ORIGINAL RESEARCH

National Quality Assessment Evaluating Spironolactone Use During Hospitalization for Acute Myocardial Infarction (AMI) in China: China Patient-centered Evaluation Assessment of Cardiac Events (PEACE)-Retrospective AMI Study, 2001, 2006, and 2011

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***Background*—**Spironolactone, the only aldosterone antagonist available in China, improves outcomes in acute myocardial infarction (AMI) among patients with systolic dysfunction and either diabetes or heart failure (HF). However, national practice patterns in the use of spironolactone in China are unknown.

***Methods and Results*—**From a nationally representative sample of AMI patients from in 2001, 2006, and 2011, we identified 6906 patients with either diabetes or HF and classified them into 1 of 4 groups according to their eligibility for spironolactone —"ideal"(left ventricular ejection fraction [LVEF] ≤40% and without contraindications), "contraindicated," "not indicated" (neither ideal nor contraindicated), and "unknown indications" (LVEF unmeasured)—to determine how frequently patient eligibility for this drug is assessed in the hospital, how it is used in several groups, and to identify factors associated with the use in these groups. From 2001 to 2011, the proportion of patients whose eligibility for spironolactone was not assessed decreased (66.9% in 2001 to 32.8% in 2011). Spironolactone use significantly increased among ideal patients over this period (28.6% to 72.4%; $P<0.001$ for trend), but also in contraindicated patients (11.4% to 27.5%; $P=0.002$ for trend) and in other patients groups (not indicated: 27.5% to 38.3%; unknown indications: 21.3% to 35.1%; both $P<0.01$ for trend). In all 4 groups, patients presenting with HF on admission were more likely to receive spironolactone.

***Conclusions*—**Although the appropriate use of spironolactone and assessment of eligibility increased in China over the past decade, there remains marked opportunities for improvement.

***Clinical Trial Registration*—**URL: http://www.clinicaltrials.gov Unique identifier: NCT01624883. **(*J Am Heart Assoc*. 2015; 4: e001718 doi: 10.1161/JAHA.114.001718)**

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Abstract

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Table. Bivariate Analysis of Characteristics Associated With Spironolactone Therapy Among Ideal Patients

Characteristics	No. of Patients With Characteristic	% of Receiving Spironolactone	*P* Value
All ideal patients	637	66.4	
Demographics			
Age, y			
<65	216	55.1	<0.0001
≥65	421	72.2	
Gender			
Male	431	64.5	0.141
Female	206	70.4	
Cardiovascular risk factors			
Hypertension			
No	265	61.1	0.017
Yes	372	70.2	
Diabetes			
No	388	67.5	0.455
Yes	249	64.7	
Current smoking			
No	438	69.2	0.028
Yes	199	60.3	

Table. Continued

Characteristics	No. of Patients With Characteristic	% of Receiving Spironolactone	*P* Value
Medical history			
Myocardial infarction			
No	510	66.1	0.727
Yes	127	67.7	
Clinical characteristics at admission			
Cardiogenic shock			
No	600	66.5	0.838
Yes	37	64.9	
Heart failure			
No	201	52.2	<0.0001
Yes	436	72.9	
AMI type			
STEMI	530	64.5	0.026
NSTEMI/ uncertain	107	75.7	
SBP, mm Hg			
<90	20	75	0.464
90 to 139	410	64.9	
≥140	207	68.6	
Heart rate, beats/min			
<60	38	60.5	0.003

Table. Continued

Characteristics	No. of Patients With Characteristic	% of Receiving Spironolactone	*P* Value
60 to 90	327	60.9	
>90	272	73.9	
eGFR, mL/min per 1.73 m^2			
<60	169	63.3	<0.0001
60 to 89	207	63.8	
≥90	131	56.5	
Unmeasured	130	84.6	
Treatment			
ACE inhibitor/ ARB use			
No	161	59.0	0.021
Yes	476	68.9	
Beta-blocker use			
No	179	71.0	0.129
Yes	458	64.6	
ACE inhibitor/ARB+ beta-blocker			
No	270	67.0	0.772
Yes	367	65.9	

Table. Continued

Characteristics	No. of Patients With Characteristic	% of Receiving Spironolactone	*P* Value
Hospital level			
Teaching hospital			
No	86	58.1	0.081
Yes	551	67.7	
PCI-capable hospital			
No	153	51.6	<0.0001
Yes	484	71.1	
Economic-geographical region			
Eastern	391	67.3	0.532
Central	136	67.6	
Western	110	61.8	
Urban/rural			
Urban	180	61.7	0.112
Rural	457	68.3	
Year			
2001	38	31.6	<0.0001
2006	174	66.7	
2011	425	69.4	

ACE inhibitor indicates angiotensin-converting enzyme inhibitor; AMI, acute myocardial infarction; ARB, angiotensin receptor blocker; eGFR, estimated glomerular filtration rate; NSTEMI, non-ST-segment elevation myocardial infarction; PCI, percutaneous coronary intervention; SBP, systolic blood pressure; STEMI, ST-segment elevation myocardial infarction.

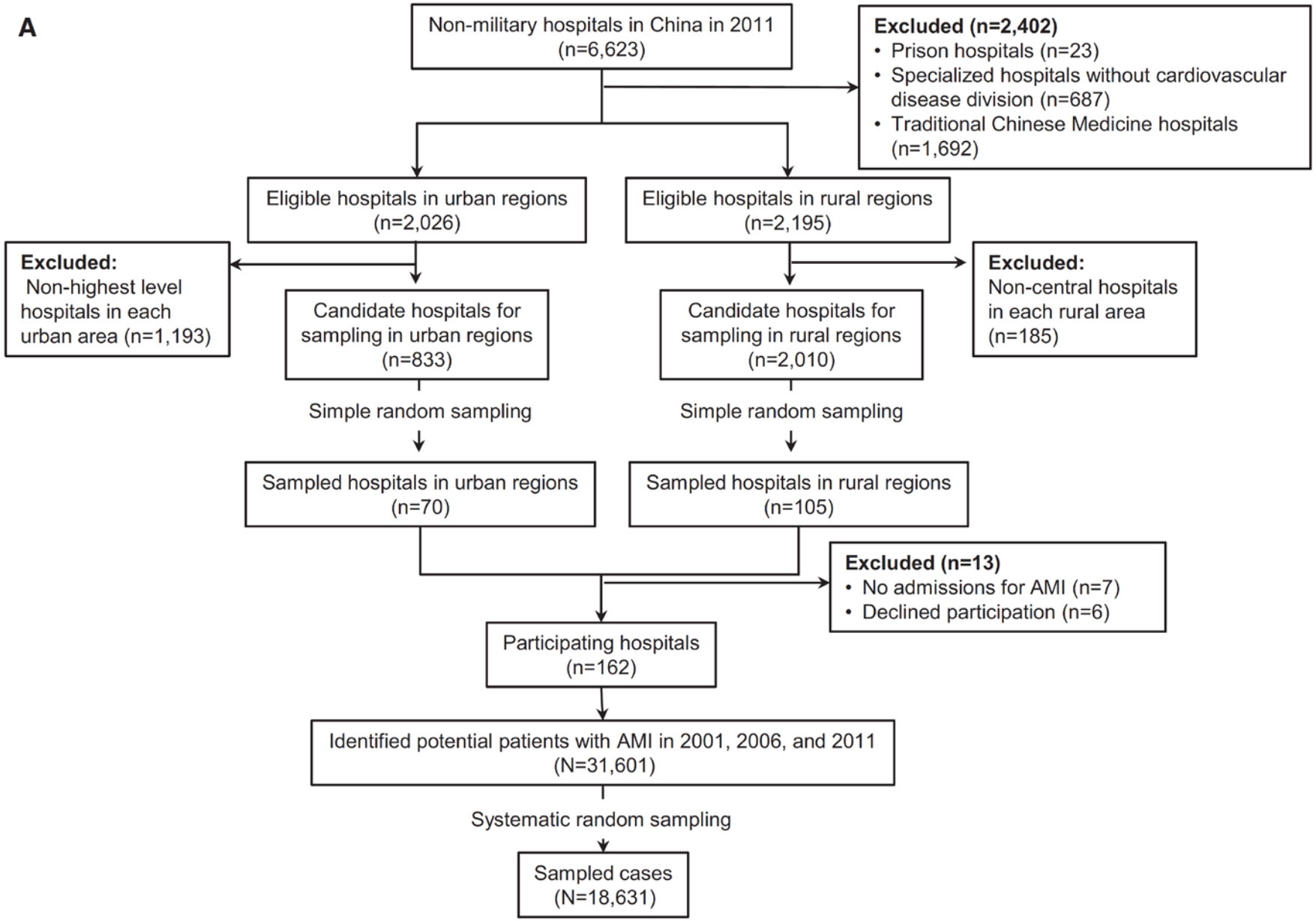

Figure 1. (A) Flow diagram showing the process used to produce a nationally representative sampling of hospitals in China. "N" represents number of patients; "n" represents number of hospitals.

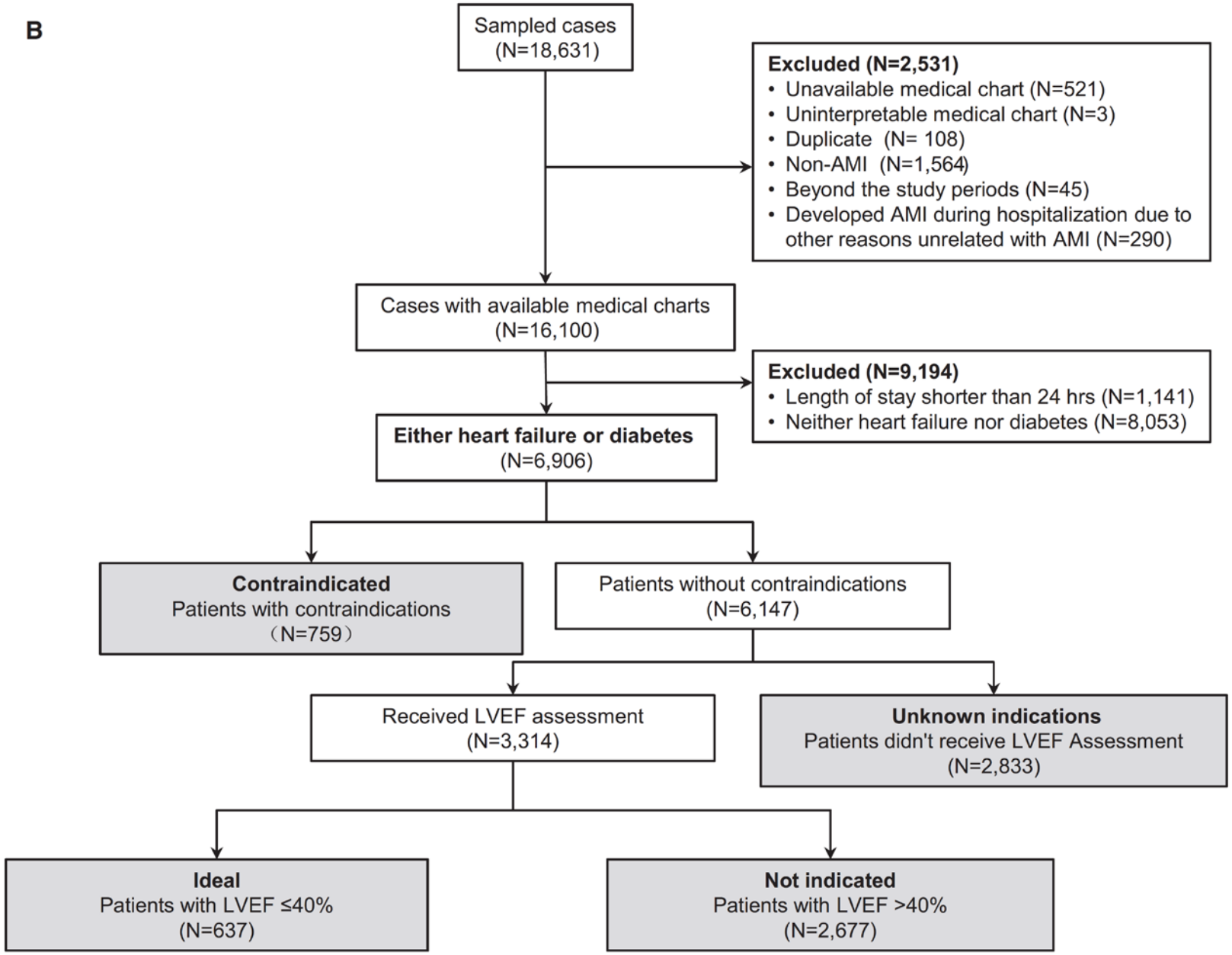

Figure 1. (B) Flow diagram showing the approach to classify patients into 4 groups according to their indications for spironolactone. "N" represents number of patients. AMI indicates acute myocardial infarction; LVEF, left ventricular ejection fraction.

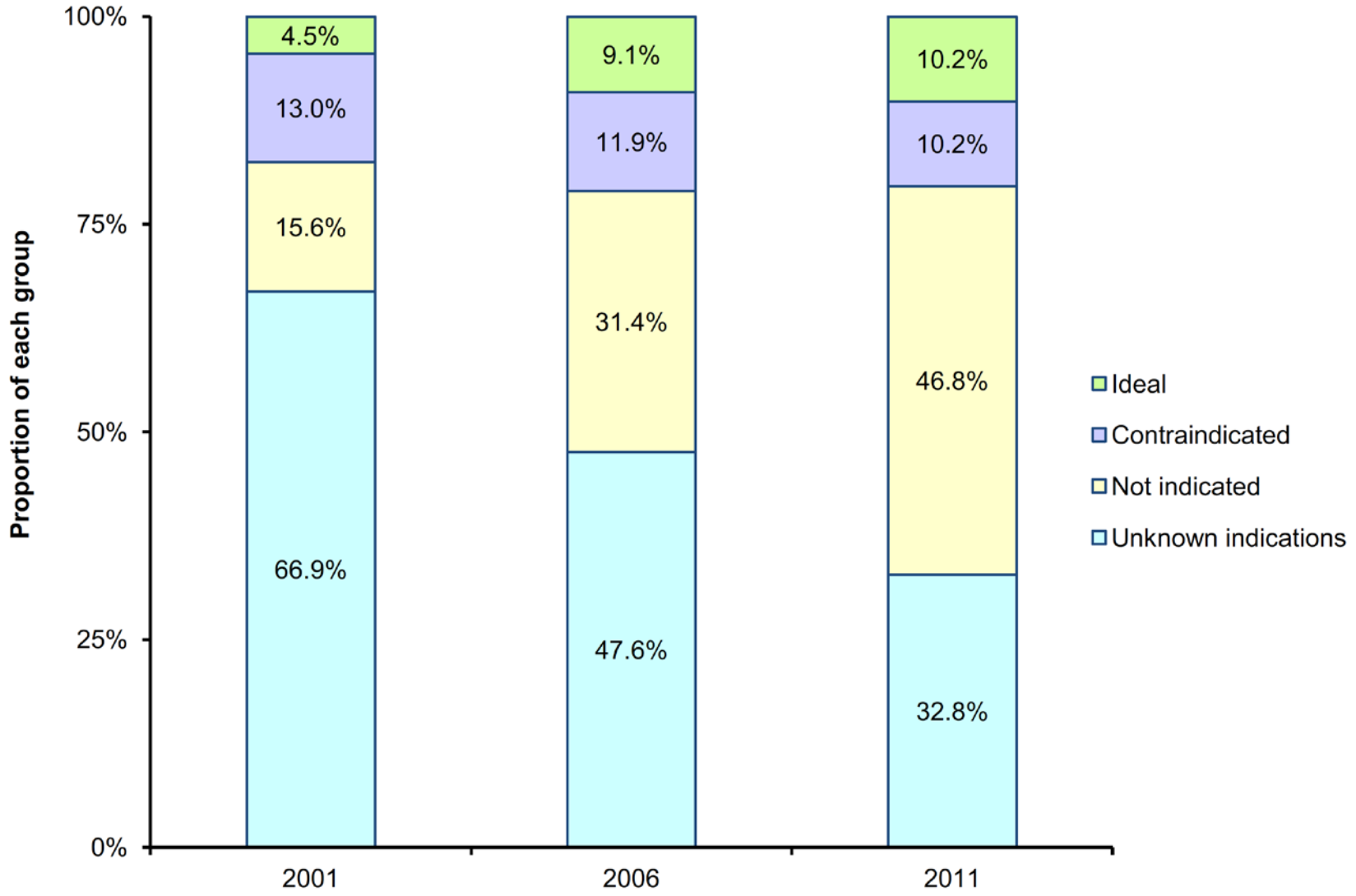

Figure 2. Acute myocardial infarction patients with heart failure or diabetes grouped by their eligibility for spironolactone in 2001, 2006, and 2011. Ideal: patients with a left ventricular ejection fraction (LVEF) ≤40% and without contraindications to spironolactone; contraindicated: patients with a contraindication (serum potassium >5 mmol/L, or serum creatinine >2.5 mg/dL [men] or >2.0 mg/dL [women], or documented allergy to spironolactone); not indicated: patients with neither indication (ie, LVEF >40%) nor contraindication to spironolactone; unknown indications: patients whose LVEF was not measured during the hospitalization.

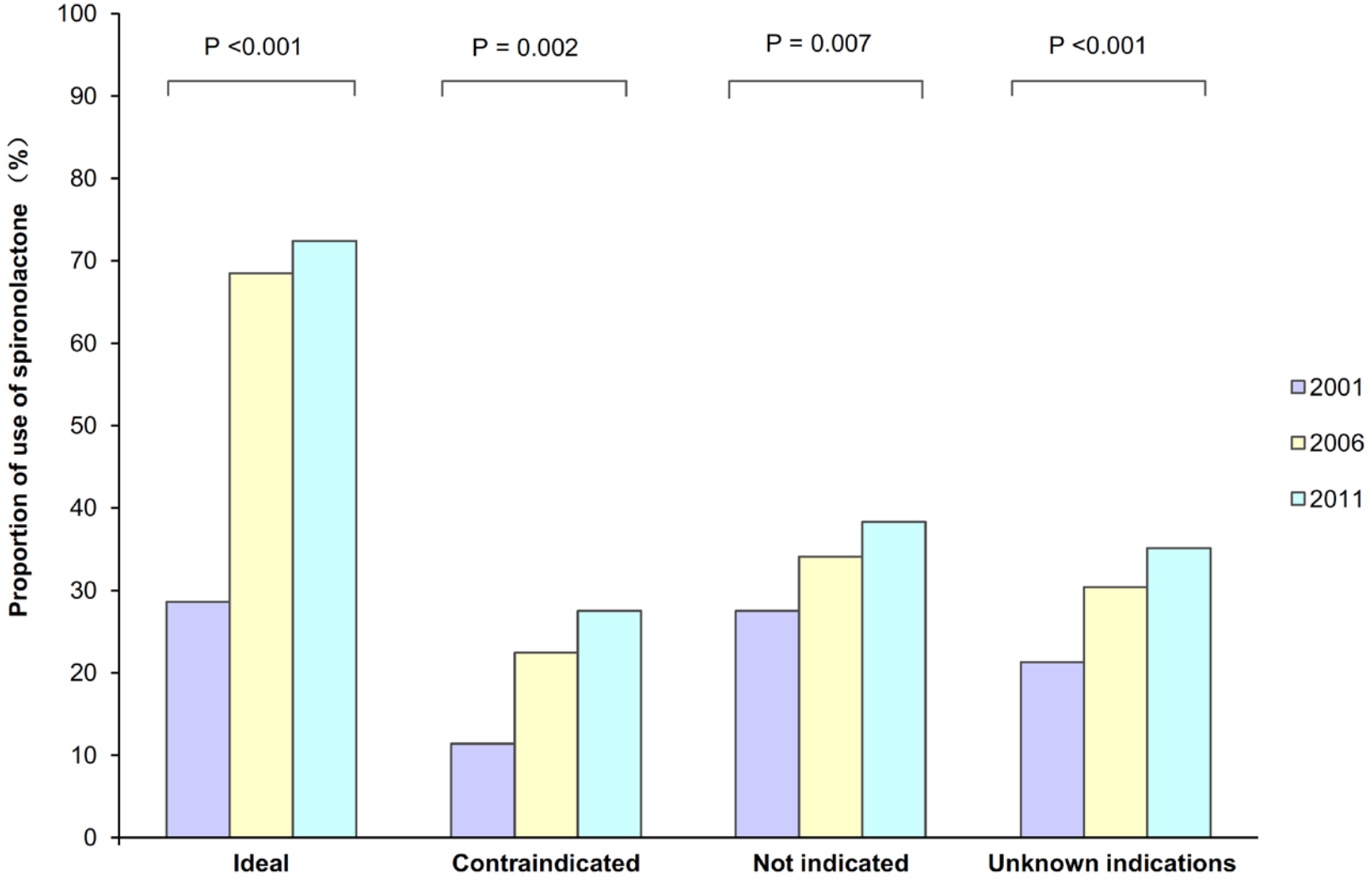

Figure 3. Spironolactone use (weighted) among different groups of acute myocardial infarction patients with heart failure or diabetes according to their eligibility for spironolactone in 2001, 2006, and 2011. Ideal: patients with a left ventricular ejection fraction (LVEF) ≤40% and without contraindications to spironolactone; contraindicated: patients with a contraindication (serum potassium >5 mmol/L, or serum creatinine >2.5 mg/dL [men] or >2.0 mg/dL [women], or documented allergy to spironolactone); not indicated: patients with neither indication (ie, LVEF >40%) nor contraindication to spironolactone; unknown indications: patients whose LVEF was not measured during the hospitalization.

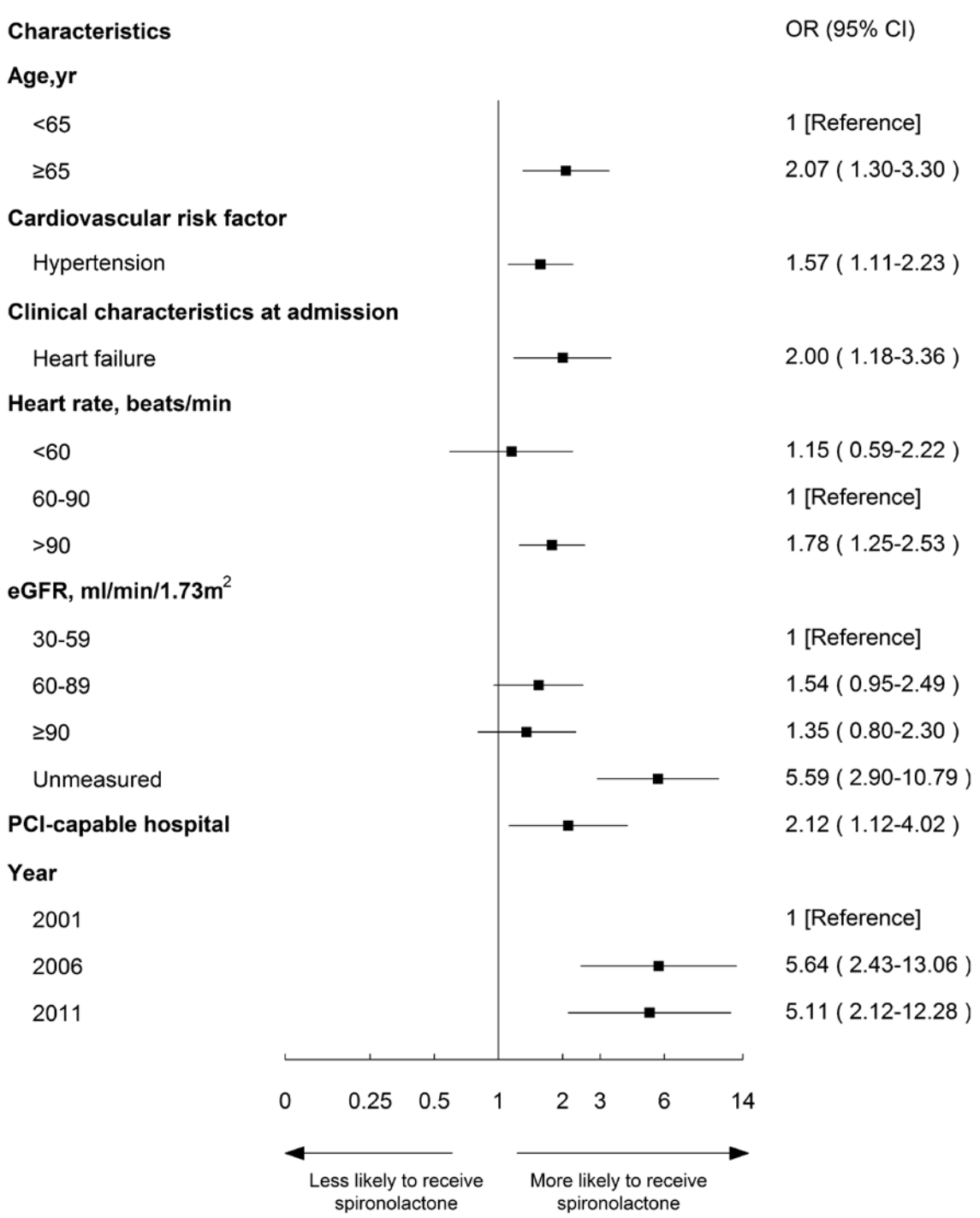

Figure 4. Factors associated with spironolactone therapy among "ideal" patients in the multivariable model. Variables associated with spironolactone therapy among ideal patients are shown along the vertical axis. The adjusted odds ratio of 1 shows no difference to receive spironolactone therapy among ideal patients. Each dot represents the point estimate of the effect of that variable in the model; the line shows the 95% confidence interval (CI). eGFR indicates estimated glomerular filtration rate; OR, odds ratio; PCI, percutaneous coronary intervention.

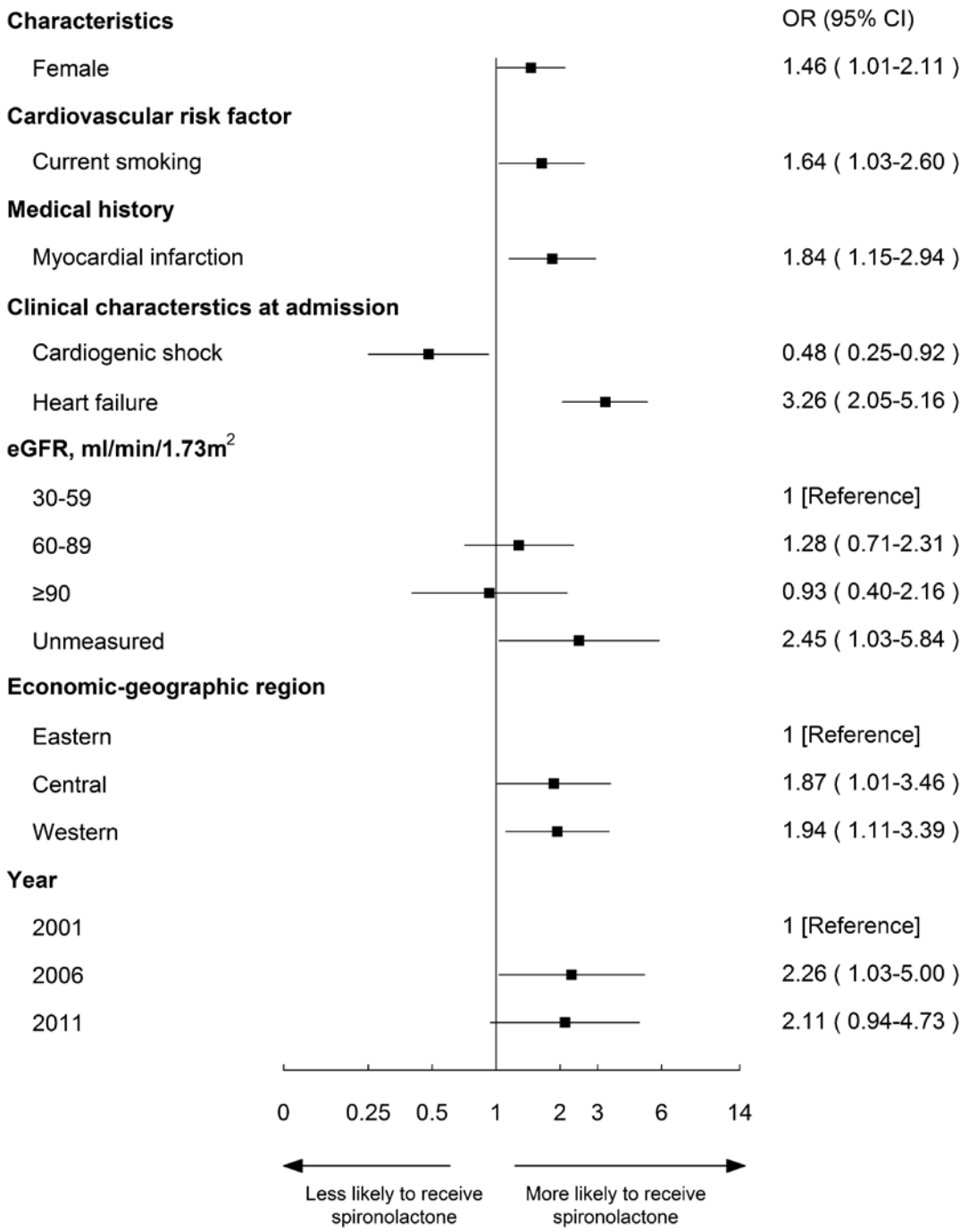

Figure 5. Factors associated with spironolactone therapy among "contraindicated" patients in multivariable model. Variables associated with spironolactone therapy among ideal patients are shown along the vertical axis. The adjusted odds ratio of 1 shows no difference to receive spironolactone therapy among ideal patients. Each dot represents the point estimate of the effect of that variable in the model; the line shows the 95% confidence interval (CI). eGFR indicates estimated glomerular filtration rate; OR, odds ratio.

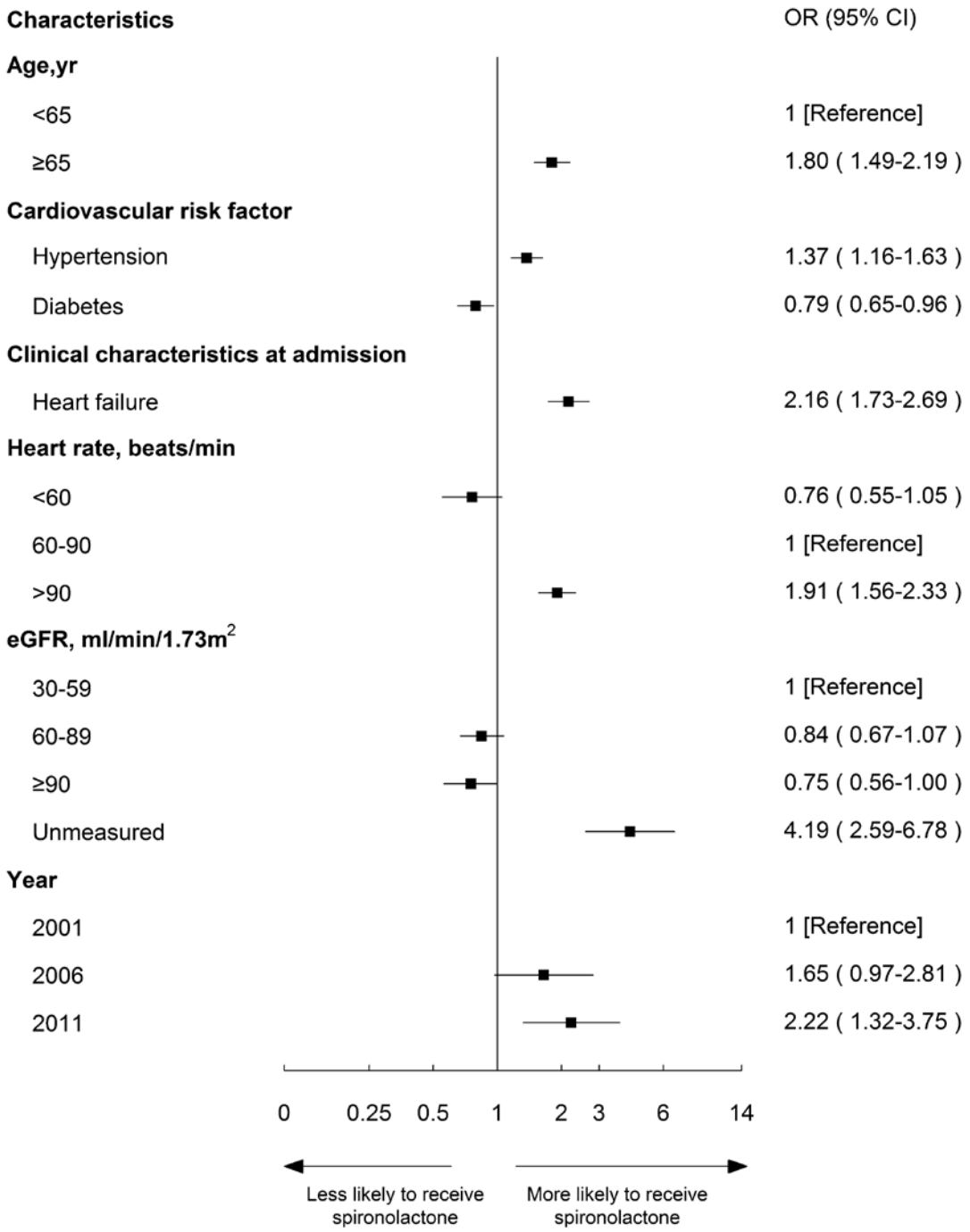

Figure 6. Factors associated with spironolactone therapy among "not indicated" patients in the multivariable model. Variables associated with spironolactone therapy among ideal patients are shown along the vertical axis. The adjusted odds ratio of 1 shows no difference to receive spironolactone therapy among ideal patients. Each dot represents the point estimate of the effect of that variable in the model; the line shows the 95% confidence interval (CI). eGFR indicates estimated glomerular filtration rate; OR, odds ratio.

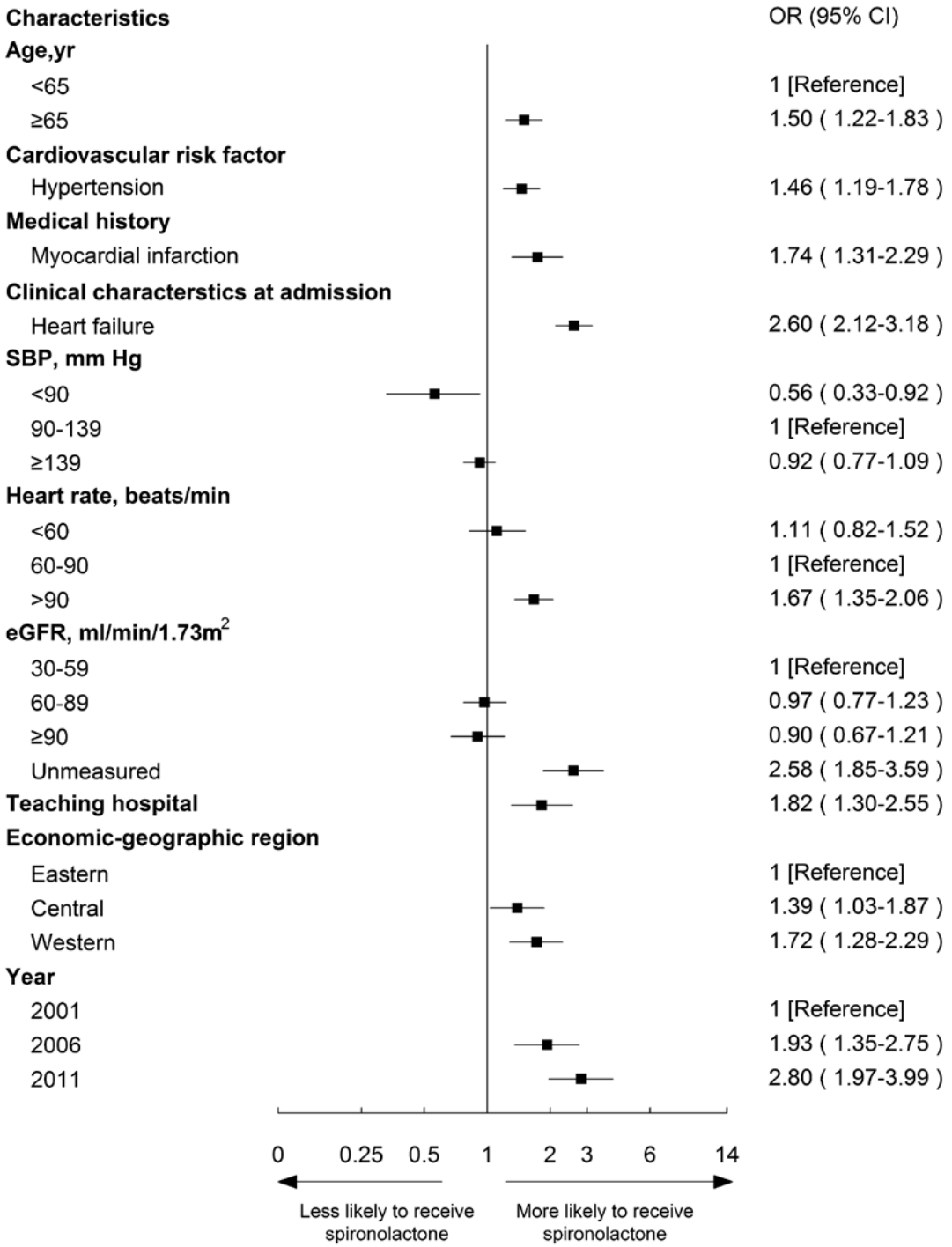

Figure 7. Factors associated with spironolactone therapy among “unknown indications” patients in the multivariable model. Variables associated with spironolactone therapy among ideal patients are shown along the vertical axis. The adjusted odds ratio of 1 shows no difference to receive spironolactone therapy among ideal patients. Each dot represents the point estimate of the effect of that variable in the model; the line shows the 95% confidence interval (CI). eGFR indicates estimated glomerular filtration rate; OR, odds ratio; SBP, systolic blood pressure.

Conclusion

- We identified opportunities to optimize the use of spironolactone post-AMI in Chinese clinical practice, including wider LVEF assessment, more-careful selection of patients, and increasing the utilization among ideal patients.
- Our findings shed light on existing practice patterns in the treatment of AMI in China, serve as the basis for future quality assessment efforts, and illuminate the barriers to more-appropriate use of evidence-based therapies for all countries seeking opportunity to optimize care.