Availability, cost, and prescription patterns of antihypertensive medications in primary health care in China: a nationwide cross-sectional survey

Meng Su, Qiuli Zhang*, Xueke Bai, Chaoqun Wu, Yetong Li, Elias Mossialos, George A Mensah, Frederick A Masoudi, Jiapeng Lu, Xi Li, Sebastian Salas-Vega, Anwen Zhang, Yuan Lu, Khurram Nasir, Harlan M Krumholz†, Lixin Jiang†*

Summary

Background Around 200 million adults in China have hypertension, but few are treated or achieve adequate control of their blood pressure. Available and affordable medications are important for successfully controlling hypertension, but little is known about current patterns of access to, and use of, antihypertensive medications in Chinese primary health care.

Methods We used data from a nationwide cross-sectional survey (the China Patient-Centered Evaluative Assessment of Cardiac Events Million Persons Project primary health care survey), which was undertaken between November, 2016 and May, 2017, to assess the availability, cost, and prescription patterns of 62 antihypertensive medications at primary health-care sites across 31 Chinese provinces. We surveyed 203 community health centres, 401 community health stations, 284 township health centres, and 2474 village clinics to assess variation in availability, cost, and prescription by economic region and type of site. We also assessed the use of high-value medications, defined as guideline-recommended and low-cost. We also examined the association of medication cost with availability and prescription patterns.

Findings Our study sample included 3362 primary health-care sites and around 1 million people (613 638 people at 2758 rural sites and 478 393 people at 604 urban sites). Of the 3362 sites, 8·1% (95% CI 7·2–9·1) stocked no antihypertensive medications and 33·8% (32·2–35·4) stocked all four classes that were routinely used. Village clinics and sites in the western region of China had the lowest availability. Only 32·7% (32·2–33·3) of all sites stocked high-value medications, and few high-value medications were prescribed (11·2% [10·9–11·6] of all prescription records). High-cost medications were more likely to be prescribed than low-cost alternatives.

Interpretation China has marked deficiencies in the availability, cost, and prescription of antihypertensive medications. High-value medications are not preferentially used. Future efforts to reduce the burden of hypertension, particularly through the work of primary health-care providers, will need to improve access to, and use of, antihypertensive medications, paying particular attention to those with high value.

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Introduction

An estimated 200 million adults in China have hypertension but fewer than 15% are treated.[1–4] Moreover, among those who are treated, about two-thirds do not achieve adequate control of their blood pressure.[5–8] Inadequate management of patients with hypertension might have substantial health and economical consequences; the sequelae of hypertension, including stroke and heart disease, are the leading causes of morbidity and mortality in China,[9,10] and are associated with substantial expense to patients and the health system.

The successful management of hypertension in China requires, in addition to lifestyle and behavioural modifications, affordable and widely available antihypertensive medications prescribed appropriately in primary health-care settings, a main point of contact with the health system in China. Findings from studies have suggested low availability and high costs as major barriers to optimum use and adherence to essential antihypertensive medications, especially in low-income rural areas in China.[3,11]

The Chinese health reform in 2009 strengthened the role of primary health care that serves as gatekeeper to the health-care system.[12] The reform also introduced the National Essential Medicine Program that was designed to provide affordable and equitable basic health care for all by 2020. Pharmaceutical policy has also evolved quickly, such as allowances for primary health-care sites to procure non-essential medicines in 2014 and abolishment of the government price ceiling in 2015 (appendix). Although availability of medications increased after the National Essential Medicine Policy was launched,[13–15] little is known about current patterns of access to antihypertensive medications across Chinese primary health-care settings, where higher financial burdens and few medication choices might

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Abstract

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Findings- Our study sample included 3362 primary health-care sites and around 1 million people (613 638 people at 2758 rural sites and 478 393 people at 604 urban sites). Of the 3362 sites, 8·1% (95% CI 7·2–9·1) stocked no antihypertensive medications and 33·8% (32·2–35·4) stocked all four classes that were routinely used. Village clinics and sites in the western region of China had the lowest availability. Only 32·7% (32·2–33·3) of all sites stocked high-value medications, and few high-value medications were prescribed (11·2% [10·9–11·6] of all prescription records). High-cost medications were more likely to be prescribed than low-cost alternatives.

Interpretation- China has marked deficiencies in the availability, cost, and prescription of antihypertensive medications. High-value medications are not preferentially used. Future efforts to reduce the burden of hypertension, particularly through the work of primary health-care providers, will need to improve access to, and use of, antihypertensive medications, paying particular attention to those with high value.

Table 1: Characteristics of primary health-care sites and Million Persons Project population included by rural and urban area

	Rural	Urban	Total
Primary health-care site			
Number	..	..	3362
Township health centre	284 (8·4%)	..	..
Village clinic	2474 (73·6%)	..	..
Community health centre	..	203 (6·0%)	..
Community health station	..	401 (11·9%)	..
Eastern region	..	..	31·9% (30·3–33·5)
Township health centre	28·5% (23·3–34·2)	..	..
Village clinic	27·8% (26·0–29·6)	..	..
Community health centre	..	38·9% (32·2–46·0)	..
Community health station	..	56·4% (51·3–61·3)	..
Central region	..	..	35·6% (34·0–37·2)
Township health centre	31·0% (25·7–36·7)	..	..
Village clinic	39·9% (37·9–41·8)	..	..
Community health centre	..	29·1% (22·9–35·8)	..
Community health station	..	15·7% (12·3–19·6)	..
Western region	..	..	32·5% (30·9–34·1)
Township health centre	40·5% (34·7–46·5)	..	..
Village clinic	32·4% (30·5–34·3)	..	..
Community health centre	..	32·0% (25·7–38·9)	..
Community health station	..	27·9% (23·6–32·6)	..

Table 1: Continued

	Rural	Urban	Total
Linked MPP population*			
Number	613 638	478 393	1 092 031
Age (years)	56·2 (9·8)	55·8 (9·8)	56·0 (9·8)
Women	59·6% (59·4–59·7)	60·9% (60·8–61·0)	60·1% (60·1–60·2)
Men	40·4% (40·3–40·6)	39·1% (39·0–39·2)	39·9% (39·8–39·9)
Ethnic Han	88·8% (88·7–88·9)	93·3% (93·2–93·3)	90·8% (90·7–90·8)
12 years of education or more	9·4% (9·3–9·5)	32·3% (32·2–32·5)	19·5% (19·4–19·5)
Current smoker	21·7% (21·6–21·8)	18·4% (18·3–18·5)	20·2% (20·2–20·3)
No insurance	0·2% (0·2–0·2)	1·1% (1·1–1·1)	0·6% (0·6–0·6)
Last-year income >¥50 000	8·6% (8·5–8·6)	18·3% (18·2–18·4)	12·8% (12·7–12·9)
Patients with hypertension	46·4% (46·2–46·5)	44·1% (43·9–44·2)	45·4% (45·3–45·5)
Awareness†	43·8% (43·6–44·0)	48·7% (48·5–48·9)	45·9% (45·8–46·0)
Treatment†	27·1% (27·0–27·3)	34·5% (34·3–34·7)	30·3% (30·1–30·4)
Control†	5·5% (5·4–5·6)	9·8% (9·7–9·9)	7·3% (7·3–7·4)

Data are n (%), % (95% CI), or mean (SD). MPP=Million Persons Project. ..=not applicable. *The population is linked at the township or community level. †Among all patients with hypertension. Awareness was defined as self-reported diagnosis of hypertension at the baseline interview.

Table 2: Availability of individual and classes of medications among all primary health-care sites

	Essential medicines list*			Guidelines			Availability, % (95% CI), (n=3362)	Class availability, % (95% CI), (n=3362)	Annual cost per patient (RMB), median (IQR)	Prescription frequency, % (95% CI), (n=29 171)
	WHO	NEM	PSEM	Guideline in primary health care 2014	JNC 8 2014	Chinese guideline 2010				
ACE inhibitors	..	..	..	..	..	..	..	62·6% (61·0–64·3)	..	..
Captopril	..	Y	1	Y	Y	Y	44·0% (42·3–45·7)	..	16 (11–43)	2·5% (2·3–2·7)
Enalapril	Y	Y	1	Y	Y	Y	38·9% (37·3–40·6)	..	225 (160–435)	4·3% (4·1–4·5)
Benazepril	..	..	13	Y	..	Y	8·4% (7·5–9·4)	..	1066 (748–1144)	1·2% (1·1–1·3)
Ramipril	..	..	1	..	..	Y	0·4% (0·2–0·6)	..	1819 (1819–2021)	0
Perindopril	..	..	3	..	..	Y	1·0% (0·7–1·4)	..	1255 (1172–1261)	0·2% (0·2–0·3)
Fosinopril	..	..	7	Y	..	Y	3·6% (3·0–4·3)	..	1022 (723–1054)	0·7% (0·6–0·8)
Lisinopril	..	..	2	Y	Y	Y	3·3% (2·8–4·0)	..	659 (469–678)	0·1% (0·1–0·2)
Quinapril	..	..	1	..	..	..	<0·1% (<0·1–0·2)	..	1166 (1166–1166)	<0·1% (<0·1–0·1)
Imidapril	..	..	1	..	..	Y	0·3% (0·1–0·5)	..	1123 (1123–1123)	0
Cilazapril	..	..	0	..	..	Y	0	..	..	0
Angiotensin receptor blockers	..	..	..	..	..	..	..	34·4% (32·7–36·0)	..	..
Valsartan	..	Y	15	Y	Y	Y	21·4% (20·0–22·8)	..	663 (340–1028)	7·4% (7·1–7·7)
Losartan	..	..	7	Y	Y	Y	7·8% (6·9–8·7)	..	1306 (942–1883)	2·1% (1·9–2·3)
Irbesartan	..	..	13	Y	Y	Y	21·1% (19·7–22·5)	..	850 (610–1101)	6·7% (6·4–7·0)
Candesartan	..	..	1	..	Y	Y	4·2% (3·5–4·9)	..	589 (468–751)	1·0% (0·9–1·1)
Eprosartan	..	..	0	..	Y	..	0	..	..	0
Telmisartan	..	..	7	Y	..	Y	10·3% (9·3–11·4)	..	516 (298–801)	4·3% (4·0–4·5)
Olmesartan	..	..	0	..	..	Y	0·9% (0·6–1·2)	..	1833 (1761–2660)	0·2% (0·2–0·3)
ACE inhibitors or angiotensin receptor blockers	..	..	..	..	..	..	..	69·0% (67·4–70·6)	..	..

Table 2. Continued

	Essential medicines list*			Guidelines			Availability, % (95% CI), (n=3362)	Class availability, % (95% CI), (n=3362)	Annual cost per patient (RMB), median (IQR)	Prescription frequency, % (95% CI), (n=29 171)
	WHO	NEM	PSEM	Guideline in primary health care 2014	JNC 8 2014	Chinese guideline 2010				
Beta-blockers	..	..	..	..	..	..	..	47·2% (45·5–48·9)	..	..
Bisoprolol	Y	Y	5	Y	..	Y	8·8% (7·9–9·8)	..	791 (549–1080)	0·9% (0·8–1·0)
Metoprolol	Y	..	8	Y	Y	Y	41·0% (39·4–42·7)	..	251 (171–281)	8·0% (7·7–8·4)
Metoprolol extended release	..	..	0	..	..	Y	3·6% (3·0–4·3)	..	438 (401–440)	0·2% (0·2–0·3)
Atenolol	Y	..	1	Y	Y	Y	5·1% (4·4–5·9)	..	7 (5–8)	0·2% (0·1–0·2)
Propranolol	..	..	2	..	..	Y	7·6% (6·7–8·5)	..	26 (16–86)	<0·1% (<0·1–0·1)
Betaxolol	..	..	0	..	..	Y	0	..	..	0
Calcium channel blockers	..	..	..	..	..	..	..	75·5% (74·0–76·9)	..	..
Amlodipine	Y	Y	23	Y	Y	Y	33·8% (32·2–35·4)	..	369 (206–565)	16·8% (16·3–17·2)
Nifedipine	..	Y	16	Y	..	Y	34·4% (32·8–36·0)	..	9 (5–19)	2·7% (2·5–2·8)
Nifedipine extended release	..	Y	0	Y	..	Y	41·2% (39·5–42·9)	..	413 (266–468)	7·4% (7·1–7·7)
Nifedipine controlled release	..	..	0	Y	..	Y	15·0% (13·8–16·2)	..	1012 (890–1526)	6·0% (5·7–6·3)
Felodipine extended release	..	..	15	Y	..	Y	19·2% (17·9–20·6)	..	425 (313–1049)	3·7% (3·5–3·9)
Levamlodipine	..	..	9	Y	..	Y	11·8% (10·7–12·9)	..	688 (437–904)	7·7% (7·4–8·0)
Nitrendipine	..	Y	1	Y	Y	Y	30·3% (28·7–31·9)	..	12 (7–44)	1·0% (0·9–1·1)
Verapamil	..	..	4	..	..	Y	1·4% (1·1–1·9)	..	302 (288–360)	0
Verapamil extended release	..	..	0	..	..	Y	<0·1% (<0·1–0·2)	..	460 (460–460)	0
Diltiazem	..	..	11	..	..	Y	1·9% (1·5–2·4)	..	507 (269–1117)	0
Diltiazem extended release	..	..	0	..	Y	..	0·7% (0·5–1·1)	..	583 (527–869)	0·1% (<0·1–0·1)
Lacidipine	..	..	7	Y	..	Y	4·0% (3·4–4·8)	..	228 (225–273)	0·3% (0·3–0·4)
Nicardipine	..	..	1	..	..	Y	0	..	..	0
Benidipine	..	..	0	..	..	Y	0·1% (<0·1–0·3)	..	999 (908–1610)	0
Lercanidipine	..	..	0	..	..	Y	0·3% (0·1–0·5)	..	1530 (1509–1530)	0

Table 2. Continued

	Essential medicines list*			Guidelines			Availability, % (95% CI), (n=3362)	Class availability, % (95% CI), (n=3362)	Annual cost per patient (RMB), median (IQR)	Prescription frequency, % (95% CI), (n=29 171)
	WHO	NEM	PSEM	Guideline in primary health care 2014	JNC 8 2014	Chinese guideline 2010				
Diuretics	..	..	..	..	..	..	..	59·9% (58·2–61·5)	..	..
Indapamide	..	Y	1	Y	Y	Y	32·5% (31·0–34·2)	..	42 (18–99)	1·2% (1·1–1·3)
Indapamide extended release	..	..	0	..	..	Y	12·6% (11·5–13·8)	..	279 (197–389)	1·3% (1·2–1·4)
Hydrochlorothiazide	Y	..	1	Y	Y	Y	34·7% (33·1–36·3)	..	3 (1–5)	1·0% (0·9–1·1)
Bendroflumethiazide	..	..	0	..	Y	..	0	..	..	0
Chlortalidone	..	..	0	..	Y	..	0	..	..	0
Spironolactone	..	..	2	..	..	Y	22·3% (20·9–23·7)	..	41 (28–56)	0·5% (0·5–0·6)
Furosemide	..	..	1	..	..	Y	14·1% (13·0–15·4)	..	17 (16–25)	0·5% (0·5–0·6)
Triamterene	..	..	1	..	..	Y	3·3% (2·7–4·0)	..	115 (58–158)	0
Amiloride	..	..	1	..	..	Y	1·2% (0·9–1·7)	..	232 (232–232)	0
Traditional compound drugs†	..	..	..	..	..	..	..	55·6% (53·9–57·3)	..	..
Compound reserpine triamterene	..	Y	1	Y	..	Y	36·6% (35·0–38·2)	..	414 (299–435)	2·7% (2·5–2·9)
Compound reserpine	..	Y	1	Y	..	Y	34·9% (33·3–36·6)	..	80 (54–158)	0·6% (0·5–0·7)
Compound dihydralazine sulfate	..	..	2	..	..	..	1·2% (0·9–1·7)	..	137 (137–158)	<0·1% (<0·1–0·1)
Compound trizin and rutinum	..	..	1	..	..	..	0·1% (<0·1–0·2)	..	..	0
Compound kendir	..	..	1	..	..	..	2·5% (2·0–3·1)	..	65 (63–194)	0
Zhenju jiangya tablet	..	..	7	Y	..	Y	8·2% (7·3–9·2)	..	178 (130–269)	0·8% (0·7–0·9)

Table 2. Continued

	Essential medicines list*			Guidelines			Availability, % (95% CI), (n=3362)	Class availability, % (95% CI), (n=3362)	Annual cost per patient (RMB), median (IQR)	Prescription frequency, % (95% CI), (n=29 171)
	WHO	NEM	PSEM	Guideline in primary health care 2014	JNC 8 2014	Chinese guideline 2010				
Fixed-dose combination drugs	..	..	..	..	..	..	..	10·4% (9·4–11·5)	..	..
Amiloride compounds	..	..	2	Y	..		0·1% (<0·1–0·3)	..	116 (116–116)	<0·1% (<0·1–0·1)
Losartan potassium and hydrochlorothiazide	..	..	1	Y	..	Y	2·7% (2·2–3·3)	..	1983 (895–2427)	1·6% (1·4–1·7)
Valsartan and hydrochlorothiazide	..	..	0	Y	..	Y	1·2% (0·9–1·7)	..	3750 (1726–4720)	<0·1% (<0·1–0·1)
Irbesartan and hydrochlorothiazide	..	..	1	..	..	Y	6·1% (5·3–6·9)	..	1136 (805–1609)	3·1% (2·9–3·3)
Captopril and hydrochlorothiazide	..	..	6	Y	..	Y	5·5% (4·8–6·4)	..	147 (66–197)	0·2% (0·1–0·2)
Nitrendipine and atenolol	..	..	0	Y	..	Y	0	..	..	0
Centrally active drugs	..	..	..	..	..	..	..	2·3% (1·9–2·9)	..	..
Rauwofia	..	..	1	..	..	Y	0·1% (<0·1–0·2)	..	588 (588–588)	0·1% (0·1–0·1)
Clonidine	..	..	2	..	..	Y	1·5% (1·1–2·0)	..	104 (104–104)	0
Reserpine	..	..	15	..	..	Y	0·4% (0·2–0·7)	..	45 (45–45)	0·2% (0·2–0·3)

.. =not applicable. NEM=National Essential Medicine List. PSEM=provincial supplementary essential medicine lists (value refers to the number of provinces that had this medication in its provincial list).
*Essential lists: WHO=WHO Model Lists of Essential Medicines. †Ingredients per tablet forTraditional compound drugs: compound reserpine triamterene: reserpine 0·1 mg, triamterene 12·5 mg, hydrochlorothiazide 12·5 mg, dihydralazine 12·5 mg. Compound reserpine: reserpine 0·032 mg, hydrochlorothiazide 3·1 mg, dihydralazine 4·2 mg, promethazine 2·1 mg. Compound dihydralazine sulfate: dihydralazine sulfate 10·0 mg, hydrochlorothiazide 12·5 mg, reserpine 0·1 mg. Compound trizin and rutinum: hydrochlorothiazide 2·0 mg, dihydralazine sulfate 1·5 mg, rutinum 5·0 mg, reserpine 0·03 mg. Compound kendir: kendir 220 mg, dihydralazine sulfate 1·6 mg, hydrochlorothiazide 1·6 mg, promethazine 1·05 mg. Zhenju jiangya tablet: clonidine hydrochloride 0·03 mg, hydrochlorothiazide 5·0 mg, rutinum 20·0 mg, chrysanthemum indicum powder, nacre powder.

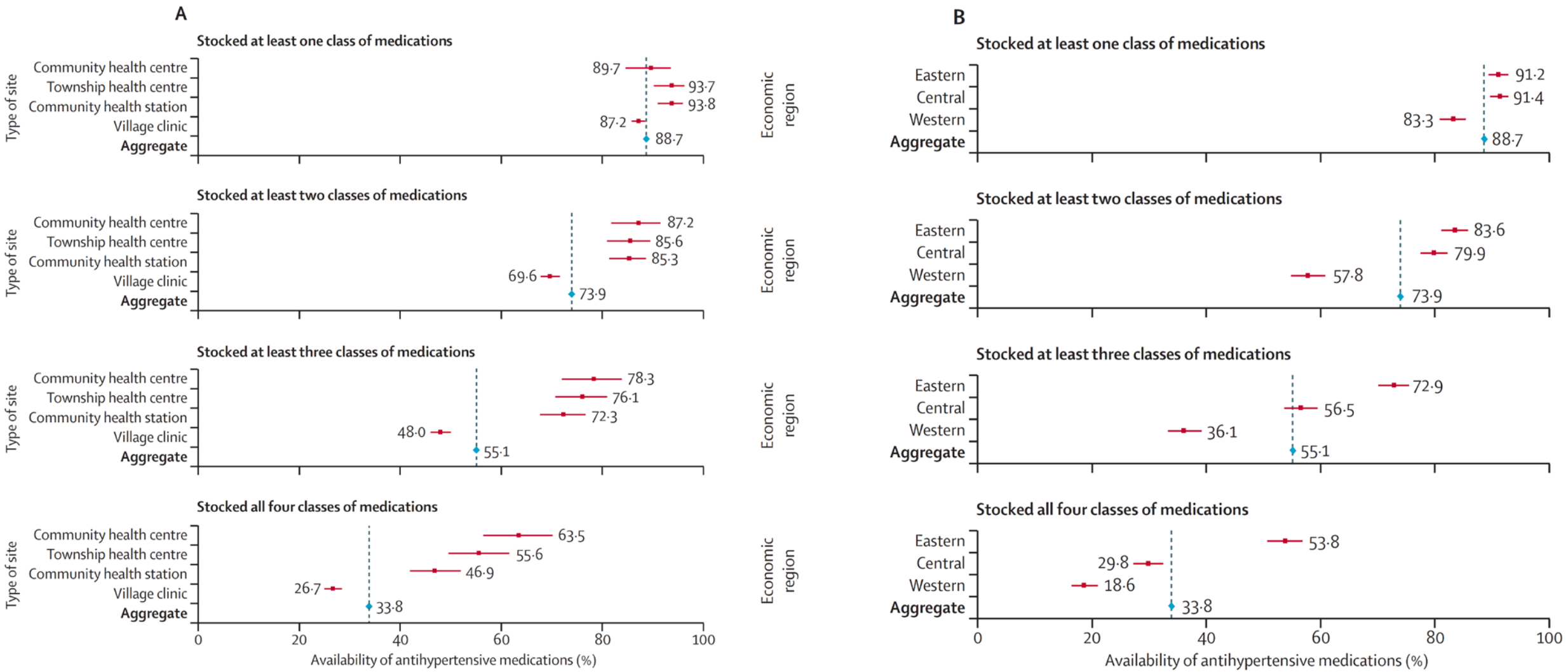


Figure 1: Availability of antihypertensive medicines in China by type of site and economic region.

Data are percentage (95% CI). The four classes of antihypertensive medicines assessed were angiotensin converting- enzyme inhibitors or angiotensin-receptor blockers, beta-blockers, calcium-channel blockers, and diuretics. Definitions of the three economic regions are in the appendix.

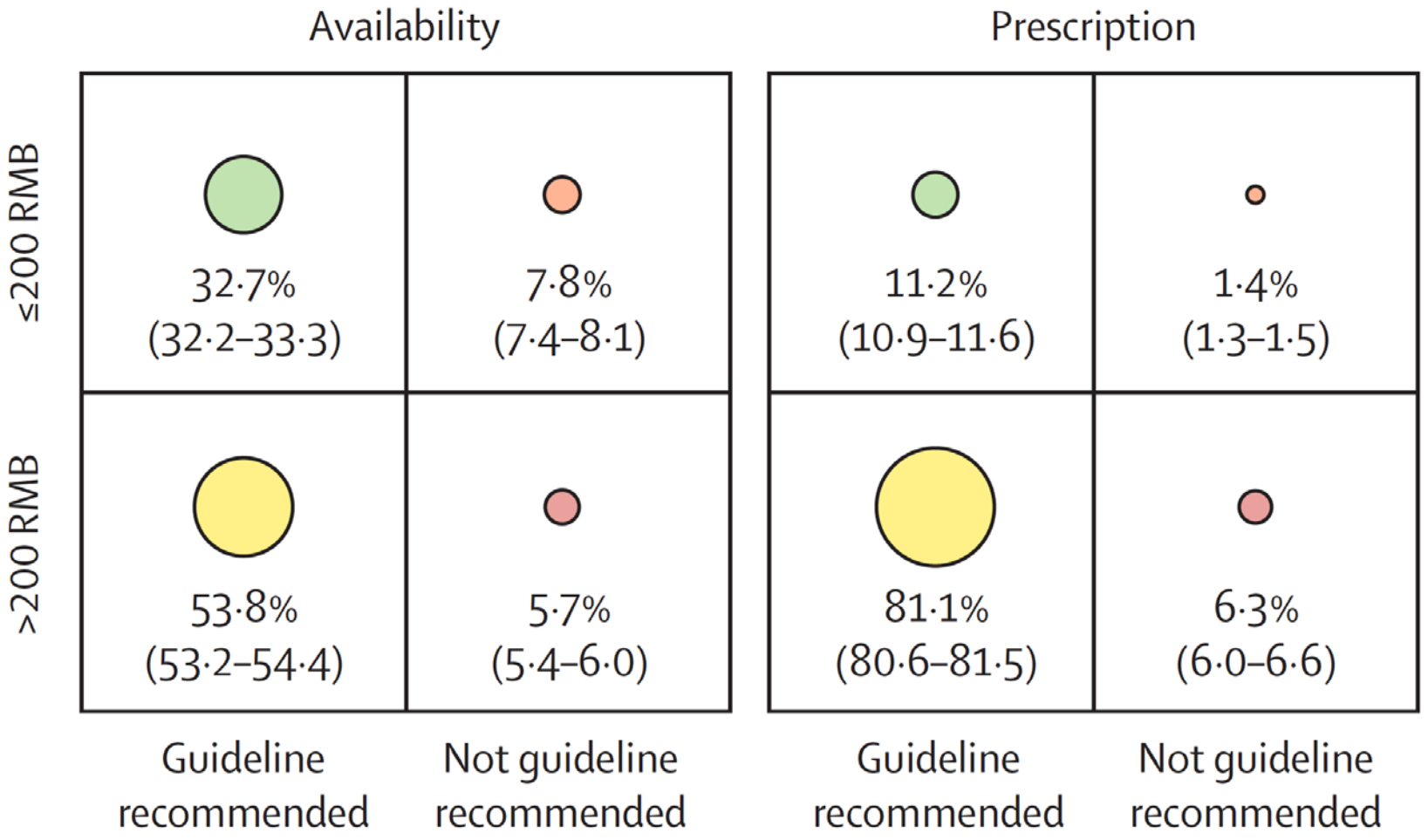
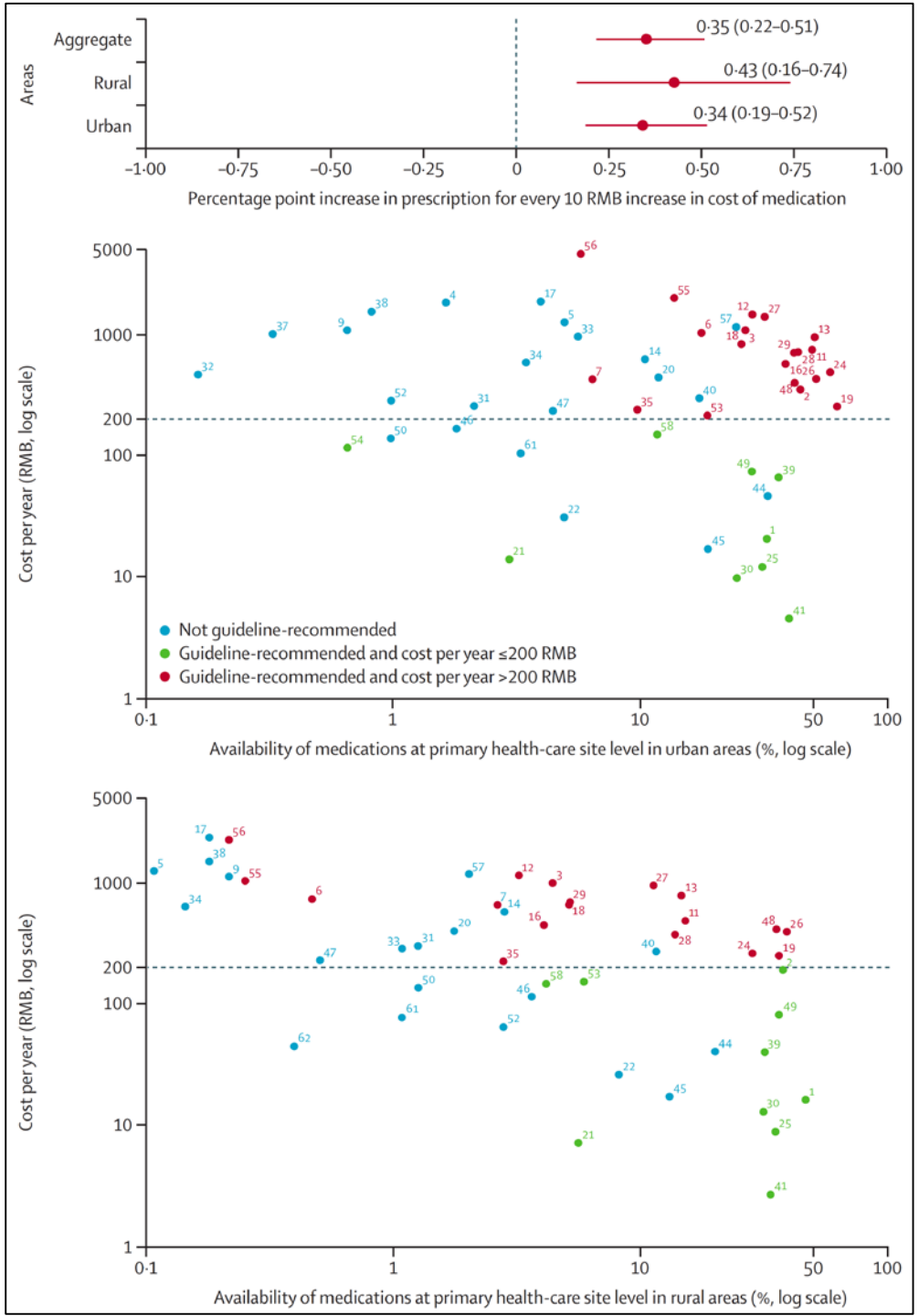


Figure 2: Availability and prescription of medications in China by value quadrants



1 Captopril	2 Enalapril	3 Benazepril
4 Ramipril	5 Perindopril	6 Fosinopril
7 Lisinopril	8 Quinapril	9 Imidapril
10 Cilazapril	11 Valsartan	12 Losartan
13 Irbesartan	14 Candesartan	15 Eprosartan
16 Telmisartan	17 Olmesartan	18 Bisoprolol
19 Metoprolol	20 Metoprolol extended release	21 Atenolol
22 Propranolol	23 Betaxolol	24 Amlodipine
25 Nifedipine	26 Nifedipine extended release	27 Nifedipine controlled release
28 Felodipine extended release	29 Levamlodipine	30 Nitrendipine
31 Verapamil	32 Verapamil extended release	33 Diltiazem
34 Diltiazem extended release	35 Lacidipine	36 Nicardipine
37 Benidipine	38 Lercanidipine	39 Indapamide
40 Indapamide extended release	41 Hydrochlorothiazide	42 Bendroflumethiazide
43 Chlortalidone	44 Spironolactone	45 Furosemide
46 Triamterene	47 Amiloride	48 Compound reserpine triamterene
49 Compound reserpine	50 Compound dihydralazine sulfate	51 Compound trizin and rutinum
52 Compound kendir	53 Zhenju jiangya tablet	54 Amiloride compound
55 Losartan potassium and hydrochlorothiazide	56 Valsartan and hydrochlorothiazide	57 Irbesartan and hydrochlorothiazide
58 Captopril and hydrochlorothiazide	59 Nitrendipine and atenolol	60 Rauwolfia
61 Clonidine	62 Reserpine	

Figure 3: Annual costs per patient compared with availability and prescription patterns of antihypertensive medications. Data are (A) percentage point increase (95% CI) and (B) and (C) percentages

Conclusion

- This study revealed key obstacles to progress in mitigating hypertension in China.
- Despite advances in health-care coverage and policy to limit financial risks and improve health outcomes, this study highlighted deficiencies in the availability, cost, and prescription of antihypertensive medications.
- Future policies aimed at alleviating the burden of hypertension in China, particularly through the work of primary health-care providers, will need to improve access to high-value antihypertensive medications.