ST-segment elevation myocardial infarction in China from 2001 to 2011 (the China PEACE-Retrospective Acute Myocardial Infarction Study): a retrospective analysis of hospital data

Jing Li, Xi Li, Qing Wang, Shuang Hu, Yongfei Wang, Frederick A Masoudi, John A Spertus, Harlan M Krumholz, Lixin Jiang*, for the China PEACE Collaborative Group†*

Summary

Background Despite the importance of ST-segment elevation myocardial infarction (STEMI) in China, no nationally representative studies have characterised the clinical profiles, management, and outcomes of this cardiac event during the past decade. We aimed to assess trends in characteristics, treatment, and outcomes for patients with STEMI in China between 2001 and 2011.

Methods In a retrospective analysis of hospital records, we used a two-stage random sampling design to create a nationally representative sample of patients in China admitted to hospital for STEMI in 3 years (2001, 2006, and 2011). In the first stage, we used a simple random-sampling procedure stratified by economic–geographical region to generate a list of participating hospitals. In the second stage we obtained case data for rates of STEMI, treatments, and baseline characteristics from patients attending each sampled hospital with a systematic sampling approach. We weighted our findings to estimate nationally representative rates and assess changes from 2001 to 2011. This study is registered with ClinicalTrials.gov, number NCT01624883.

Findings We sampled 175 hospitals (162 participated in the study) and 18 631 acute myocardial infarction admissions, of which 13 815 were STEMI admissions. 12 264 patients were included in analysis of treatments, procedures, and tests, and 11 986 were included in analysis of in-hospital outcomes. Between 2001 and 2011, estimated national rates of hospital admission for STEMI per 100 000 people increased (from 3·5 in 2001, to 7·9 in 2006, to 15·4 in 2011; $p_{trend}<0·0001$) and the prevalence of risk factors—including smoking, hypertension, diabetes, and dyslipidaemia—increased. We noted significant increases in use of aspirin within 24 h (79·7% [95% CI 77·9–81·5] in 2001 *vs* 91·2% [90·5–91·8] in 2011, $p_{trend}<0·0001$) and clopidogrel (1·5% [95% CI 1·0–2·1] in 2001 *vs* 82·1% [81·1–83·0] in 2011, $p_{trend}<0·0001$) in patients without documented contraindications. Despite an increase in the use of primary percutaneous coronary intervention (10·6% [95% CI 8·6–12·6] in 2001 *vs* 28·1% [26·6–29·7] in 2011, $p_{trend}<0·0001$), the proportion of patients who did not receive reperfusion did not significantly change (45·3% [95% CI 42·1–48·5] in 2001 *vs* 44·8% [43·1–46·5] in 2011, $p_{trend}=0·69$). The median length of hospital stay decreased from 12 days (IQR 7–18) in 2001 to 10 days (6–14) in 2011 ($p_{trend}<0·0001$). Adjusted in-hospital mortality did not significantly change between 2001 and 2011 (odds ratio 0·82, 95% CI 0·62–1·10, $p_{trend}=0·07$).

Interpretation During the past decade in China, hospital admissions for STEMI have risen; in these patients, comorbidities and the intensity of testing and treatment have increased. Quality of care has improved for some treatments, but important gaps persist and in-hospital mortality has not decreased. National efforts are needed to improve the care and outcomes for patients with STEMI in China.

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A previous version of this Article has been retracted. For changes made see appendix 1.

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See Online for appendices

Introduction

As China has grown economically, it has experienced an epidemiological transition, with mortality due to ischaemic heart disease more than doubling during the past two decades to more than 1 million deaths per year.[1,2] This trend is expected to accelerate, with the World Bank estimating that the number of individuals with myocardial infarction in China will increase to 23 million by 2030.[3] Concurrent with this changing epidemiology, the Chinese medical care system has developed rapidly, implementing policies that have improved access by reducing financial barriers and increasing the numbers of hospitals and physicians.[4,5]

Despite the importance of acute myocardial infarction in China—particularly ST-segment elevation myocardial infarction (STEMI), which accounts for more than 80% of such events in the country[6,7]—no nationally representative studies have defined the clinical profiles, management, and outcomes of patients with this disorder during the past decade. The scarcity of contemporary national estimates and data for changes in burden of disease, quality of care (including use of recommended treatments

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Interpretation- During the past decade in China, hospital admissions for STEMI have risen; in these patients,
comorbidities and the intensity of testing and treatment have increased. Quality of care has improved for some treatments, but important gaps persist and in-hospital mortality has not decreased. National eff orts are needed to improve the care and outcomes for patients with STEMI in China.

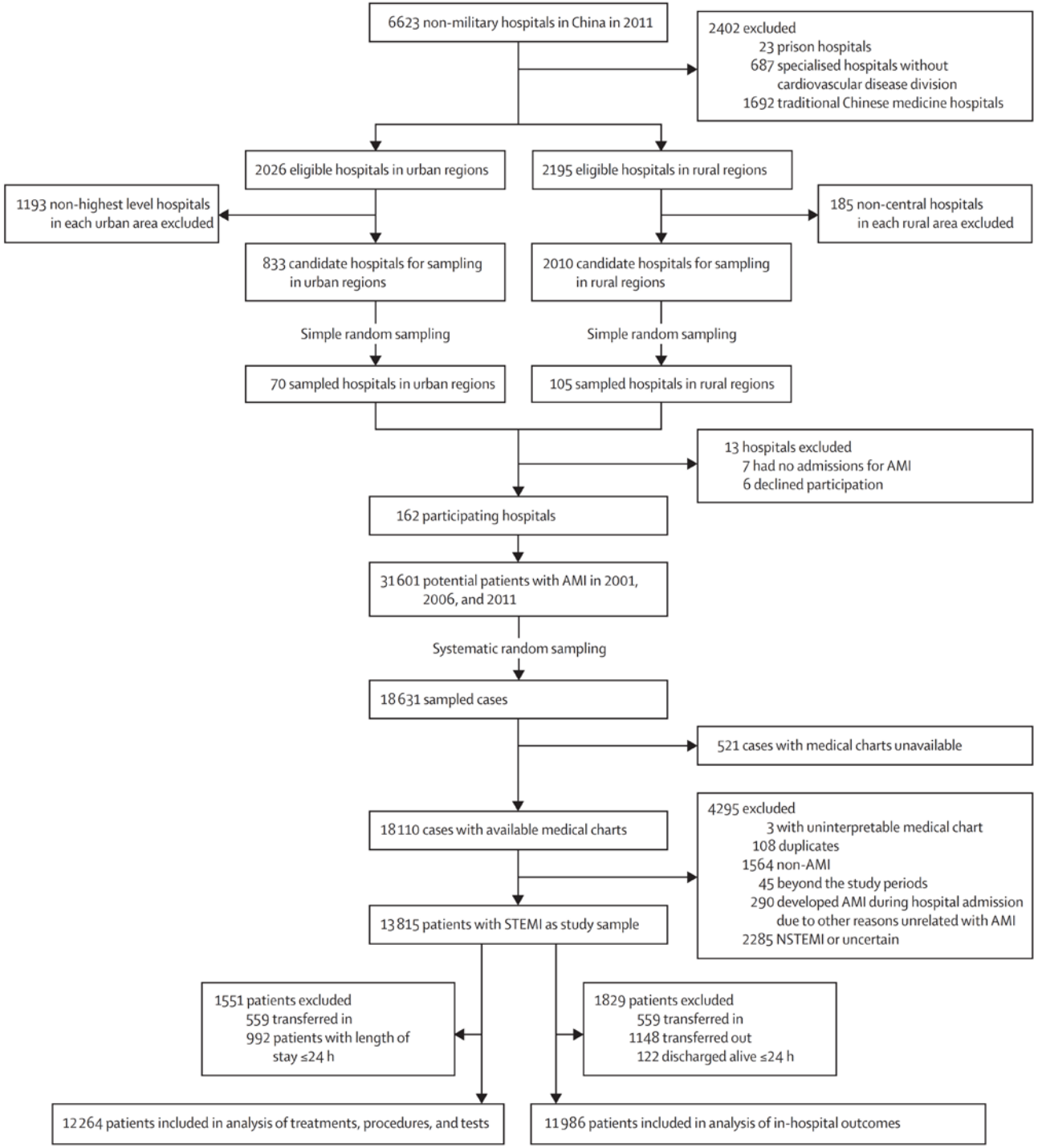

Figure 1: Study profile

AMI=acute myocardial infarction. STEMI= ST-segment elevation myocardial infarction. NSTEMI= non-ST-segment elevation myocardial infarction.

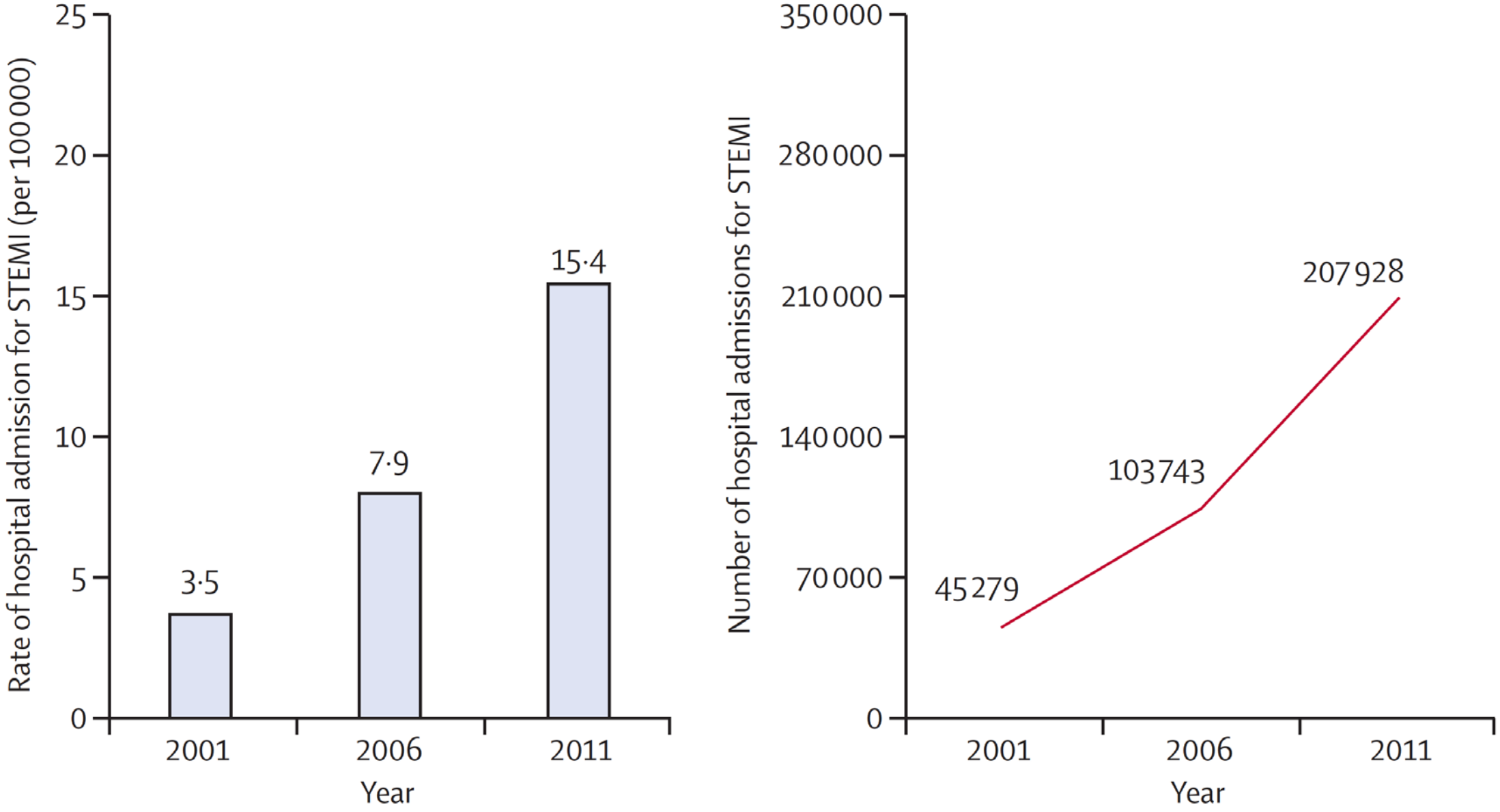

Figure 2: Hospital admissions for STEMI in China

STEMI=ST-segment elevation myocardial infarction.

Table 1: Characteristics of patients with STEMI in 2001, 2006, and 2011

	2001 (n=2127)	2006 (n=3992)	2011 (n=7696)	p_{trend}
Demographic				
Age (years)	65 (56–72)	66 (55–74)	65 (55–74)	0·14
Women	614 (28·9% [27·0–30·8])	1137 (28·7% [27·3–30·1])	2247 (29·5% [28·4–30·5])	0·47
Cardiovascular risk factors				
Hypertension	866 (41·5% [39·4–43·6])	1894 (49·3% [47·8–50·9])	3890 (51·7% [50·6–52·8])	<0·0001
Diabetes	296 (13·9% [12·4–15·4])	747 (20·2% [19·0–21·5])	1558 (21·2% [20·3–22·1])	<0·0001
Dyslipidaemia	908 (42·7% [40·6–44·8])	2101 (54·1% [52·6–55·7])	4843 (64·6% [63·5–65·6])	<0·0001
Current smoker	629 (30·4% [28·5–32·4])	1306 (35·1% [33·6–36·5])	2854 (39·5% [38·4–40·6])	<0·0001
Number of risk factors				
≥3	214 (10·4% [9·1–11·7])	658 (18·8% [17·5–20·0])	1612 (22·8% [21·9–23·8])	<0·0001
2	609 (29·1% [27·2–31·0])	1308 (33·5% [32·1–35·0])	2878 (38·3% [37·2–39·3])	<0·0001
1	822 (38·5% [36·4–40·5])	1390 (33·4% [31·9–34·8])	2357 (29·3% [28·3–30·3])	<0·0001
None	482 (22·1% [20·3–23·8])	636 (14·3% [13·3–15·4])	849 (9·7% [9·0–10·3])	<0·0001
Medical history				
Myocardial infarction	218 (10·3% [9·0–11·6])	374 (10·0% [9·1–11·0])	814 (11·2% [10·5–11·9])	0·10
Coronary heart disease	503 (23·7% [21·9–25·5])	790 (20·4% [19·2–21·7])	1568 (20·7% [19·8–21·6])	0·020
Percutaneous coronary intervention	14 (0·8% [0·4–1·2])	40 (1·2% [0·8–1·5])	180 (2·7% [2·3–3·0])	<0·0001
Coronary artery bypass graft	10 (0·6% [0·3–0·9])	9 (0·3% [0·2–0·5])	21 (0·2% [0·1–0·3])	0·012
Stroke	198 (9·5% [8·3–10·8])	421 (11·2% [10·2–12·2])	897 (12·1% [11·4–12·9])	0·0008

	2001 (n=2127)	2006 (n=3992)	2011 (n=7696)	p_{trend}
Clinical characteristic				
Symptom onset to admission (h)	15 (3–72)	15 (3–72)	13 (4–72)	0·22
Chest discomfort	1970 (93·1% [92·0–94·2])	3680 (92·7% [91·9–93·5])	7118 (93·0% [92·4–93·6])	0·95
Left bundle branch block	31 (1·5% [1·0–2·0])	74 (1·7% [1·3–2·1])	97 (1·1% [0·9–1·4])	0·043
Cardiac arrest	21 (0·9% [0·5–1·3])	49 (1·5% [1·1–1·9])	125 (1·7% [1·4–2·0])	0·0075
Cardiogenic shock	94 (4·6% [3·7–5·4])	245 (5·9% [5·2–6·6])	508 (6·2% [5·7–6·7])	0·0085
Acute stroke	18 (0·8% [0·4–1·2])	69 (1·7% [1·3–2·1])	83 (0·9% [0·7–1·1])	0·31
Heart rate (beats per min)				
<50	109 (5·2% [4·2–6·1])	221 (5·2% [4·5–5·9])	384 (4·9% [4·4–5·4])	0·53
50–110	1888 (88·7% [87·3–90·0])	3494 (87·9% [86·9–88·9])	6917 (90·2% [89·6–90·9])	0·0021
>110	130 (6·1% [5·1–7·2])	277 (6·9% [6·1–7·7])	395 (4·9% [4·4–5·4])	0·0004
Heart rate (beats per min)	78 (67–90)	78 (66–90)	76 (65–89)	<0·0001
Systolic blood pressure (mm Hg)				
<90	154 (7·1% [6·0–8·2])	264 (6·2% [5·4–6·9])	408 (4·7% [4·2–5·2])	<0·0001
90–139	1281 (60·0% [57·9–62·1])	2399 (60·5% [59·0–62·0])	4658 (60·8% [59·7–61·9])	0·47
≥140	692 (33·0% [31·0–34·9])	1329 (33·3% [31·8–34·8])	2630 (34·5% [33·4–35·5])	0·12
Systolic blood pressure (mm Hg)	125 (109–143)	125 (110–143)	128 (110–145)	<0·0001
Estimated glomerular filtration rate (mL/min per 1·73 m²)*				
<30	67 (5·3% [4·0–6·5])	140 (4·3% [3·6–5·0])	232 (3·2% [2·8–3·7])	<0·0001
30–59	317 (24·6% [22·2–26·9])	756 (22·1% [20·6–23·5])	1263 (16·8% [15·9–17·7])	<0·0001
≥60	910 (70·2% [67·7–72·7])	2300 (73·7% [72·1–75·2])	5583 (80·0% [79·0–80·9])	<0·0001
Estimated glomerular filtration rate (mL/min per 1·73 m²)*	72 (56–91)	75 (58–96)	86 (66–107)	<0·0001
Troponin concentration (multiple of upper limit of normal)*	18 (2–89)	24 (6–106)	32 (6–202)	<0·0001
Haematocrit (proportion of 1·0)*	0·39 (0·35–0·43)	0·39 (0·36–0·43)	0·40 (0·37–0·44)	<0·0001
Ejection fraction ≤0·40*	72 (17·6% [14·0–21·2])	284 (17·7% [15·7–19·6])	568 (12·6% [11·6–13·5])	<0·0001
Mini-GRACE risk score*	139 (120–158)	142 (123–160)	140 (120–160)	0·42
Transfer status				
Transferred in	37 (1·7% [1·1–2·2])	103 (3·1% [2·6–3·7])	419 (7·1% [6·5–7·7])	<0·0001
Transferred out	144 (6·7% [5·7–7·8])	275 (7·0% [6·2–7·8])	752 (8·3% [7·7–8·9])	0·0028

GRACE=Global Registry of Acute Coronary Events. Data are median (IQR) or n (weighted % [95% CI]), for which n is the number of patients in the study sample and weighted % is a nationally representative rate. STEMI=ST-segment elevation myocardial infarction. *Among patients with measurements available.

Table 1: Continued

Table 2: Use of treatments, procedures, and tests among patients with STEMI

	2001 (n=1995)		2006 (n=3626)		2011 (n=6643)		p_{trend}
	Relative frequency	Weighted %	Relative frequency	Weighted %	Relative frequency	Weighted %	
Reperfusion therapies*							
No reperfusion	425/917	45·3% (42·1–48·5)	786/1689	45·5% (43·1–47·9)	1509/3278	44·8% (43·1–46·5)	0·69
Primary PCI	74/917	10·6% (8·6–12·6)	218/1689	17·4% (15·6–19·2)	691/3278	28·1% (26·6–29·7)	<0·0001
Fibrinolytic therapy	418/917	44·1% (40·8–47·3)	685/1689	37·1% (34·8–39·4)	1078/3278	27·0% (25·5–28·6)	<0·0001
Acute drugs							
Aspirin within 24 h*	1559/1953	79·7% (77·9–81·5)	3089/3545	86·8% (85·7–87·9)	5904/6490	91·2% (90·5–91·8)	<0·0001
Clopidogrel within 24 h*	24/1832	1·5% (1·0–2·1)	1490/3551	47·4% (45·7–49·0)	5069/6498	82·1% (81·1–83·0)	<0·0001
β blockers within 24 h*	422/840	51·3% (47·9–54·7)	1037/1624	63·7% (61·4–66·0)	1846/3106	57·3% (55·6–59·0)	0·58
Statins*†	573/1995	30·2% (28·2–32·2)	2675/3626	75·9% (74·5–77·3)	6045/6642	92·5% (91·9–93·1)	<0·0001
ACE inhibitors or angiotensin receptor blockers*†	1177/1932	61·7% (59·5–63·8)	2429/3513	70·7% (69·2–72·2)	4224/6440	66·4% (65·2–67·5)	0·26
Traditional Chinese medicine within 24 h	903/1995	43·6% (41·5–45·8)	2003/3626	49·7% (48·1–51·3)	4200/6643	57·4% (56·2–58·6)	<0·0001
Traditional Chinese medicine†	1181/1995	57·2% (55·0–59·4)	2420/3626	61·9% (60·4–63·5)	4827/6643	68·8% (67·7–69·9)	<0·0001
Magnesium sulfate†	656/1995	33·1% (31·0–35·1)	719/3626	18·6% (17·4–19·9)	1159/6643	16·1% (15·2–17·0)	<0·0001
Procedures†							
Cardiac catheterisation	209/1995	12·7% (11·3–14·2)	736/3626	25·8% (24·3–27·2)	2204/6643	41·9% (40·7–43·1)	<0·0001
PCI (non-primary)	60/1995	3·4% (2·6–4·2)	368/3626	12·3% (11·2–13·4)	1077/6643	20·3% (19·4–21·3)	<0·0001
Coronary artery bypass graft	14/1995	1·1% (0·6–1·5)	21/3626	0·9% (0·6–1·3)	30/6643	0·6% (0·4–0·8)	0·019
Intra-aortic balloon pump	8/1995	0·5% (0·2–0·8)	32/3626	1·0% (0·7–1·3)	137/6643	2·5% (2·1–2·9)	<0·0001
Stents†‡							
Drug-eluting stents only	37/89	39·7% (29·6–49·9)	354/442	80·7% (77·1–84·4)	1306/1329	98·6% (98·0–99·3)	<0·0001
Bare-metal stents only	44/89	50·0% (39·6–60·4)	71/442	15·5% (12·1–18·9)	23/1329	1·4% (0·7–2·0)	<0·0001
Both	8/89	10·3% (4·0–16·6)	17/442	3·8% (2·0–5·6)	0/1329	0	<0·0001
Tests†							
Troponin	385/1995	22·3% (20·5–24·1)	1560/3626	46·9% (45·3–48·5)	4195/6643	68·6% (67·5–69·7)	<0·0001
Cardiac enzymes	1732/1995	87·3% (85·9–88·8)	3344/3626	93·1% (92·3–93·9)	6443/6643	97·2% (96·8–97·6)	<0·0001
Creatinine	1241/1995	63·8% (61·7–65·9)	2981/3626	84·7% (83·5–85·9)	6253/6643	94·9% (94·4–95·5)	<0·0001
Echocardiogram	572/1995	30·1% (28·1–32·1)	1581/3626	47·6% (46·0–49·2)	4191/6643	67·7% (66·6–68·8)	<0·0001

PCI=percutaneous coronary intervention. ACE=angiotensin-converting enzyme. STEMI=ST-segment elevation myocardial infarction. Data are n/N or weighted % (95% CI), for which n is the number of patients in the study sample and weighted % is a nationally representative rate, unless otherwise stated. *Only among ideal patients for the treatment (ie, patients with no documented contraindications). †During hospital admission. ‡Among patients who received at least one stent.

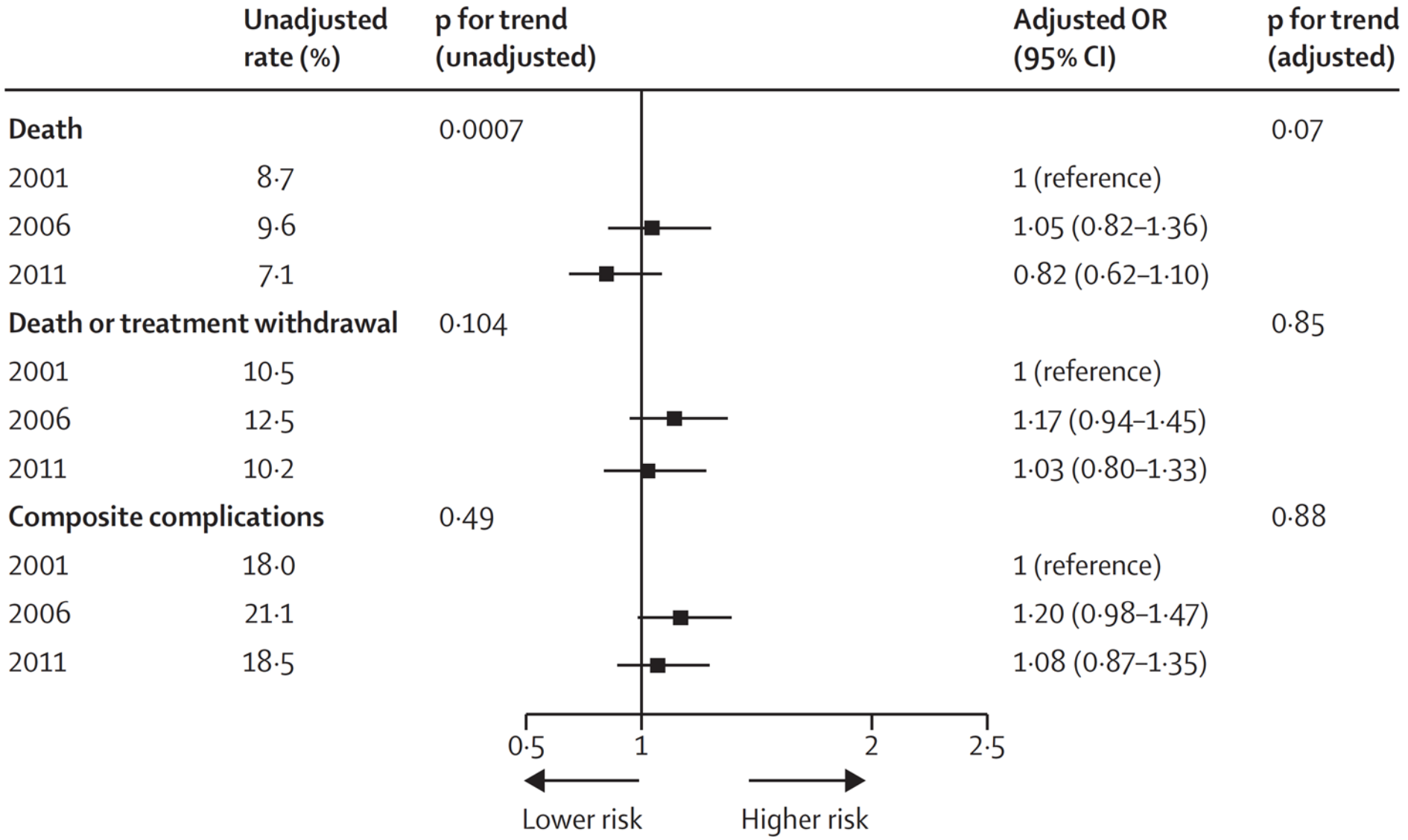

Figure 3: Adjusted in-hospital outcomes for patients with STEMI

Adjusted odds ratio of 1 shows no difference from year 2001. We included 11 986 patients (1933 in 2001, 3581 in 2006, and 6472 in 2011); 559 patients transferred in from other facilities, 1148 patients transferred out, and 122 patients discharged alive within 24 h were excluded. C=0.76 for mortality, C=0.78 for death or treatment withdrawal, and C=0.68 for composite complications. STEMI=ST-segment elevation myocardial infarction.

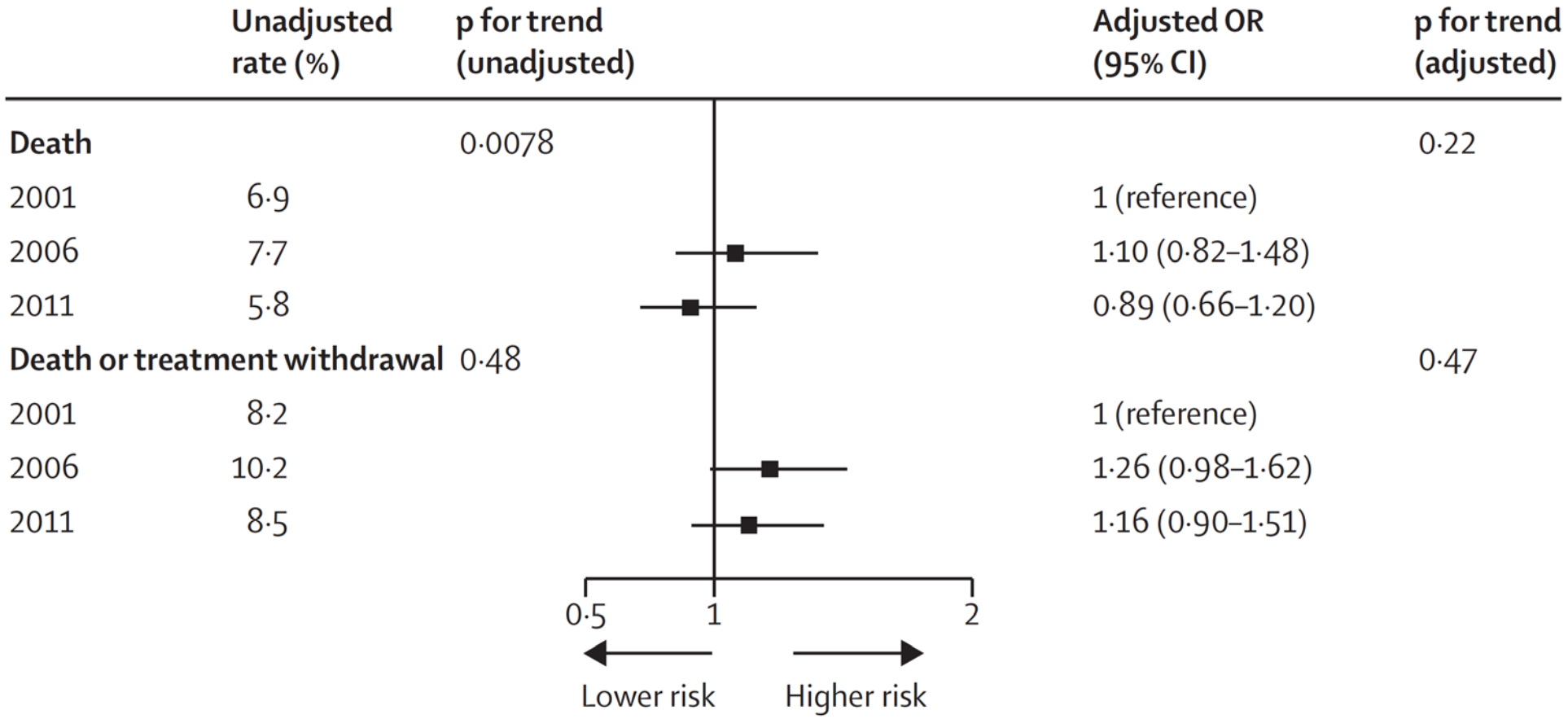

Figure 4: Adjusted 7-day outcomes among patients with STEMI

Adjusted odds ratio of 1 shows no difference from year 2001. We included 12 421 patients (2010 in 2001, 3696 in 2006, and 6715 in 2011); 559 patients transferred in from other facilities, 713 patients transferred out within 7 days, and 122 patients discharged alive within 24 h were excluded. C=0.76 for mortality and C=0.79 for death or treatment withdrawal. STEMI=ST-segment elevation myocardial infarction.

Conclusion

- Our study showed that, among patients admitted to hospital with STEMI, persistent gaps are present between practice and recommended care and outcomes have not significantly improved during the past decade.
- Although China has launched health-care reform and recently doubled annual expenditures for health care to improve access, challenges exist in optimization of the use of scarce resources to provide the highest-quality care.
- Our findings provide evidence for policy makers and health professionals in China and other countries with a rapidly growing burden of STEMI to inform future strategies for medical resource allocation, system improvement, and disease management.