2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation

The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology

Chairpersons: Borja Ibanez (Spain), Stefan James (Sweden).

Authors/Task Force Members: Stefan Agewall (Norway), Manuel J. Antunes (Portugal), Chiara Bucciarelli-Ducci (UK), Héctor Bueno (Spain), Alida L. P. Caforio (Italy), Filippo Crea (Italy), John A. Goudevenos (Greece), Sigrun Halvorsen (Norway), Gerhard Hindricks (Germany), Adnan Kastrati (Germany), Mattie J. Lenzen (The Netherlands), Eva Prescott (Denmark), Marco Roffi (Switzerland), Marco Valgimigli (Switzerland), Christoph Varenhorst (Sweden), Pascal Vranckx (Belgium), Petr Widimský (Czech Republic).
Task Force Members

- 19 Authors
- ESC
- 30 Reviewers
- 1224 comments and requests

## Level of evidence

<table>
<thead>
<tr>
<th></th>
<th>Level Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Data derived from multiple randomized clinical trials or meta-analyses.</td>
</tr>
<tr>
<td>B</td>
<td>Data derived from a single randomized clinical trial or large non-randomized studies.</td>
</tr>
<tr>
<td>C</td>
<td>Consensus of opinion of the experts and/or small studies, retrospective studies, registries.</td>
</tr>
</tbody>
</table>

159 recommendations based on 477 references

- **A**: 37 recommendations (23%)
- **B**: 78 recommendations (49%)
- **C**: 44 recommendations (28%)
# What is new in 2017 Guidelines on AMI-STEMI

## 2017 NEW / REVISED CONCEPTS

### MINOCA AND QUALITY INDICATORS:
- New chapters dedicated to these topics.

### STRATEGY SELECTION AND TIME DELAYS:
- Clear definition of first medical contact (FMC).
- Definition of “time 0” to choose reperfusion strategy (i.e. the strategy clock starts at the time of “STEMI diagnosis”).
- Selection of PCI over fibrinolysis: when anticipated delay from “STEMI diagnosis” to wire crossing is ≤120 min.
- Maximum delay time from “STEMI diagnosis” to bolus of fibrinolysis agent is set in 10 min.
- “Door-to-Balloon” term eliminated from guidelines.

### ELECTROCARDIOGRAM AT PRESENTATION:
- Left and right bundle branch block considered equal for recommending urgent angiography if ischaemic symptoms.

### TIME LIMITS FOR ROUTINE OPENING OF AN IRA:
- 0-12h (Class I); 12-48h (Class IIa); >48h (Class III).

### TIME TO ANGIOGRAPHY AFTER FIBRINOLYSIS:
- Timeframe is set in 2-24h after successful fibrinolysis.

### PATIENTS TAKING ANTICOAGULANTS:
- Acute and chronic management presented.
Modes of patient presentation, components of ischaemic time and flowchart for reperfusion strategy selection

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>FMC</td>
<td>The time point when the patient is either initially assessed by a physician, paramedic, nurse or other trained EMS personnel who can obtain and interpret the ECG, and deliver initial interventions (e.g. defibrillation). FMC can be either in the prehospital setting or upon patient arrival at the hospital (e.g. emergency department).</td>
</tr>
</tbody>
</table>
ΣΑΣ ΠΑΡΑΛΑΜΒΑΝΟΥΜΕ
ΑΠΟ ΟΠΟΥ ΘΕΛΕΤΕ

AIRLINES PALAIOKOSTAS
Modes of patient presentation, components of ischaemic time and flowchart for reperfusion strategy selection

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<tr>
<td>STEMI diagnosis</td>
<td>The time at which the ECG of a patient with ischaemic symptoms is interpreted as presenting ST-segment elevation or equivalent.</td>
</tr>
</tbody>
</table>

**Ambiguous terms are eliminated:**

- "Door-to-balloon"
- "Door to door"

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**Total ischaemic time**

- **Patient delay**
- **EMS delay**
- **System delay**

**Term**

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<td>FMC: EMS &lt;10’</td>
<td>STEMI diagnosis</td>
</tr>
<tr>
<td>FMC: Non-PCI centre &lt;10’</td>
<td>STEMI diagnosis</td>
</tr>
<tr>
<td>FMC: PCI centre &lt;10’</td>
<td>STEMI diagnosis</td>
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</table>

**Primary PCI strategy**

- <60’ Reperfusion (Wire crossing)
Atypical ECG presentations

- Bundle branch block,
- Ventricular pacing,
- Hyper-acute T waves,
- Isolated depression in anterior leads,
- Universal ST depression with aVR elevation

In the presence of symptoms, a primary PCI strategy (urgent angiography and PCI if indicated) should be followed.

Left and right bundle branch block are considered equal for recommending urgent angiography if ischaemic symptoms.

- Total ischaemic time
  - Patient delay
  - System delay

- Time to PCI?
  - ≤120 min
    - Primary PCI strategy
    - Reperfusion (Wire crossing)
  - >120 min
    - Fibrinolysis strategy
    - Reperfusion (Lytic bolus)

- STEMI diagnosis
  - ≤60' Primary PCI strategy
    - Reperfusion (Wire crossing)
Reperfusion strategies in the infarct-related artery according to time from symptoms onset

Early phase of STEMI
- 0 hours: Primary PCI
- 3 hours: Primary PCI
- 12 hours: Primary PCI

Fibrinolysis (only if PCI cannot be performed within 120 min from STEMI diagnosis)
Reperfusion strategies in the infarct-related artery according to time from symptoms onset (continued)

Evolved STEMI

48 hours

Recent STEMI

12 hours

Primary PCI
(if symptoms, hemodynamic instability, or arrhythmias)

Primary PCI
(asymptomatic stable patients)

Routine PCI
(asymptomatic stable patients)

I C

Ila B

III A

## What is new in 2017 Guidelines on AMI-STEMI

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<td>EXAMINATION, COMFORTABLE-AMI, NORSTENT</td>
<td></td>
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<td>Complete Revascularization</td>
<td>PRAMI, DANAMI-3-PRIMULTI, CVLPRIT, Compare-Acute</td>
<td></td>
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<td>Thrombus Aspiration</td>
<td>TOTAL, TASTE</td>
<td></td>
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<tr>
<td>Bivalirudin</td>
<td>MATRIX, HEAT-PPCI</td>
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<td>ATOLL, Meta-analysis</td>
<td></td>
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<tr>
<td>Early Hospital Discharge</td>
<td>Small trials &amp; observational data</td>
<td></td>
</tr>
<tr>
<td>Oxygen when SaO2 &lt; 95%</td>
<td>OXYGEN</td>
<td>Oxygen when SaO2 &lt; 90%</td>
</tr>
<tr>
<td>Same dose i.V in all patients</td>
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<td>AVOID, DETO2X</td>
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<tr>
<td>TNK-tPA</td>
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<td>Half dose i.V. in Pts ≥ 75 years</td>
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</table>
What is new in 2017 Guidelines on AMI-STEMI

### Change in Recommendations

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Radial access</strong></td>
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<tr>
<td><strong>BMS</strong></td>
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<td><strong>Cardiac catheterization</strong></td>
<td><strong>PRAMI, DANAMI-3-PRIMULTI, CVLPRIT, Compare-Acute</strong></td>
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<td><strong>Thrombolysis</strong></td>
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<tr>
<td><strong>Oxygen</strong> when SaO2 &lt;90%</td>
<td><strong>Small trials &amp; observational data</strong></td>
</tr>
<tr>
<td><strong>Valgimigli et al. Lancet 2015;385:2465-76</strong></td>
<td><strong>TNK-tPA - Oxygen</strong></td>
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</tbody>
</table>

**A**

![Cumulative incidence (%)](image1)

**Number at risk**

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<thead>
<tr>
<th>Femoral access</th>
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</table>

**Rate ratio 0.85; 95% CI 0.74-0.99, p=0.0037**

**B**

![Cumulative incidence (%)](image2)

**Number at risk**

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<tbody>
<tr>
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<td>3709</td>
<td>3727</td>
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**Rate ratio 0.83; 95% CI 0.73-0.96, p=0.0052**

**15**
### What is new in 2017 Guidelines on AMI-STEMI

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**Sabate et al. Lancet 2012;380:1482-90**
What is new in 2017 Guidelines on AMI-STEMI

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<td><strong>Half dose i.V. in Pts ≥75 years</strong></td>
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**Graph:**
- **Engstrom et al, Lancet 2015**

![Graph](https://via.placeholder.com/150)
What is new in 2017 Guidelines on AMI-STEMI

### CHANGE IN RECOMMENDATIONS

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#### 2012

**Radial access**: Same dose i.V in all patients

**DES over BMS**: Half dose i.V in Pts ≥75 years

**Complete Revascularization**: STREAM, OXYGEN

**Thrombus Aspiration**: AVOID, DETOX, radial access

#### 2017

**Radial access**: MATRIX

**DES over BMS**: EXAMINATION, COMFORTABLE-AMI, NORSTENT

**Complete Revascularization**: PRAMI, DANAMI-3-PRIMULTI, CVLPRIT, Compare-Acute

**Thrombus Aspiration**: TOTAL, TASTE

---

**Graph A**: Cumulative Risk of Death from Any Cause (%)

**Graph A Primary Outcome**: Jolly et al, NEJM 2015

**Graph A**: Cumulative Hazard Rate

**Graph B**: No. at Risk

**Graph B**: Months of Follow-up

---

**Frobert et al, NEJM 2013**: Bivalirudin vs. enoxaparin

**Frobert et al, NEJM 2013**: Early Hospital Discharge

**Jolly et al, NEJM 2015**: FXa-therapy: TNK-tPA vs. Bivalirudin

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**2012 Guidelines**: Frobert et al, NEJM 2013

**2017 Guidelines**: Jolly et al, NEJM 2015
What is new in 2017 Guidelines on AMI-STEMI

**COMMENDATION**

- Radial access
- DES over BMS
- Complete revascularization
- Thrombus Aspiration
- Bivalirudin

**CHANGE IN RECOMMENDATIONS**

- **2012**
  - Same dose i.V in all patients
  - Half dose i.V. in Pts ≥75 years
- **2017**
  - Oxygen when SaO2 <95%
  - Oxygen when SaO2 <90%
  - AVOID, DETO2X
  - Radial access

**EXAMINATION, COMFORTABLE AMI, NORSTENT**

- **Bivalirudin**
  - MATRIX, HEAT-PPCI
- **Enoxaparin**
  - ATOLL, Meta-analysis
- **Early Hospital Discharge**
  - Small trials & observational data
- **OXYGEN**
  - Oxygen when SaO2 <90%
  - AVOID, DETO2X
- **TNK-tPA**
  - Half dose i.V. in Pts ≥75 years
  - STREAM

Valgimigli et al, NEJM 2015

Shazad et al, Lancet 2014
What is new in 2017 Guidelines on AMI-STEMI

**Change in Recommendations**

- **2012**
  - Same dose i.V in all patients
  - Oxygen when SaO2 < 95%
  - TNK-tPA

- **2017**
  - Half dose i.V. in Pts ≥75 years
  - STREAM

**Primary PCI for STEMI**

- **Death**
  - 34
  - 112/13550 ± 401/6653
  - 0.52 (0.42 to 0.64) < 0.001
  - 0.53

- **Complications of myocardial infarction**
  - 28
  - 139/13550 ± 499/6653
  - 0.56 (0.42 to 0.76) < 0.001
  - 0.50

- **Major bleeding**
  - 68
  - 96/3550 ± 275/6653
  - 0.76 (0.60 to 0.96) < 0.02
  - 0.80

- **Minor bleeding**
  - 53
  - 92/3499 ± 298/6553
  - 0.72 (0.56 to 0.93) < 0.01
  - 0.69

  - 138/3216 ± 177/4372
  - 0.94 (0.60 to 1.47) < 0.78
  - 0.56

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Silvain et al, BMJ 2012

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**Thrombus Aspiration**

**Bivalirudin**

**Enoxaparin**

**Early Hospital Discharge**

**Oxygen when SaO2 <95%**

**OXYGEN**

**TNK-tPA**

**Small trials & observational data**

**Avoid, Detox**

**EXAMINATION, COMFORTABLE-AMI, NORSTENT**

**PRAMI, DANAMI-3-PRIMULTI, CVLPRIT, Compare-Acute**

**MATRIX**

**HEAT-PPCI**

**ATOLL, Meta-analysis**

**TOTAL, TASTE**
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<td>Half dose i.V. in Pts ≥75 years STREAM</td>
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What is new in 2017 Guidelines on AMI-STEMI

**CHANGE IN RECOMMENDATIONS**

- **Access**
  - 2012: Same dose i.V in all patients
  - 2017: Half dose i.V. in Pts ≥75 years

- **Oxygen**
  - 2012: Oxygen when SaO2 <95%
  - 2017: Oxygen when SaO2 <90%

- **Avoid, Detox**
  - Radial access

- **Bivalirudin**
  - 2017: MATRIX, HEAT-PPCI

- **Enoxaparin**
  - 2017: ATOLL, Meta-analysis

- **Early Hospital Discharge**
  - 2017: Small trials & observational data

- **Oxygen**
  - 2017: Avoid, Detox

- **TNK-TPA**
  - 2017: Half dose i.V. in Pts ≥75 years

**Small trials & observational data**

**Matrix**

**Des over BMS**

**Complete Revascularization**

**Thrombus Aspiration**

**Bivalirudin**

**Enoxaparin**

**Early Hospital Discharge**

**Oxygen when SaO2 <95%**

**Oxygen when SaO2 <90%**

**Same dose i.V in all patients**

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**STREAM**

**PRAMI, DANAMI-3-PRIMULTI, CVLPRIT, Compare-Acute**

**TOTAL, TASTE**

**2017 ESC Guidelines for the Management of AMI-STEMI**

[Stubb et al, Circ 2015]

What is new in 2017 Guidelines on AMI-STEMI

2017 NEW RECOMMENDATIONS

- Additional lipid lowering therapy if LDL > 1.8 mmol/L (70 mg/dL) despite on maximum tolerated statins. **IMPROVE-IT, FOURIER**

- Cangrelor if P2Y$_{12}$ inhibitors have not been given. **CHAMPION**

- Switch to potent P2Y$_{12}$ inhibitors 48 hours after fibrinolysis. Expert opinion

- Extend Ticagrelor up to 36 months in high-risk patients. **PEGASUS-TIMI 54**

- Use of polypill to increase adherence. **FOCUS**

- Complete revascularization during index primary PCI in STEMI patients in shock. Expert opinion

- Routine use of deferred stenting. **DANAMI 3-DEFER**

---

What is new in 2017 Guidelines

2017 NEW RECOMMENDATIONS

• Additional lipid lowering therapy if LDL >1.8 mmol/L (70 mg/dL) despite on maximum tolerated statins.

  IMPROVE-IT, FOURIER

• Cangrelor if P2Y\textsubscript{12} inhibitors have not been given.

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• Use of polypill to increase adherence. FOCUS

• Complete revascularization during index primary PCI in shock.

  Expert opinion

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What is new in 2017 Guidelines on AMI-STEMI

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- Switch to potent P2Y\(_{12}\) inhibitors 48 hours after fibrinolysis. Expert opinion

- Extend Ticagrelor up to 36 months in high-risk patients. *PEGASUS-TIMI 54*

- Use of polypill to increase adherence. *FOCUS*

- Complete revascularization during index primary PCI in STEMI patients in shock. Expert opinion

- Routine use of deferred stenting. *DANAMI 3-DEFER*
“Do not forget” interventions in STEMI patients undergoing a primary PCI strategy
Diagnostic test flow chart in MINOCA

SUSPECTED STEMI
ACUTE INVESTIGATION

Coronary stenosis $\geq 50\%$
Urgent angiography
No Coronary stenosis $\geq 50\%$ + Fulfilment universal AMI criteria

Treat as STEMI
MINOCA

Acute LV wall motion assessment (angiogram/echo)
Διάρκεια 12 μήνες
(1/10/05 - 31/9/06)

n: 359 (άνδρες 82%)

Άφιξη από την έναρξη των συμπτωμάτων <3 h
Primary PCI
Athens area

Athens area

<table>
<thead>
<tr>
<th>Year</th>
<th>% pPCI</th>
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<tbody>
<tr>
<td>2009</td>
<td>31%</td>
</tr>
<tr>
<td>2010</td>
<td>42%</td>
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<tr>
<td>2011</td>
<td>59%</td>
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<tr>
<td>2015</td>
<td>70%</td>
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## STEMI pPCI patients

### Time Delays

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<th>2011</th>
<th>2012</th>
<th>2015</th>
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<tbody>
<tr>
<td><strong>Thrombolysis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptoms – FMC</td>
<td>136,91 min</td>
<td>125,5 min</td>
<td>136 min</td>
</tr>
<tr>
<td>FMC – needle</td>
<td></td>
<td>62,17 min</td>
<td>65,5 min</td>
</tr>
<tr>
<td></td>
<td>36 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>pPCI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptoms – FMC</td>
<td>142,41 min</td>
<td>131,26 min</td>
<td>125 min</td>
</tr>
<tr>
<td>FMC – PCI center</td>
<td>129,11 min</td>
<td>119,21 min</td>
<td>78 min</td>
</tr>
<tr>
<td>Door – Balloon</td>
<td>53,41 min</td>
<td>53,1 min</td>
<td>55 min</td>
</tr>
<tr>
<td>FMC – Balloon</td>
<td>182,52 min</td>
<td>172,31 min</td>
<td>133 min</td>
</tr>
</tbody>
</table>
ESC Pocket Guidelines App
Anytime - Anywhere

• All ESC Pocket Guidelines
• Over 140 interactive tools
  - Algorithms
  - Calculators
  - Charts & Scores
• Summary Cards & Essential Messages
• Online & Offline

Learn more on the Guidelines area
HELIOS 2005-6
Επαναιμάτωση σε STEMI

Lysis 50%
No Rx 41%
p PCI 9%
2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation
Ratio Total PCI/Primary PCI: 2007-2015
### Classes of recommendations

<table>
<thead>
<tr>
<th>Classes</th>
<th>Definition</th>
<th>Suggested wording</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>Evidence and/or general agreement that a given treatment or procedure is beneficial, useful, effective.</td>
<td>Recommended/is indicated.</td>
</tr>
<tr>
<td><strong>Class IIa</strong></td>
<td>Weight of evidence/opinion is in favour of usefulness/efficacy.</td>
<td>Should be considered.</td>
</tr>
<tr>
<td><strong>Class IIb</strong></td>
<td>Usefulness/efficacy is less well established by evidence/opinion.</td>
<td>May be considered.</td>
</tr>
<tr>
<td>Class III</td>
<td>Evidence or general agreement that the given treatment or procedure is not useful/effective, and in some cases may be harmful.</td>
<td>Not recommended.</td>
</tr>
</tbody>
</table>

**Diagram:**

- **159 recommendations**
- **Class I:** 92 (58%)
- **Class IIa:** 38 (24%)
- **Class IIb:** 16 (10%)
- **Class III:** 13 (8%)
2017 NEW / REVISED CONCEPTS

MINOCA AND QUALITY INDICATORS:
• New chapters dedicated to these topics.

STRATEGY SELECTION AND TIME DELAYS:
• Clear definition of first medical contact (FMC).
• Definition of “time 0” to choose reperfusion strategy (i.e. the strategy clock starts at the time of “STEMI diagnosis”).
• Selection of PCI over fibrinolysis: when anticipated delay from “STEMI diagnosis” to wire crossing is ≤120 min.
• Maximum delay time from “STEMI diagnosis” to bolus of fibrinolysis agent is set in 10 min.
• “Door-to-Balloon” term eliminated from guidelines.

TIME LIMITS FOR ROUTINE OPENING OF AN IRA:
• 0-12h (Class I); 12-48h (Class IIa); >48h (Class III).

ELECTROCARDIOGRAM AT PRESENTATION:
• Left and right bundle branch block considered equal for recommending urgent angiography if ischaemic symptoms.

TIME TO ANGIOGRAPHY AFTER FIBRINOLYSIS:
• Timeframe is set in 2-24h after successful fibrinolysis.

PATIENTS TAKING ANTICOAGULANTS:
• Acute and chronic management presented.
Modes of patient presentation, components of ischaemic time and flowchart for reperfusion strategy selection

Total ischaemic time

Patient delay → EMS delay → System delay

FMC: EMS

STEMI diagnosis

<10’

<10’

≤120 min

Primary PCI strategy

<90’

Reperfusion (Wire crossing)

FMC: Non-PCI centre

≤120 min

>120 min

Fibrinolysis strategy

<10’

Reperfusion (Lytic bolus)

FMC: PCI centre

<60’

Primary PCI strategy

<90’

Reperfusion (Wire crossing)

Time to PCI?

≥120 min

≤120 min

≥60’

Reperfusion (Wire crossing)

STEMI diagnosis

<60’

<90’

Primary PCI strategy

<60’

Reperfusion (Wire crossing)