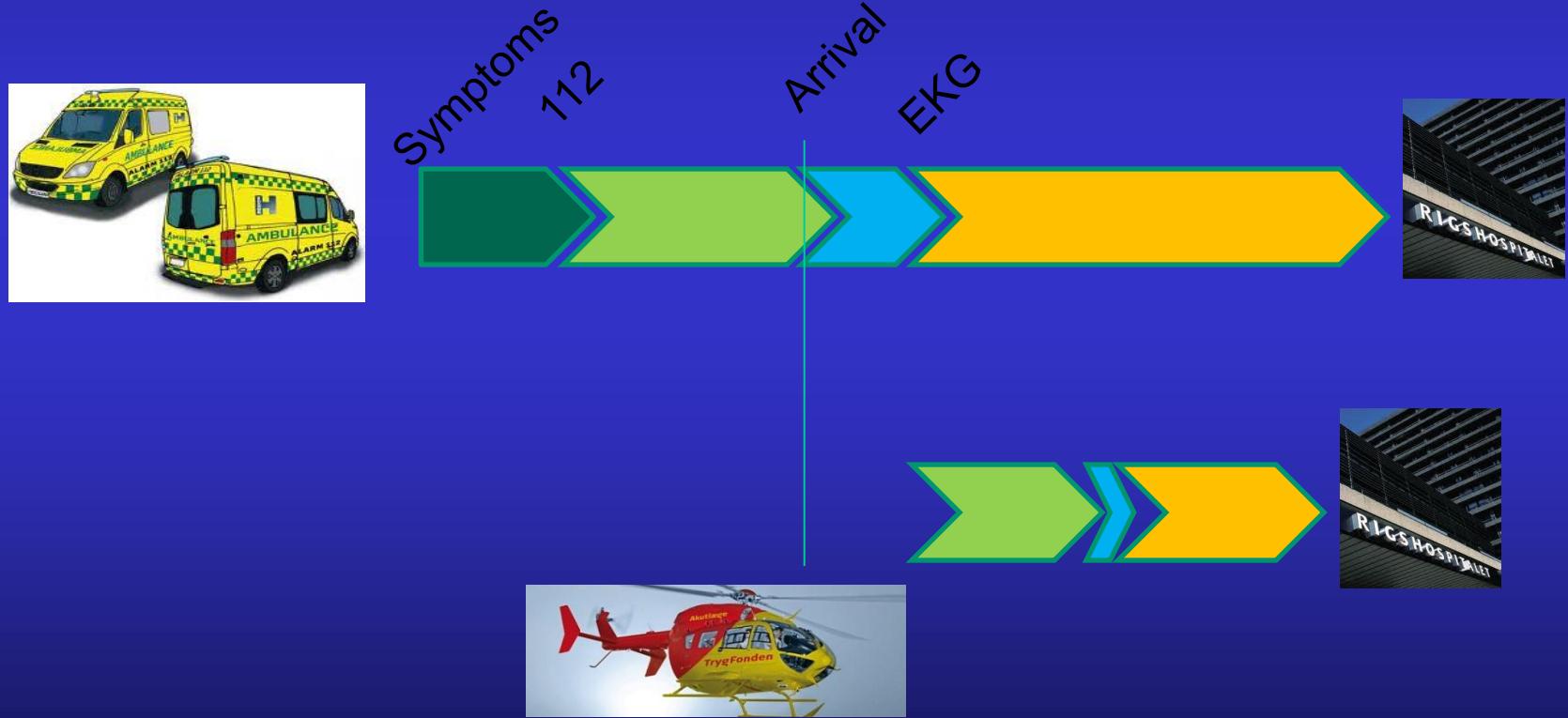


# STEMI - Methods

- Prospective, controlled, observational
- Ambulance 16 months vs Helicopter 12 months
- STEMI transferred for pPCI
- >30 min. Transport by Ambulance
- Both prehospital and interhospital



# Time analysis - STEMI



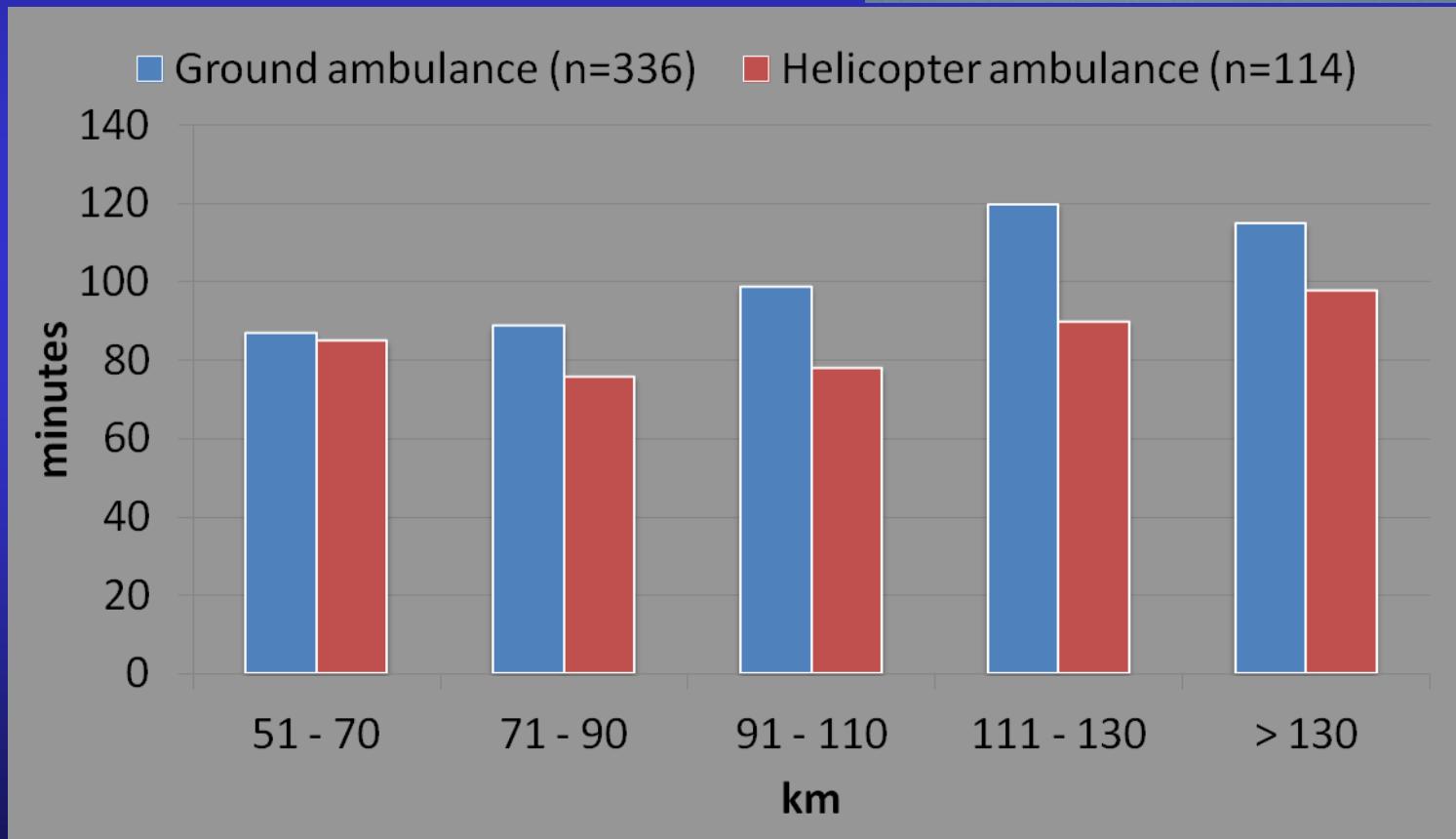
# STEMI Time delays

All transferred pts	Ambulance n=336	Helicopter n=114	P value
ECG – Cath Lab	104 (63-225)	84 (60-160)	<0.01
Distance in km	94 (64-162)	97 (65-172)	0.01
	n=262	n=91	
Symptoms - ECG	90 (21-497)	90 (16-405)	0.80
ECG / FMC - Balloon	132 (84-262)	114 (78-221)	<0.01
<120 min	48%	65 %	<0.01
Door-2-Balloon	32 (18-70)	32 (20-82)	0.66

# STEMI - Mortality

- 30 - day mortality
  - Ambulance (n=262) vs. Helicopter (n=91)  
(6.9 % vs. 2.2%, p=0.10)
- 1 – yr mortality
  - Ambulance (n=262) vs. Helicopter (n=90)  
(9.9 % vs. 6.7%, p=0.35)

# Time from ECG to PCI center



+ 30 minutes door-to-balloon

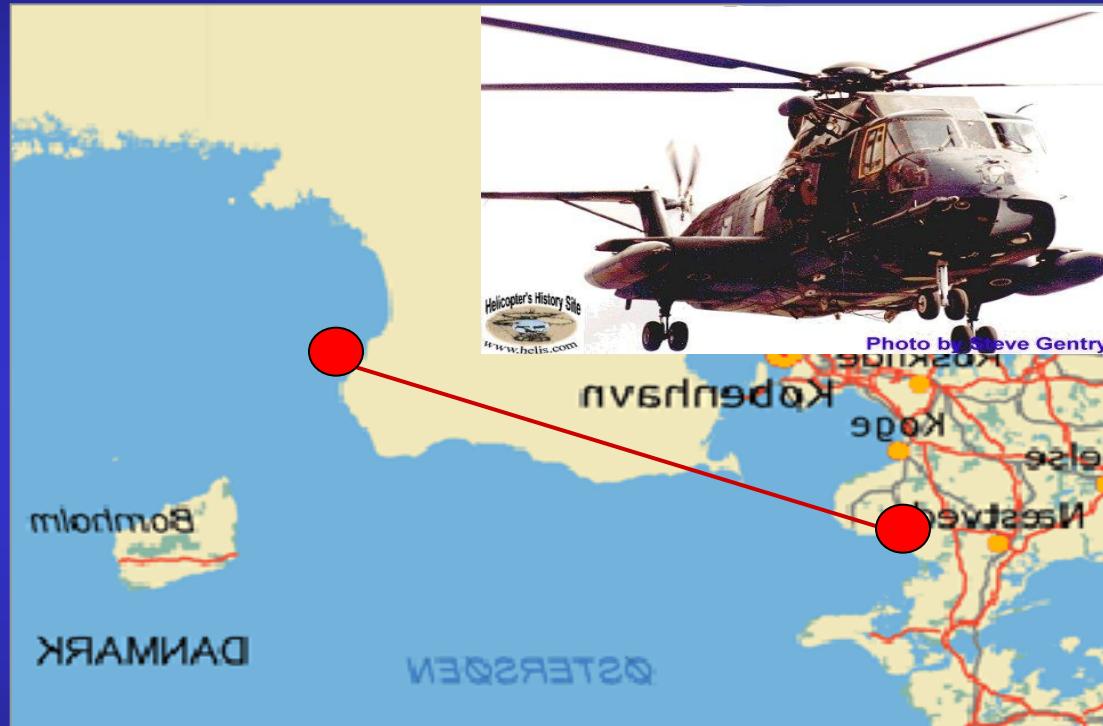
Hesselfeldt et al. Submitted

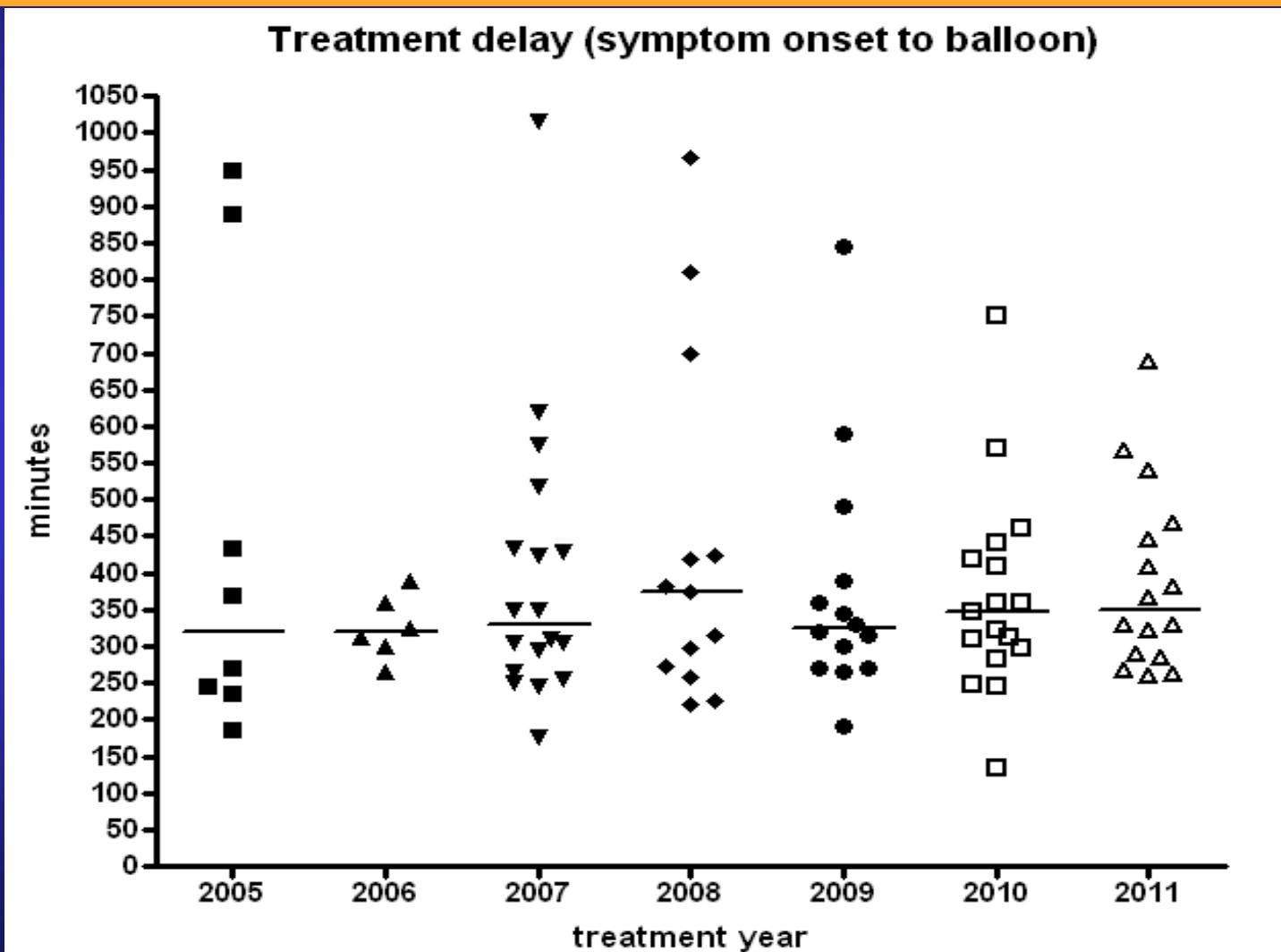


Webcam from helipad to cath lab

# Telemedicine based STEMI-Transfer Baltic Sea Island

112 - Ambulance Arrival:	15 min
ECG	7 min
Phone-Calls:	5 min
Helicopter-Flying Time:	42 min
Medication and Out:	10 min
Ambulance to Rønne:	12 min
Waiting for Helicopter:	20 min
Helicopter Transfer:	40 min
<b>ECG to Rigshospitalet:</b>	<b>94 min</b>





# Mortality

	Bornholm 2005-2011 (n=101)	Capitol region 1998-2008 (n=2774)
30 d cardiac mortality	6 (5.9 %)	205 (7.4 %)
1. Yr cardiac mortality	7 (7.7 %)	233 (8.4%)
30 d total mortality	6 (5.9 %)	222 (8 %)
1. års total mortality	9 (9.9%)	283 (10.2 %)

# Conclusions

**Telemedicine is pivotal in reducing treatment delays  
in STEMI networks**

**Primary PCI can centralized in well organised "Mega-centers" without negative effects of treatment delays**

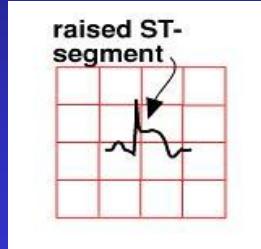
**Helicopter transfer of STEMI patients significantly reduces treatment delays, effective from a radius of only 80 km (50 miles) from the pPCI hub**

A photograph of a group of people, all dressed in light-colored, long-sleeved shirts and dark pants, sitting and standing on a set of wooden bleachers or steps. They are laughing heartily, their faces showing joy. The setting appears to be an indoor auditorium or theater. In the background, a man in a white shirt and blue jeans stands near a doorway, and another person's back is visible on the right side.

Thank you for your attention

# Prehospital ACS Triage

STEMI Patients



*Pre-hospital point-of-care*

Troponins / FABP / xx

ECHO?



In Cath Lab

# **Third Universal Definition of Myocardial Infarction**



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**Co-Chairman of The Global MI Task Force**

# Universal Definition of Myocardial Infarction Consensus Documents

European Heart Journal (2000) 21, 1502–1513  
doi:10.1053/euhj.2000.2205, available online at <http://www.idealibrary.com> on 

## Consensus Document

Myocardial infarction redefined — A consensus document of The Joint European Society of Cardiology/American College of Cardiology Committee for the Redefinition of Myocardial Infarction

The Joint European Society of Cardiology/American College of Cardiology Committee\*

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This document was developed by a consensus conference initiated by Kristian Thygesen, MD, and Joseph S. Alpert.

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Expert consensus document

## Universal definition of myocardial infarction

Kristian Thygesen, Joseph S. Alpert and Harvey D. White on behalf of the Joint ESC/ACCF/AHA/WHF Task Force for the Redefinition of Myocardial Infarction

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EXPERT CONSENSUS DOCUMENT

## Third universal definition of myocardial infarction

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Stephan Windecker (Switzerland).

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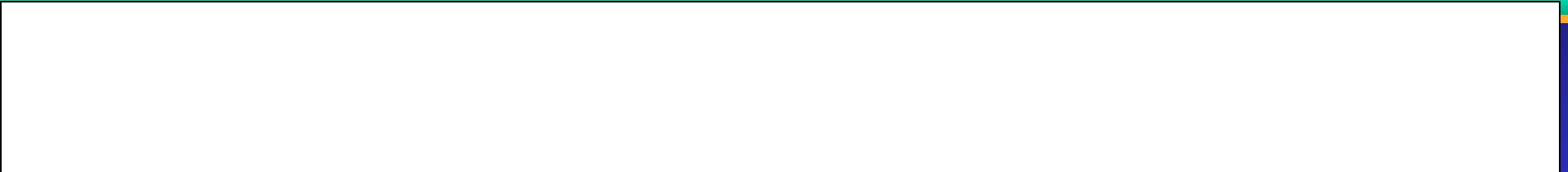
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2000

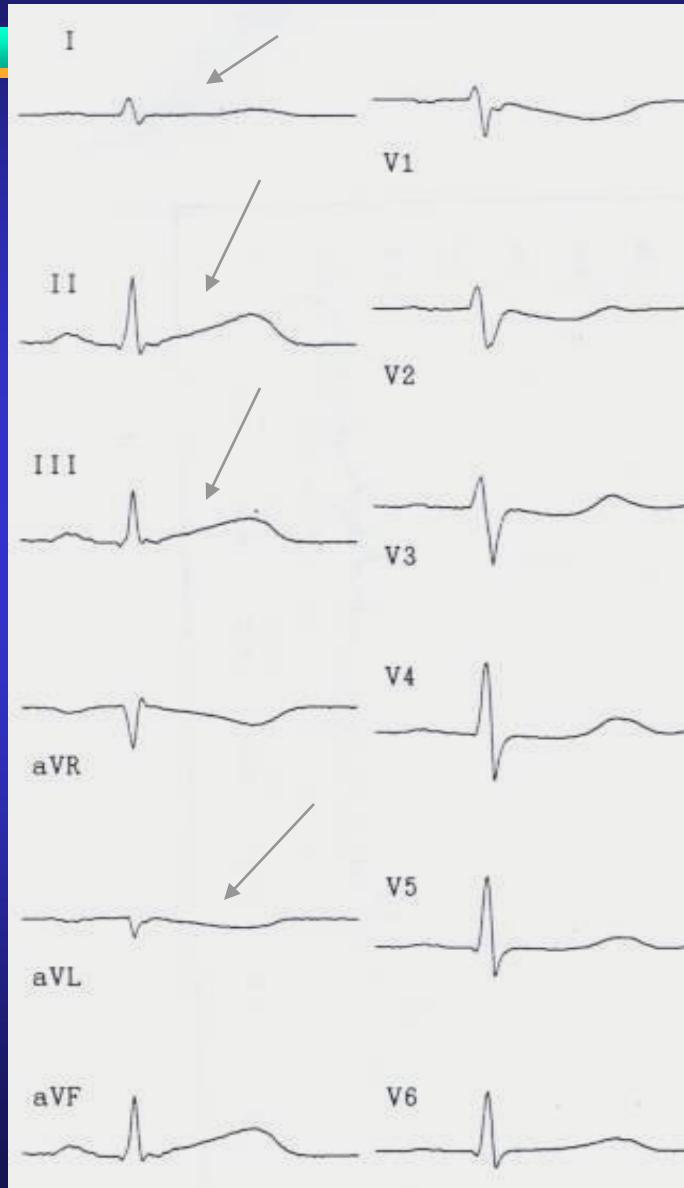
2007

2012

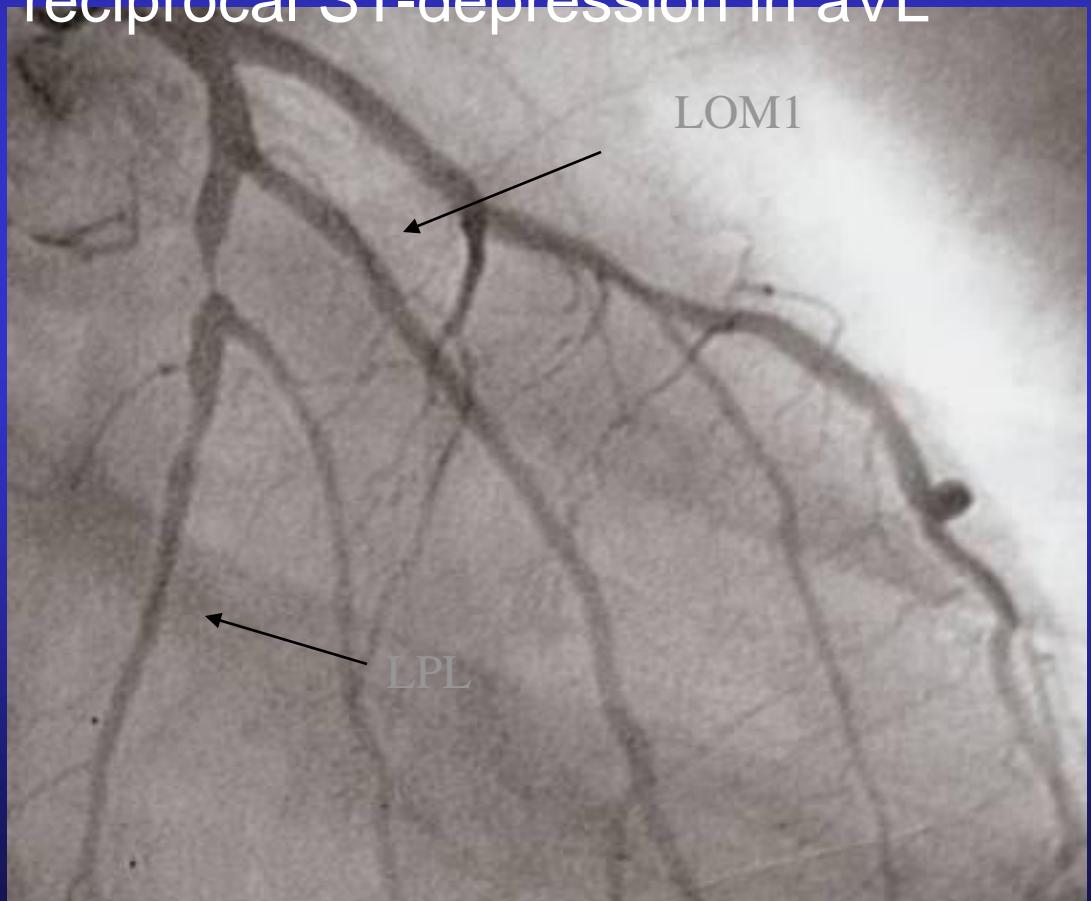
# Patient with chest pain



# Proximal or distal occlusion ?



DISTAL LCX OCCLUSION  
post-OM1  
reciprocal ST-depression in aVL



Courtesy of Dr. Kjell Nikus, Tampere

The best way to predict the future is to create it

Peter F. Drucker

# Single phone call - Team effort



?



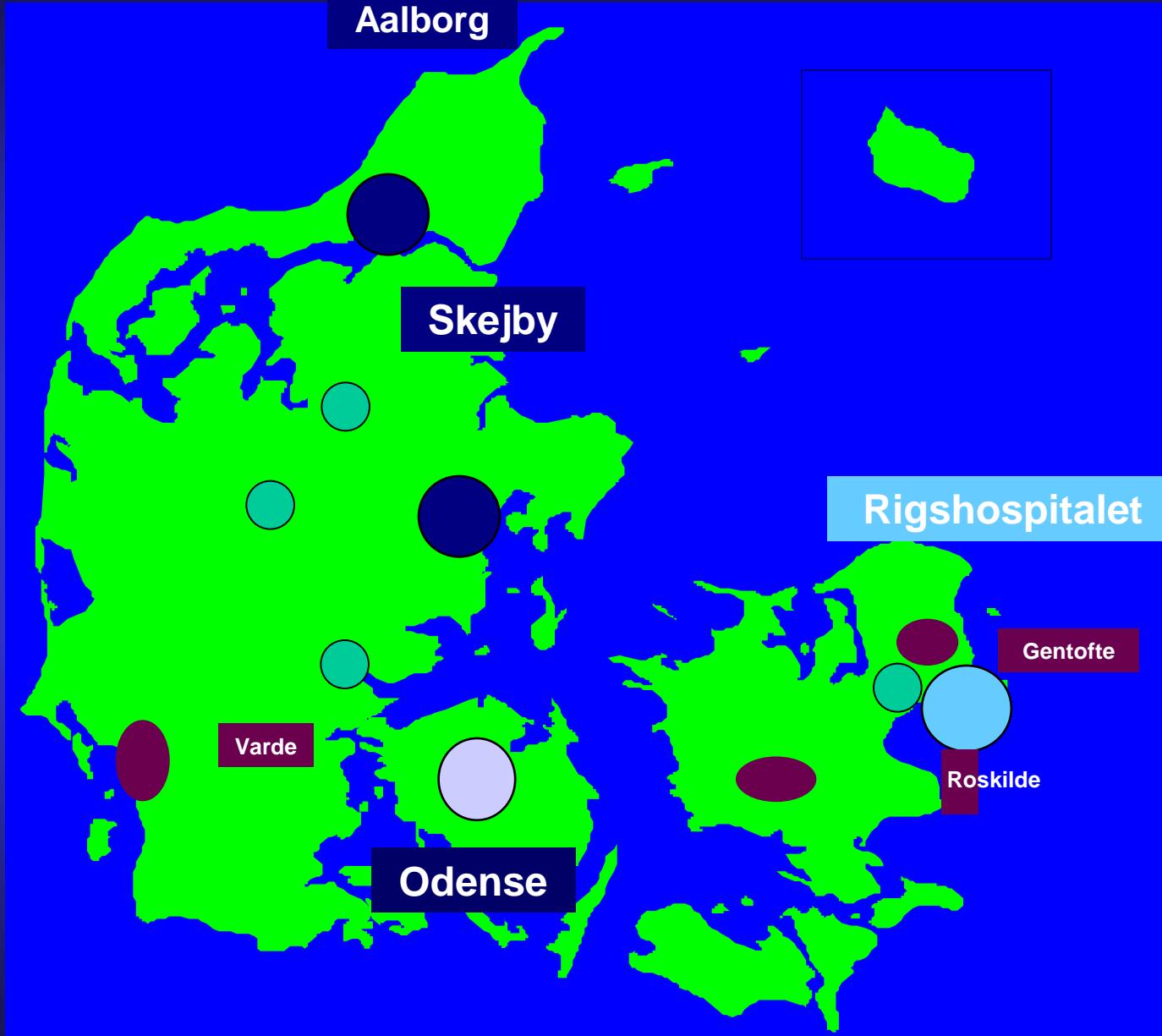
# Conclusions

- *Helicopter transfer for STEMI pts with an estimated ground transport > 30 min. to the pPCI center decreases FMC to Balloon times*
- *Using helicopter transfer for STEMI patients results in more pts being treated within the ESC guideline limits*
- *Our initial experience suggest that Helicopter transfer for STEMI patients is faster than ground transport even at distances down to 80 km  
(50 miles)*

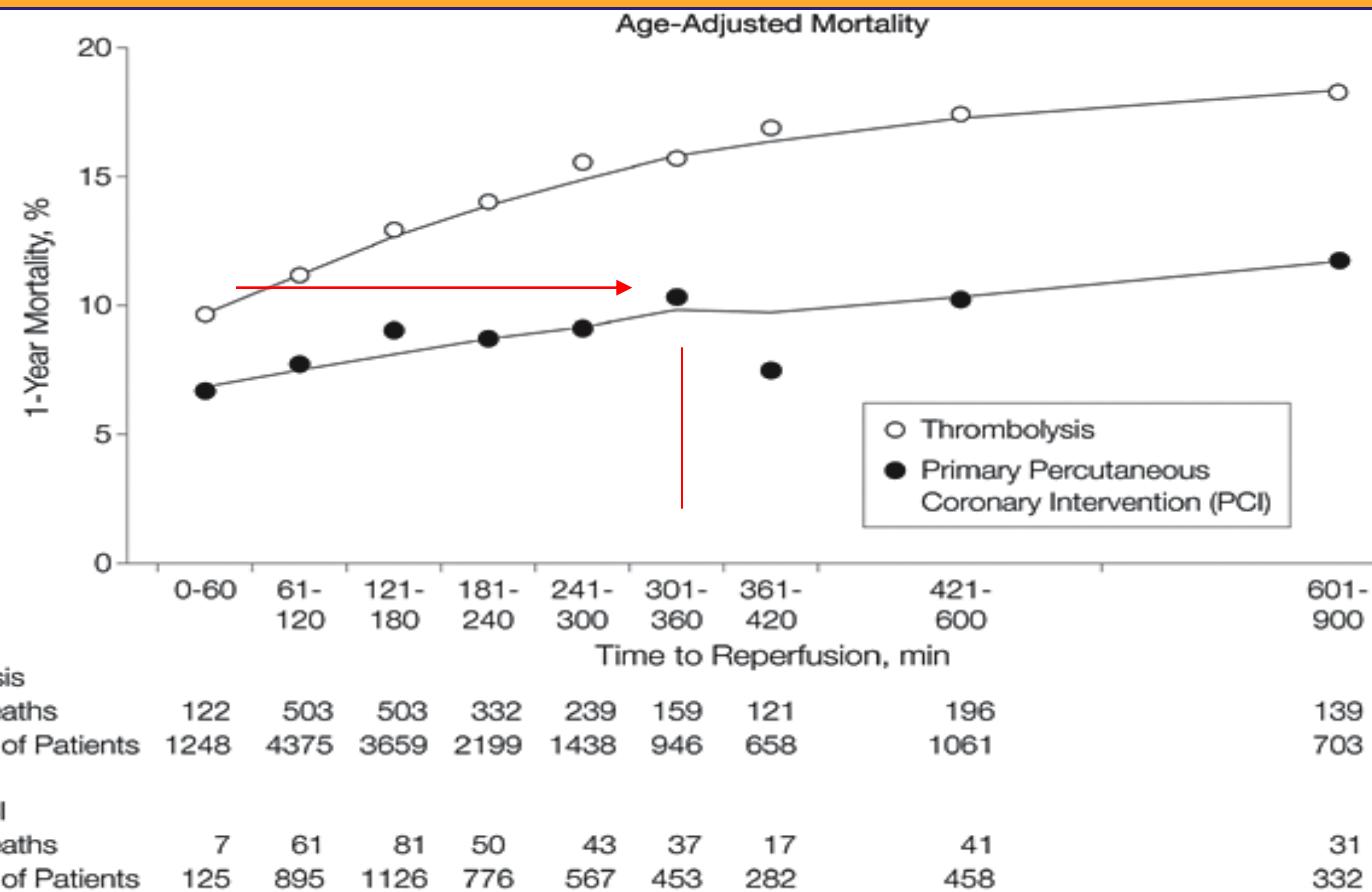
	Bornholm 2005-2011 (n=101)	Alle STEMI patienter behandlet på RH med pPCI fra 1998-2008 (n=2774)
Age	$62.2 \pm 12.6$	$62.7 \pm 13.1$
Gender (female)	18 (17.8)	788 (28)
Hypertension	32 (31.7)	788 (33)
Dyslipidemia	24 (23.8)	468 (32)
Active or previous smoker	68 (67.3)	1752 (79)
Diabetes	9 (8.9)	415 (15)
BMI	$27.4 \pm 5.3$	$26.5 \pm 4.4$
Culprit artery		
LAD	44 (43.6)	1286 (45)
RCA	42 (41.6)	1117 (41)
LCX	12 (11.9)	337 (13)
LM	2 (2)	23 (0.8)
TIMI 0/I/II/III (%)	55/12/14/19	65/8/14/13
1/2/3/>3 lesions (%)	77/16/5/2	79/17/3/1

# Denmark 5.5 M Inhabitants

Tele  
Transmission  
between  
6 Elective PCI  
or CAG Centers  
  
and  
  
4 pPCI  
University Centers



# Age-Adjusted Mortality According to Time to Reperfusion and Type of Therapy

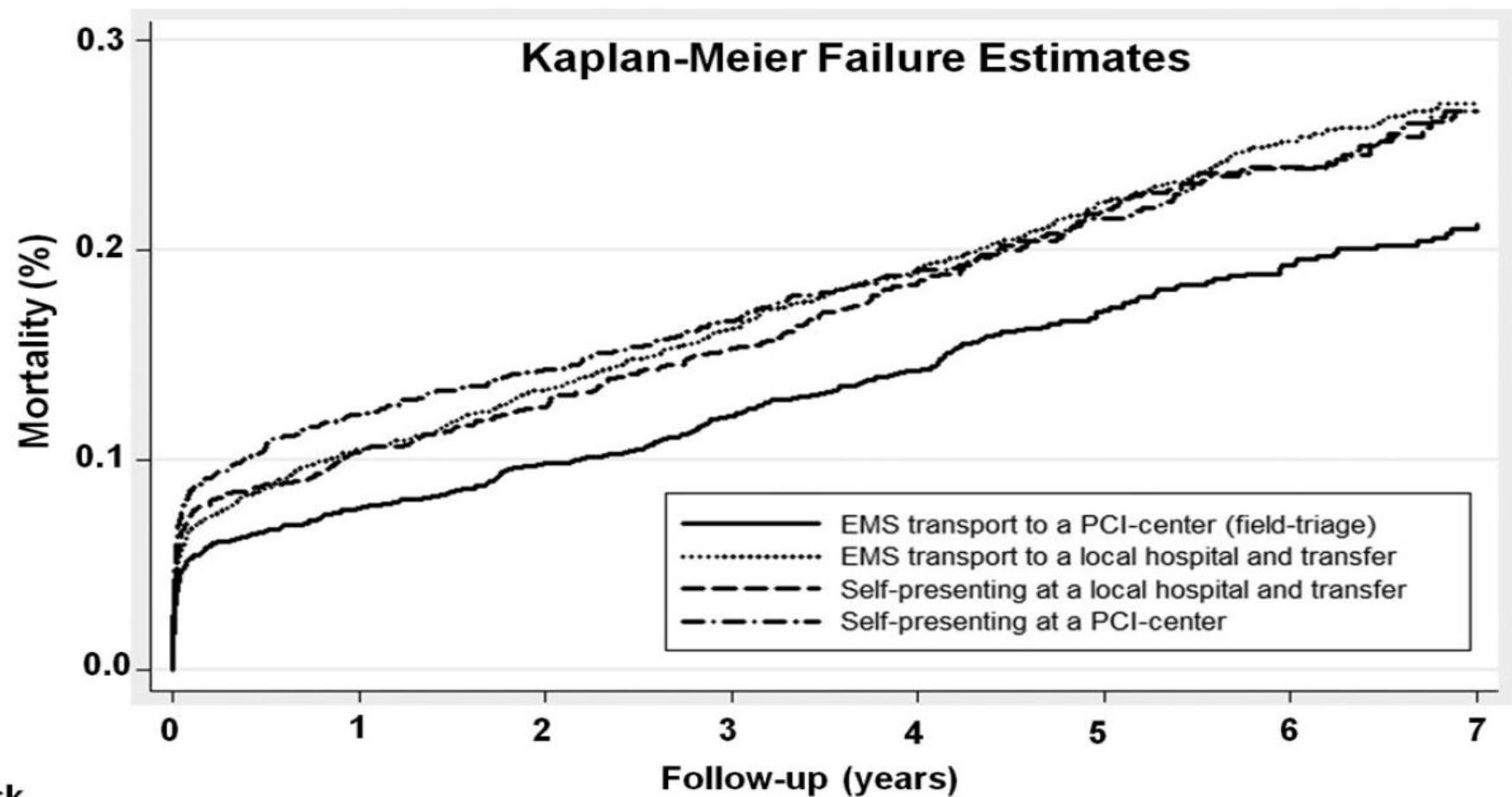


Stenestrland, U. et al.

JAMA 2006;296:1749-1756.

JAMA

# Outcome according to triage of patients



No. at risk

3053	2503	1978	1533	1154	808	572	358
3291	2850	2535	2143	1758	1344	919	543
1514	1280	1126	965	785	603	432	286
1656	1348	1142	911	713	527	371	244

# PCI Mega center



Optimal catchment area for pPCI: 250-500.000  
Should rarely exceede 1.000.000

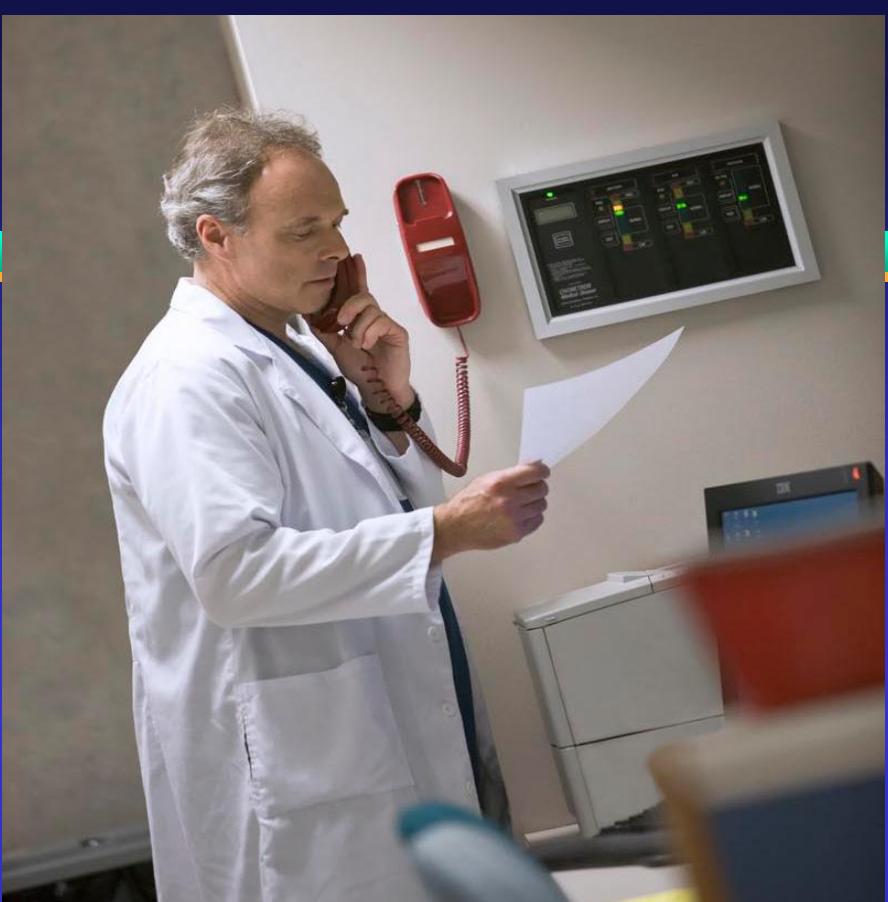
ESC

# Level 1 MI Emergency Department Kit

## Going prehospital !

- ASA tablets in package and i.v.
- Prasugrel, Ticagrelor, Clopidogrel tables in package
- Metoprolol bolus x3
- Heparin bolus
- Bivalirudin drip and tubing
- Alcohol swabs
- Calculator
- Standing orders with fibrinolytic calculations
- Blood vials
- PCS forms (Physician Certification Statement for Transfer)
- Transfer datasheet
- Standing orders





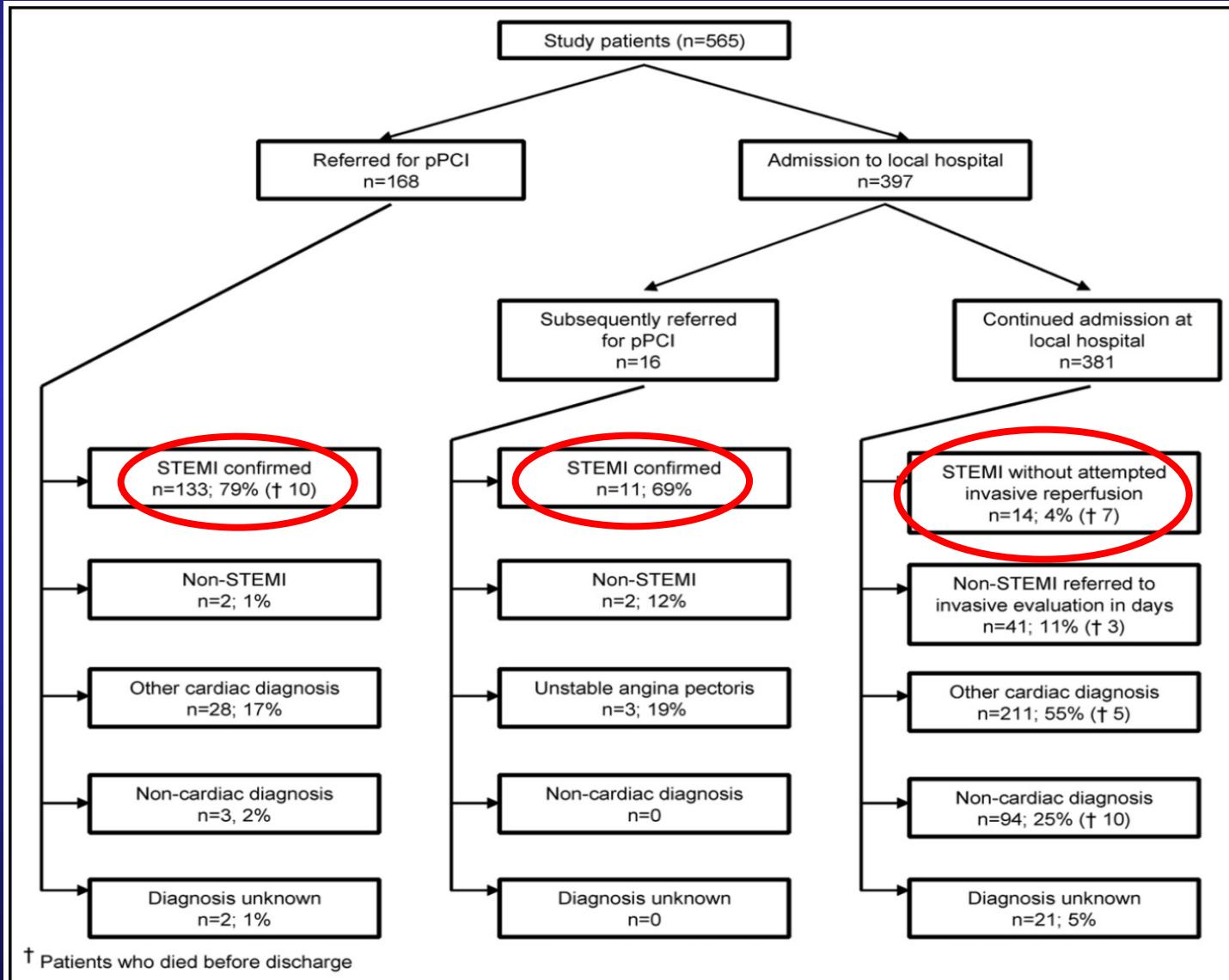
# KPI

Call back 90 sec. after incoming ECG

# From High Volume to Mega-Center pPCI Center



# Real World Tele-ECG Triage



## *STEMI diagnosis*

- PPV 79%
- NPV 94%
- Sensitivity 84%
- Specificity 91%