# BMJ Open

# China PEACE risk estimation tool for in-hospital death from acute myocardial infarction: an early risk classification tree for decisions about fibrinolytic therapy

Xi Li,[1] Jing Li,[1] Frederick A Masoudi,[2] John A Spertus,[3] Zhenqiu Lin,[4] Harlan M Krumholz,[5] Lixin Jiang,[1] for the China PEACE Collaborative Group

For numbered affiliations see end of article.

**Correspondence to**
Professor Lixin Jiang; jiangl@fwoxford.org

## ABSTRACT

**Objectives:** As the predominant approach to acute reperfusion for ST segment elevation myocardial infarction (STEMI) in many countries, fibrinolytic therapy provides a relative risk reduction for death of ~16% across the range of baseline risk. For patients with low baseline mortality risk, fibrinolytic therapy may therefore provide little benefit, which may be offset by the risk of major bleeding. We aimed to construct a tool to determine if it is possible to identify a low-risk group among fibrinolytic therapy-eligible patients.

**Design:** Cross-sectional study.

**Setting:** The China Patient-centered Evaluative Assessment of Cardiac Events (PEACE) study includes a nationally representative retrospective sample of patients admitted with acute myocardial infarction (AMI) in 162 hospitals.

**Participants:** 3741 patients with STEMI who were fibrinolytic-eligible but did not receive reperfusion therapy.

**Main outcome measures:** In-hospital mortality, which was defined as a composite of death occurring within hospitalisation or withdrawal from treatment due to a terminal status at discharge.

**Results:** In the study cohort, the in-hospital mortality was 14.7%. In the derivation cohort and the validation cohort, the combination of systolic blood pressure (≥100 mm Hg), age (<60 years old) and gender (male) identified one-fifth of the cohort with an average mortality rate of <3.0%. Half of this low risk group—those with non-anterior AMI—had an average in-hospital death risk of 1.5%.

**Conclusions:** Nearly, one in five patients with STEMI who are eligible for fibrinolytic therapy are at a low risk for in-hospital death. Three simple factors available at the time of presentation can identify these individuals and support decision-making about the use of fibrinolytic therapy.

**Trial registration number:** NCT01624883.

### Strengths and limitations of this study

- We identified a fibrinolytic-eligible but untreated cohort with similar risk profiles as their treated counterparts, in a nationally representative sample of patients with acute myocardial infarction.
- We used the classification and regression tree to gain a more nuanced view of interactions while maintaining a simple algorithm in identifying the low risk group.
- The decision analysis involved only the short-term benefits; however, the entire benefit of fibrinolytic therapy was concentrated in short-term period.
- Patient eligibility and data collection on some predictors were based on local diagnosis in medical records.

## INTRODUCTION

Fibrinolytic therapy remains a mainstay of acute reperfusion for patients with ST segment elevation myocardial infarction (STEMI) in many countries and is the only treatment option in settings where primary percutaneous coronary intervention (PCI) is not available.[1–3] Based on landmark trials, fibrinolytic therapy in eligible patients confers about a 16% relative risk reduction in short-term mortality.[4] Clinical practice guidelines currently recommend the use of fibrinolytic therapy for all patients without contraindications who do not have timely access to primary PCI and present to the hospital within 12 hours of symptom onset,[5 6] consider the treatment is reasonable for patients with clinical and/or ECG evidence of ongoing ischaemia within 12–24 hours of symptom onset.[7 8]

# BMJ Open    China PEACE risk estimation tool for in-hospital death from acute myocardial infarction: an early risk classification tree for decisions about fibrinolytic therapy

Xi Li,[1] Jing Li,[1] Frederick A Masoudi,[2] John A Spertus,[3] Zhenqiu Lin,[4] Harlan M Krumholz,[5] Lixin Jiang,[1] for the China PEACE Collaborative Group

# China PEACE risk estimation tool for in-hospital death from acute myocardial infarction: an early risk classification tree for decisions about fibrinolytic therapy

Xi Li, Jing Li, Frederick A Masoudi, John A Spertus, Zhenqiu Lin, Harlan M Krumholz, Lixin Jiang for the China PEACE Collaborative Group

# Abstract

*Objectives:* As the predominant approach to acute reperfusion for ST segment elevation myocardial infarction (STEMI) in many countries, fibrinolytic therapy provides a relative risk reduction for death of ~16% across the range of baseline risk. For patients with low baseline mortality risk, fibrinolytic therapy may therefore provide little benefit, which may be offset by the risk of major bleeding. We aimed to construct a tool to determine if it is possible to identify a low-risk group among fibrinolytic therapy eligible patients.

*Design:* Cross-sectional study.

*Setting:* The China Patient-centered Evaluative Assessment of Cardiac Events (PEACE) study includes a nationally representative retrospective sample of patients admitted with acute myocardial infarction (AMI) in 162 hospitals.

*Participants:* 3741 patients with STEMI who were fibrinolytic-eligible but did not receive reperfusion therapy.

*Main outcome measures:* In-hospital mortality, which was defined as a composite of death occurring within hospitalization or withdrawal from treatment due to a terminal status at discharge.

*Results:* In the study cohort, the in-hospital mortality was 14.7%. In the derivation cohort and the validation cohort, the combination of systolic blood pressure (≥100 mm Hg), age (<60 years old) and gender (male) identified one-fifth of the cohort with an average mortality rate of <3.0%. Half of this low risk group—those with non-anterior AMI—had an average in-hospital death risk of 1.5%.

*Conclusions:* Nearly, one in five patients with STEMI who are eligible for fibrinolytic therapy are at a low risk for in-hospital death. Three simple factors available at the time of presentation can identify these individuals and support decision-making about the use of fibrinolytic therapy.
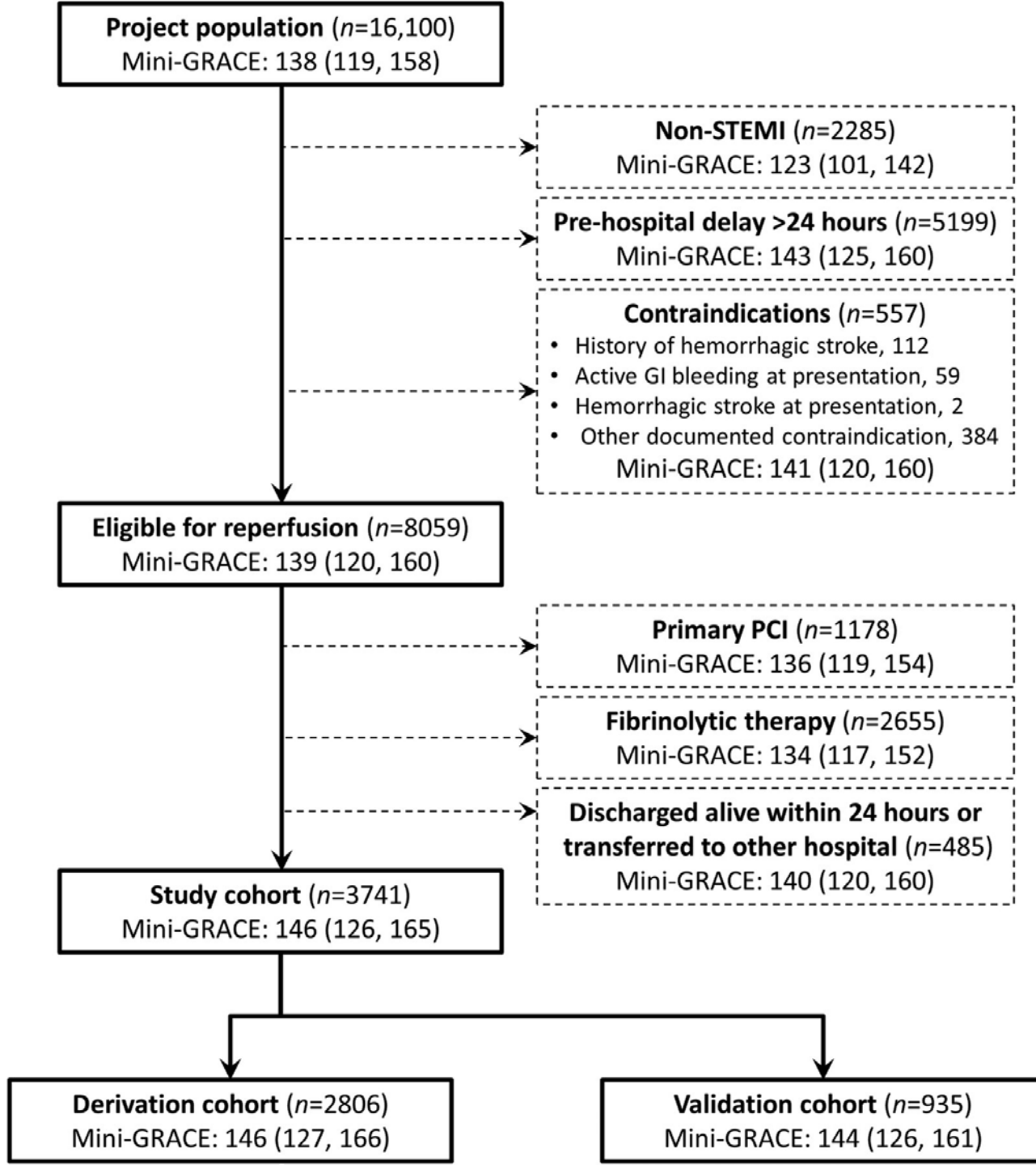
**Figure 1.** Flow chart: cohort for tool development and validation.

To develop and validate the risk tool, we identified fibrinolytic-eligible patients, who had not received any reperfusion therapy. Eligibility was defined as patients with STEMI who arrived to the hospital within 24 hours of symptom onset and did not have contraindications to fibrinolytic therapy, including history of haemorrhagic stroke, active bleeding at presentation or any other physician-documented contraindication. We excluded the patients who were discharged alive within 24 hours or transferred to other hospitals. The mini-GRACE indicates the median and IQR of mini-GRACE risk score in each patients subgroup; GRACE, Global Registry of Acute Coronary Events; PCI, percutaneous coronary intervention; STEMI, ST segment elevation myocardial infarction.
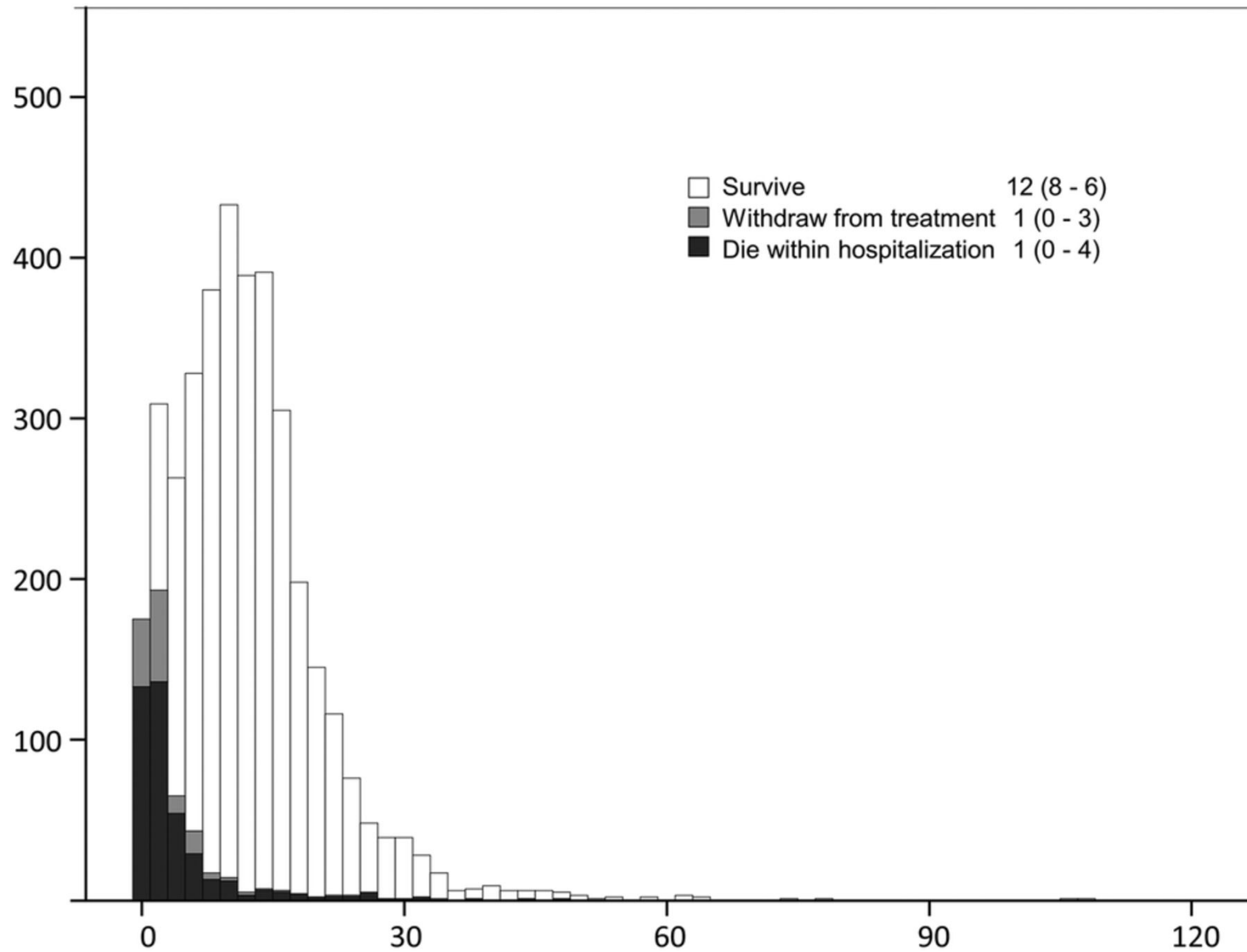
**Figure 2.** Length of stay (day) in patients with different outcomes.
In a histogram, number of patients with different outcomes (vary in colors) were stacked within each 2-day interval of the length of stay. For patients died within hospitalization, the length of stay was similar with those who withdrew from treatment due to a clinical terminal status, and much less than those survived.
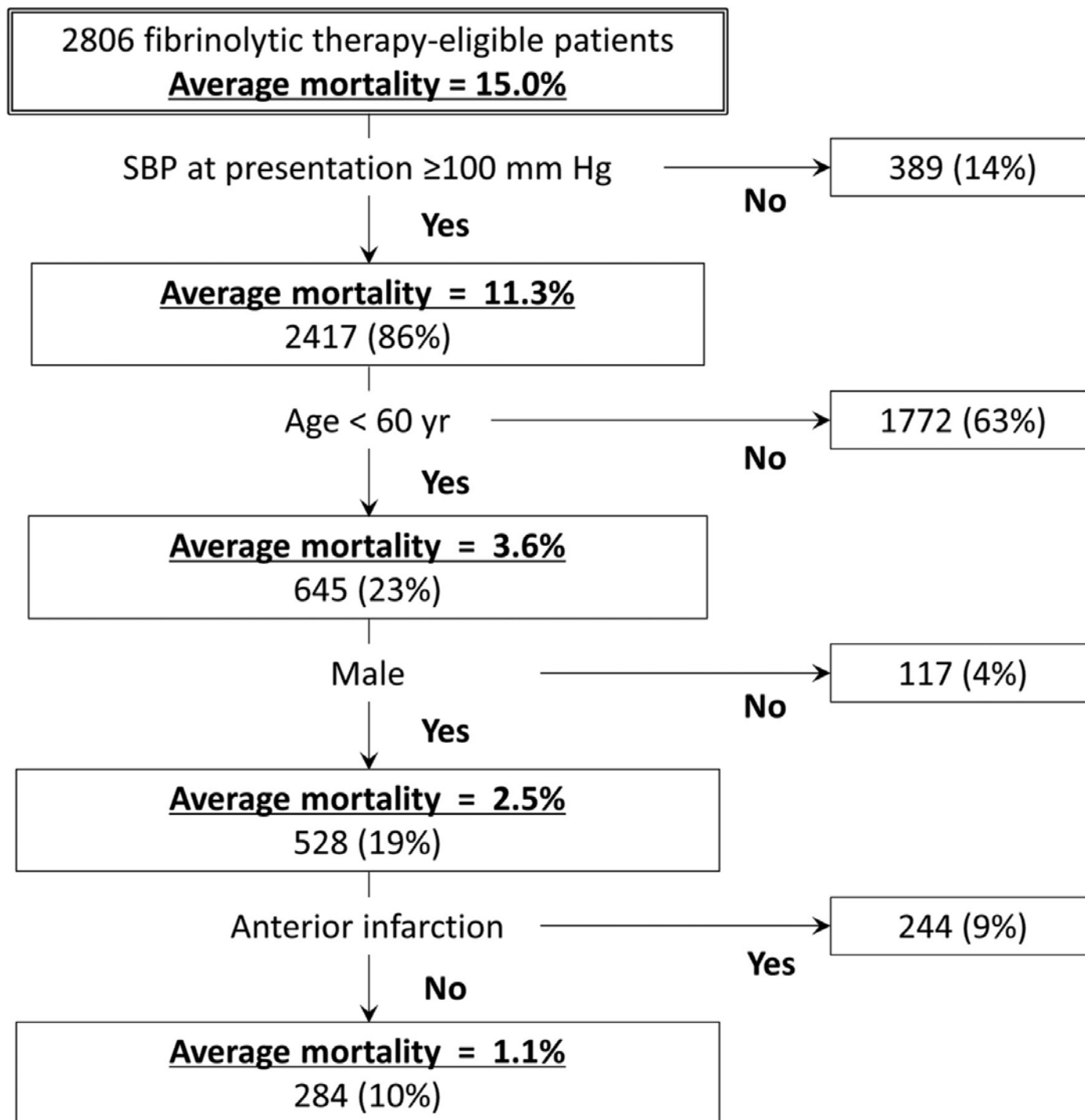
**Figure 3.** The classification tree for decision-making in the derivation cohort.

To identify the subgroup with lower risk of in-hospital mortality in the classification and regression tree (CART) analysis, systolic blood pressure (≥100 mm Hg), age (<60 years old), gender (male) and infarct location (non-anterior) was the best independent discriminator step by step. This flow chart demonstrates the size (proportion of the derivation cohort) and average risk in the lower-risk group at each step. SBP, systolic blood pressure; STEMI, ST segment elevation myocardial infarction.
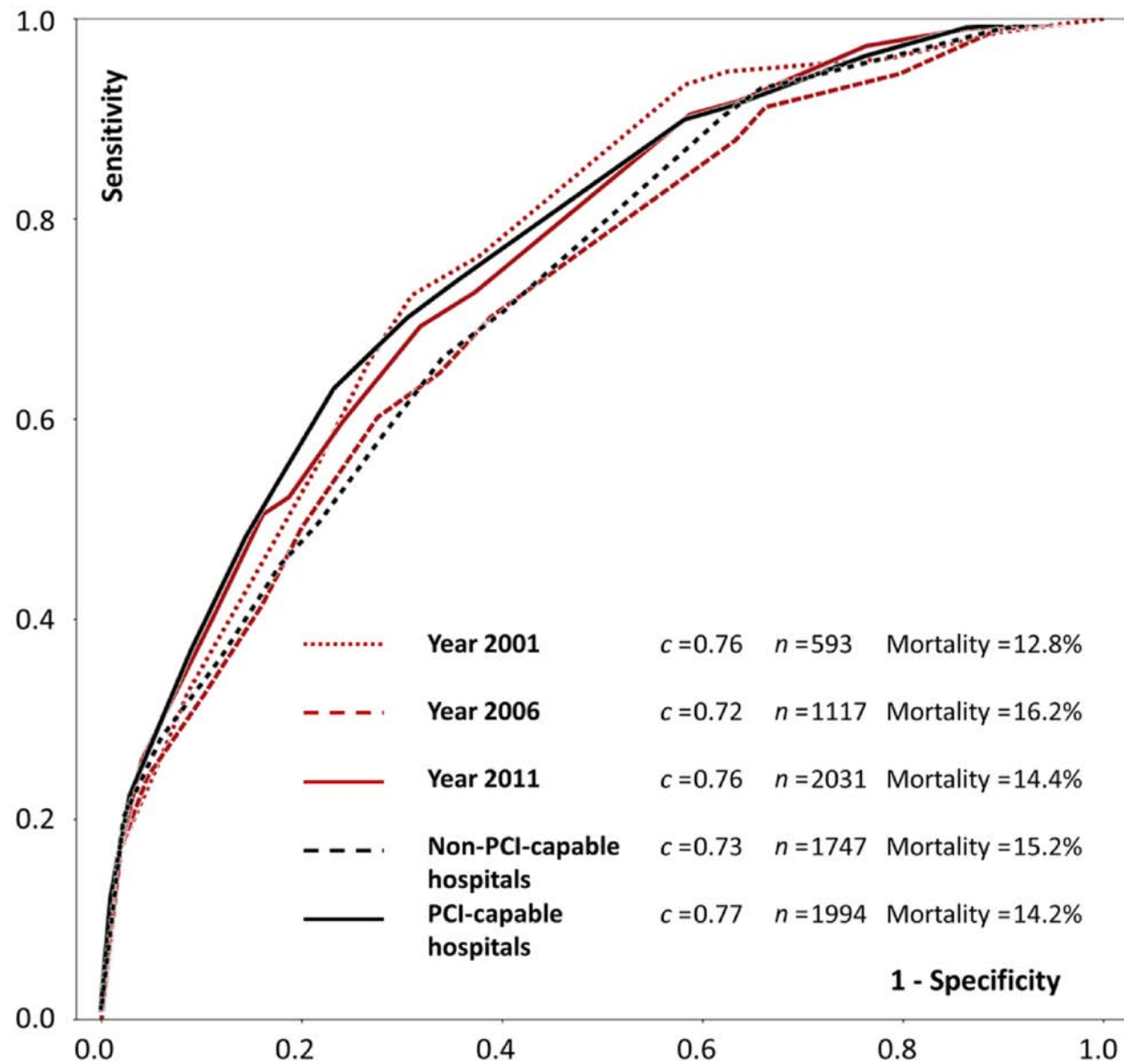
**Figure 4.** Validation of classification tree in different subgroups: the receiver-operating characteristic curve and the c-statistics. PCI, percutaneous coronary intervention.

# Conclusion

- The current study and tools helped identify a substantial subgroup of eligible patients, among whom the net benefit of fibrinolytic therapy is likely marginal, considering major bleeding complications and other realistic factors.

- A quantitative estimation of the potential risks and benefits may facilitate more informed, individualized decision-making, which reminded us to consider baseline risk as an important criterion in the balancing.

- As fibrinolytic therapy is the dominant reperfusion strategy in developing countries, its use needs to be conducted in a careful and personalized way, in order to achieve its maximum capacity in saving lives.