Supplementary material

Validation procedures

To validate the quality of the diagnostic information in the Beijing Hospital Discharge Information System (HDIS), 1069 patients with acute myocardial infarction (AMI) and 667 patients without AMI (unstable angina) admitted in 2012 were sampled using a stratified randomized sampling method according to the hospital level (secondary or tertiary) and the region in which the hospital was located (urban, suburban, or extra-urban). We over-sampled cases of AMI (4 times the estimated sample size) to increase the statistical power. Clinical information of each patient was extracted by chart review. First, we checked the concordance of ICD code-based diagnoses/procedures in the HDIS with the clinical diagnoses/procedures in the hospital charts (Table 1). Next, the ICD code-based AMI diagnosis in the HDIS was validated using the WHO-MONICA criteria (definite and possible AMI), the most widely used 'gold standard' for validation of AMI events,[1,2] based on information regarding symptoms, electrocardiogram, cardiac enzymes, and necropsy findings collected from the hospital records (Table 2). In this case, positive and negative predictive values were addressed instead of sensitivity and specificity because sensitivity and specificity were dependent on how many non-AMI cases were sampled for validation.[3] Similarly, we further validated the AMI coding in the HDIS using the contemporary Third Universal Definition of Myocardial Infarction[4] as the 'gold standard'.

The concordance of ICD code-based diagnoses/procedures in the HDIS with the clinical diagnoses/procedures in the hospital charts was evaluated by the observed agreement rate (percentage of all cases for which the two diagnoses agreed) and Kappa statistic (0.81–0.99,

almost perfect agreement; 0.61–0.80, substantial agreement; 0.41-0.60, moderate agreement; 0.21-0.40, fair agreement; 0.01-0.20 slight agreement; <0 less than chance agreement)[5] The positive predictive value (PPV) of the ICD code-based AMI diagnosis in the HDIS was calculated as the proportion of patients that actually had AMI by the 'gold standard' (WHO-MONICA criteria or universal definition) with a coding of AMI in the HDIS, while the negative predictive value (NPV) was calculated as the proportion of true non-AMI diagnoses by the 'gold standard' with a coding of non-AMI in the HDIS.

As shown in *Table 1*, agreement on the ICD code-based diagnoses/procedures in the HDIS with the clinical diagnoses/procedures in the hospital charts was 'almost perfect' or 'substantial' with the Kappa statistic ranging from 0.725 to 0.918. The PPVs of AMI diagnosis in the HDIS compared with the WHO-MONICA criteria and the Third Universal Definition were 94.4% and 87.9%, respectively, with higher PPV values in tertiary than secondary hospitals. The corresponding NPVs were 96.1% and 97.0%, respectively, and were similar in secondary and tertiary hospitals *(Table 2)*.

References for supplementary material

1. Madsen M, Gudnason V, Pajak A, et al. Population-based register of acute myocardial infarction: manual of operations. *Eur J Cardiovasc Prev Rehabil.* 2007;14 Suppl 3:S3-22.

2. World Health Organization (WHO) 1999. MONICA Manual, Part IV: Event Registration. http://www.thl.fi/publications/monica/manual/part4/iv-1.htm (25 Feb 2015).

3. Mahonen M, Salomaa V, Torppa J, et al. The validity of the routine mortality statistics on coronary heart disease in Finland: comparison with the FINMONICA MI register data for the years 1983-1992. Finnish multinational MONItoring of trends and determinants in CArdiovascular disease. *J Clin Epidemiol.* 1999;52(2):157-166.

4. Thygesen K, Alpert JS, Jaffe AS, et al. Third universal definition of myocardial infarction. *Eur Heart J.* 2012;33(20):2551-2567.

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Table 1. Concordance of ICD Code-based Diagnoses/Procedures in Hospital Discharge Information System with the

Clinical Diagnoses/Procedures in Hospital Charts

Clinical diagnosis/ procedure	ICD-10 codes	Observed agreement rate (%)	Kappa	*P*
AMI	I21-I22	92.2	0.840	<.001
STEMI	I21.0, I21.1, I21.2, I21.3, I22.0, I22.1, I22.8	91.0	0.820	<.001
NSTEMI	I21.4	94.5	0.880	<.001
Unspecified	I21.9, I22.9	97.5	0.725	<.001
PCI	00.66, 36.01, 36.02, 36.05, 36.06, 36.07	94.6	0.888	<.001
CABG	36.1	99.5	0.918	<.001

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

elevation myocardial infarction, PCI=percutaneous coronary intervention, CABG=coronary artery bypass grafting,

ICD=International Classification of Diseases.

Table 2. Predictive Value of ICD Codes for AMI in Hospital Discharge Information System for Clinical Diagnosis of AMI Defined by MONICA Criteria or Third Universal Definition of Myocardial Infarction

Diagnosis	AMI diagnosis in HDIS=Yes				AMI diagnosis in HDIS=No			
	No. of patients	Clinical AMI diagnosis		PPV(%)	No. of patients	Clinical AMI diagnosis		NPV(%)
		Yes	No			Yes	No	
MONICA criteria								
Secondary hospitals	349	311	38	89.1	267	10	257	96.3
Tertiary hospitals	720	698	22	96.9	400	16	384	96.0
Total	1069	1009	60	94.4	667	26	641	96.1
Universal definition								
Secondary hospitals	349	282	67	80.8	267	4	263	98.5
Tertiary hospitals	720	658	62	91.4	400	16	384	96.0
Total	1069	940	129	87.9	667	20	647	97.0

AMI=acute myocardial infarction, HDIS=Hospital Discharge Information System, PPV=positive predictive value, NPV=negative predictive value, MONICA=multinational MONItoring of trends and determinants in CArdiovascular disease.

Table 3. Geometric Means of Hospital Length of Stay (Days) for Patients with Acute Myocardial Infarction (AMI)

in Beijing, by Sex, AMI Subtype, and Type of Intervention, 2007 to 2012

Characteristic	2007	2008	2009	2010	2011	2012	Relative change 2007-2012,%	P for trend
Male	10.4	10.0	9.6	9.6	9.5	9.5	-8.7	<.001
STEMI	10.3	9.7	9.2	9.2	9.3	9.4	-8.7	<.001
STEMI with PCI	10.6	9.6	9.4	9.2	9.4	9.6	-9.4	<.001
STEMI with CABG	25.9	27.7	28.5	27.4	27.8	23.9	-7.7	.32
STEMI without intervention	9.8	9.4	8.7	8.8	8.5	8.7	-11.2	<.001
NSTEMI	11.2	10.8	10.4	10.2	10.1	9.5	-15.2	<.001
NSTEMI with PCI	10.4	9.6	9.5	9.0	9.3	8.7	-16.3	<.001
NSTEMI with CABG	24.8	27.1	26.0	26.0	25.7	21.7	-12.5	.002
NSTEMI without intervention	11.1	10.8	10.4	10.4	10.1	9.6	-13.5	<.001
Unspecified	9.4	10.1	9.9	10.0	9.6	9.4	0.0	.09
Female	10.8	10.3	10.2	10.4	10.0	10.1	-6.5	<.001
STEMI	10.6	10.0	9.7	9.8	9.4	9.7	-8.5	<.001
STEMI with PCI	11.9	10.8	10.1	10.1	10.1	10.5	-11.8	<.001
STEMI with CABG	30.4	28.8	31.1	31.0	28.4	24.3	-20.1	.16
STEMI without intervention	10.0	9.5	9.3	9.5	8.7	8.9	-11.0	<.001
NSTEMI	12.7	11.3	11.4	11.6	10.9	10.7	-15.7	<.001
NSTEMI with PCI	13.5	11.0	10.5	10.5	10.3	9.7	-28.1	<.001
NSTEMI with CABG	32.8	29.0	31.6	24.8	31.0	24.2	-26.2	.03
NSTEMI without intervention	12.0	11.0	11.3	11.6	10.8	10.7	-10.8	.004

Unspecified	9.6	9.5	9.5	9.8	9.4	9.0	-6.3	.24
Total	10.6	10.1	9.8	9.8	9.7	9.7	-8.5	<.001

STEMI=ST-segment elevation myocardial infarction, NSTEMI= non-ST-segment elevation myocardial infarction,

PCI=percutaneous coronary intervention, CABG=coronary artery bypass grafting.

Table 4. Geometric Means of Hospital Costs Per Hospitalization (1000 RMB)* for Patients with Acute Myocardial

Infarction (AMI) in Beijing by Sex, AMI Subtype, and Type of Intervention, 2007 to 2012

Characteristic	2007	2008	2009	2010	2011	2012	Relative change 2007-2012,%	P for trend
Male	30.9	30.3	33.7	34.4	34.8	31.7	2.3	<.001
STEMI	31.8	32.0	36.2	37.3	39.1	36.2	13.9	<.001
STEMI with PCI	67.4	63.7	63.0	61.8	61.0	55.1	-18.1	<.001
STEMI with CABG	104.8	101.6	112.2	116.3	116.6	118.2	12.8	<.001
STEMI without intervention	20.8	16.7	16.4	16.2	17.5	17.3	-16.8	<.001
NSTEMI	27.8	26.4	29.1	30.1	29.2	26.5	-4.6	.32
NSTEMI with PCI	73.7	66.3	65.7	64.5	64.2	51.6	-30.0	<.0001
NSTEMI with CABG	96.8	105.9	109.6	108.1	112.5	99.8	3.1	.79
NSTEMI without intervention	18.1	16.5	17.3	16.9	17.9	16.5	-9.2	.30
Unspecified	22.8	23.3	30.4	29.2	29.1	27.7	21.5	.01
Female	22.8	21.7	24.1	25.5	25.6	24.1	5.8	<.001
STEMI	23.0	23.2	26.1	27.5	28.5	28.5	24.1	<.001
STEMI with PCI	66.4	64.2	62.7	61.8	59.2	57.1	-14.0	<.001
STEMI with CABG	108.7	98.5	131.4	122.3	96.1	123.1	13.3	.29
STEMI without intervention	16.5	14.4	14.4	15.0	15.6	15.8	-4.2	.96
NSTEMI	23.7	19.8	22.2	24.0	23.8	21.9	-7.3	.12
NSTEMI with PCI	77.2	68.2	65.3	66.6	63.0	55.4	-28.2	<.001
NSTEMI with CABG	103.1	119.3	114.9	111.7	116.6	108.1	4.9	.83
NSTEMI without intervention	17.2	14.3	16.2	16.8	17.2	16.2	-5.6	.06

Unspecified	15.2	16.6	21.4	21.9	21.0	18.7	23.2	.22
Total	28.1	27.2	30.3	31.2	31.4	29.0	3.2	<.001

STEMI=ST-segment elevation myocardial infarction, NSTEMI=non-ST-segment elevation myocardial infarction,

PCI=percutaneous coronary intervention, CABG=coronary artery bypass grafting.

*After adjustment of inflation (1000 RMB=approximately 160 USD)