International Journal of Technology Assessment in Health Care

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Cost-effectiveness analysis of a nonphysician-led, community-based blood pressure intervention in rural China based on CRHCP research

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Abstract

Background: The China Rural Hypertension Control Project (CRHCP) is a nonphysician-led community-based hypertension intervention program that has demonstrated clear benefits in improving blood pressure (BP) control and reducing the incidence of cardiovascular disease events among hypertensive patients in rural areas of China. However, it is currently unclear whether the benefits of the CRHCP outweigh its costs, and whether promoting this project in China is justifiable from a perspective of healthcare system.

Methods: We employed a Markov model to forecast the anticipated 20-year costs and effectiveness of the CRHCP trial. Cost data for this study was gathered from public records or published papers, whereas clinical data was extracted from the CRHCP trial. Our primary outcome measure was the incremental cost-effectiveness ratio, expressed in Chinese Yuan (CNY) per quality-adjusted life-year (QALY), representing the additional cost per additional QALY gained.

Results: Over a span of 20 years, the cost for a rural hypertensive individual in China who received intensive BP intervention by a nonphysician community healthcare provider would amount to 25,129 CNY, yielding an effectiveness of 8.19 QALY. In contrast, if usual care was provided, the cost would be 26,709 CNY with an effectiveness of 7.94 QALY. The CRHCP program demonstrated lower costs and greater effectiveness for rural hypertensive individuals in China.

Conclusion: Our study indicates that the implementation of the CRHCP program among rural hypertensive individuals in China resulted in increased effectiveness and reduced costs. From the perspective of Chinese healthcare system, the CRHCP program proves to be cost-saving within the current healthcare landscape.

Assessment

Cite this article: Li Q, Xu T, Hu T, Lou Y (2024). Cost-effectiveness analysis of a nonphysician-led, community-based blood pressure intervention in rural China based on CRHCP research. *International Journal of Technology Assessment in Health Care*, **40**(1), e73, 1–9
https://doi.org/10.1017/S0266462324000461

Received: 17 October 2023
Revised: 03 June 2024
Accepted: 15 July 2024

Keywords:
hypertension; CRHCP; cost-utility analysis; Markov model; healthcare policy

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Introduction

Hypertension stands as the principal modifiable risk factor for both cardiovascular (CV) disease (CVD) and all-cause mortality on a global scale (1). With over 1 billion adults affected worldwide, it represents a significant global health challenge, and this number is projected to rise to over 1.5 billion by 2025 (2). Despite considerable strides made to lower the incidence of hypertension, suboptimal hypertension control persists in certain populations due to factors, such as poor adherence to treatment, low health literacy, and inadequate disease awareness (3–5). Notably, according to a study conducted by Lu et al., the incidence of hypertension in China has exceeded 200 million individuals. However, out of these patients, only 23 percent receive antihypertensive medications, and a mere 5.7 percent achieve the target blood pressure (BP) (6).

A survey conducted in 2018 across 298 counties/districts in China, involving 179,873 individuals over the age of 18, revealed that the prevalence of hypertension was higher in rural areas (29.4%) compared to urban areas (25.7%). The control rate for hypertension was found to be only 11 percent, highlighting the significant burden of hypertension in these regions (7). Furthermore, patient-related obstacles, such as noncompliance, reliance on traditional therapies, sociocultural influences, and insufficient awareness, significantly impede the effective management and control of hypertension (8).This issue is particularly prevalent in rural areas, where the provision of adequate hypertension care is lacking, leading to suboptimal treatment adherence among patients. Therefore, additional measures are necessary to improve the identification and treatment of hypertension in China, particularly in rural areas (9;10). The CRHCP is a nonphysician-led community-based hypertension intervention program that utilizes an open-label, cluster-randomized trial to investigate the effectiveness of a multifaceted intervention led by village doctors in controlling BP and reducing the risk of CVD among rural residents with hypertension in China (11;12). The CRHCP study results demonstrated a reduction in both systolic and diastolic BP levels among patients in the intervention group compared to those receiving usual care. Furthermore, the

intervention group also experienced a decrease in secondary outcomes, such as myocardial infarction (MI), heart failure (HF), stroke, CV death, and all-cause death (11;13). To summarize, the village doctor-led intervention resulted in statistically significant improvements in BP control among rural residents in China.

However, the utilization of antihypertensive medications in this project may lead to significant financial outlays. Moreover, implementing CRHCP will also augment the expenses of educating rural physicians (11). Although there are potential economic and clinical expenses associated with CRHCP, the benefits are also noteworthy. Effectively managing hypertension can mitigate complications, such as HF, stroke, and MI, thereby reducing hospitalization costs. Furthermore, BP control could lower the risk of CV and all-cause mortality, leading to a longer lifespan and improved health outcomes for patients. Whereas the optimal balance between the costs and benefits of CRHCP is unclear. Hence, it is essential to conduct an economic evaluation for this program to provide a theoretical basis for public health policy makers.

Methods

Ethical approval and informed consent were not required for this health economic evaluation study as it utilized publicly available and previously published data. The study adhered to the Consolidated Health Economic Evaluation Reporting Standards reporting guideline (14).

Model structure

We developed a 20-year simulation Markov model to compare the cost-effectiveness of nonphysician community healthcare provider-led intensive BP intervention with usual care for hypertensive individuals in rural China.

In the Markov model, villages involved in the project were randomly assigned to either the intervention or control group. Individuals in the intervention group received training, education, and other forms of support for hypertension treatment, whereas those in the control group lacked access to such resources. Participants in both groups were at risk of experiencing various CV events, such as MI, stroke, and HF, transitioning to corresponding health states ("post-MI," "post-stroke," or "post-HF") upon experiencing these events. Except for the "Death" state, individuals in other health states faced the possibility of CV death or death from other causes (background mortality), with CV mortality data obtained directly from the CRHCP project and background mortality accessed from the China Health Statistical Yearbook 2022 (15). In addition, individuals in health states other than "Death" may

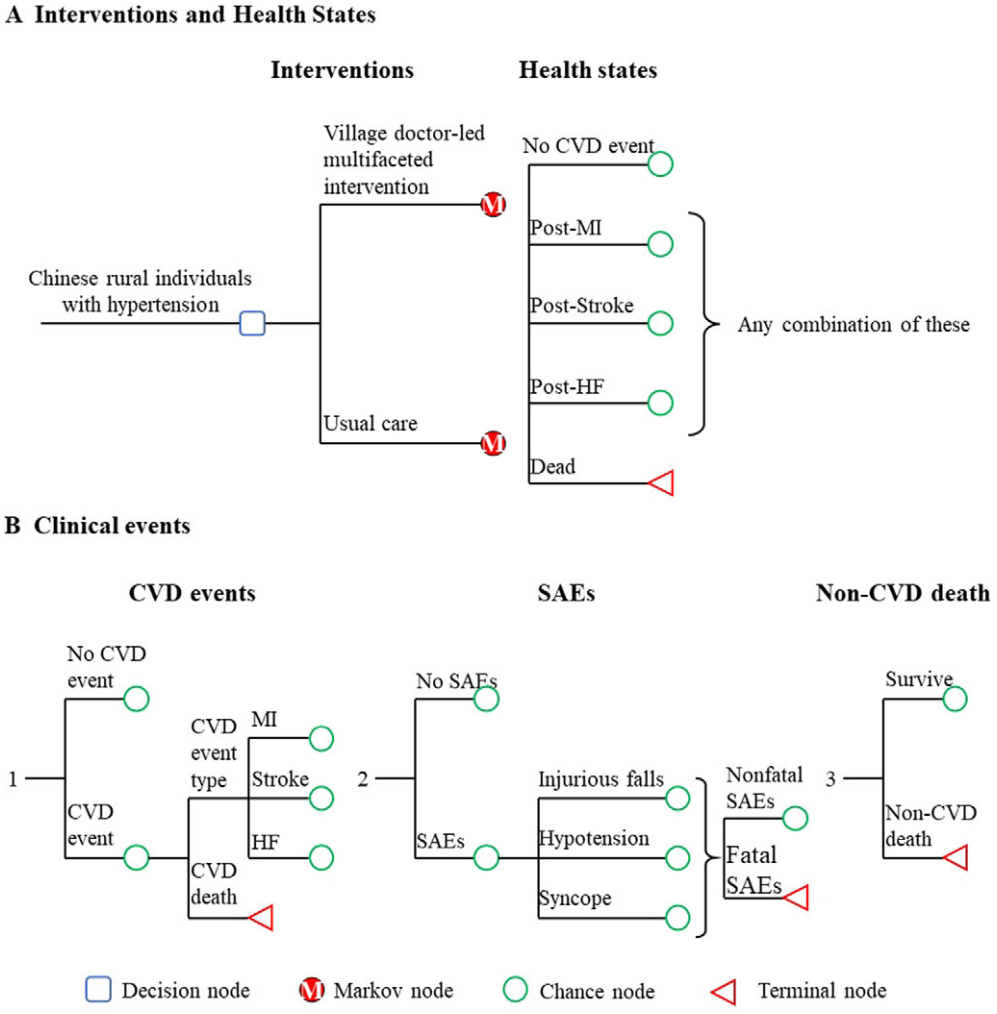

Figure 1. Schematic of the Markov model. CVD, cardiovascular disease; MI, myocardial infarction; HF, heart failure, SAE, serious adverse event.

https://doi.org/10.1017/S0266462324000461 Published online by Cambridge University Press

experience serious adverse events (SAEs), such as injurious falls, hypotension, and syncope. Transition probabilities for SAEs were obtained from the CRHCP project, showing slightly higher incidences in the intervention group compared to the control group. The model also accounted for the costs and disutilities associated with these SAEs (Figure 1).

The analysis only considered direct costs, excluding any indirect or nonmedical costs. Future costs and effectiveness were discounted at a rate of 0.05.

Intervention and control

In the intervention cohort, a standardized protocol was implemented, wherein trained village doctors took the initiative to initiate and adjust antihypertensive medications. Primary care physicians provided supervision and guidance throughout this process. The intervention cohort's village doctors received comprehensive training and support through a multifaceted intervention program. This program encompassed various aspects, including but not limited to training in accurate BP measurement techniques, health coaching on lifestyle modifications, and assistance from primary care physicians at township hospitals in hypertension management. To incentivize optimal performance, achieving a high hypertension control rate was among the metrics considered.

Participants in the intervention group also benefited from additional provisions, such as training on how to use home BP monitors, provision of free or discounted antihypertensive medications, education on healthy lifestyles and medication adherence, and more. On the other hand, participants in the usual care cohort solely received their regular care from village doctors or primary care physicians at township hospitals. Village doctors in the usual care cohort did not receive any specific training or support related to hypertension management.

Population

The CRHCP was a cluster-randomized trial that extensively recruited participants from rural Chinese villages, thus representing a broad demographic of individuals with hypertension in rural China. Specifically, participants were characterized by a mean untreated systolic BP ≥ 140 mm Hg and/or diastolic BP ≥ 90 mm Hg, or a mean treated systolic BP ≥ 130 mm Hg and/or diastolic BP ≥ 80 mm Hg for those without a history of clinical CVD. For individuals with a history of clinical coronary heart disease, HR, stroke, diabetes, or chronic kidney disease, the criteria included a mean treated/untreated systolic BP ≥ 130 mm Hg and/or diastolic BP ≥ 80 mm Hg.

Transition probabilities of clinical events

In the base case analysis, the transition probabilities utilized were obtained from the published CRHCP study. Specifically, the 3-year incidence of MI was reported as 105 out of 17,407 in the intervention group and 129 out of 16,588 in the control group within the CRHCP study. To calculate the annual transition probability, the following formula was employed: Rate = $[-\ln(1-p)]/t$, where Rate refers to the rate, p represents the probability (3-year incidence), and t denotes the time period. By using the above formula, the transition probability was derived as follows: Transition probability = $1 - \exp(-rt)$. In this equation, r represents the rate calculated using the formula above, t corresponds to the specified time period, and the exponential function $\exp(-rt)$ is utilized to calculate the probability of transitioning within the given time frame (Table 1).

The transition probabilities for HF events, stroke events, all-cause death, and SAEs were calculated using the identical formula as mentioned earlier.

Utilities

The CRHCP trial did not report utilities for the state of hypertension or other relevant states. Therefore, we sourced the utility of hypertension from a published study examining utility scores among Chinese hypertension patients. The utility scores were determined to be 0.893 for individuals aged 55–64 and 0.803 for those aged ≥65 in rural areas of China. It is noteworthy that the utility of hypertension was consistent between the intervention and control groups (Table 1) (16;17).

Utility values varied between the acute and chronic phases of MI, stroke, and HF events (Table 1). Additionally, we incorporated disutility values for SAEs (Table 1) (18–20).

Cost

The major costs incurred in the CRHCP trial included cost of training of nonphysician community healthcare providers, cost of patient education materials, cost of BP monitors, cost of medications, salaries of nonphysician community healthcare providers, incentives for nonphysician community healthcare providers, salaries of primary care physicians, and other cost. The summary of the above cost was 1,531 Chinese Yuan (CNY) (Table 1).

The cost of MI event, stroke event, and HF event was not included in the CRHCP study, but included in our analysis. In addition, the annual cost of chronic states of the CV events was also included in our analysis (Table 1). The cost of SAEs was obtained from domestic data (Table 1).

Outcomes

The primary outcome of the study was incremental cost-effectiveness ratio (ICER), which was expressed as CNY per quality-adjusted life-year (QALY), representing incremental cost (CNY) per incremental QALY. Secondary outcomes included incremental cost (CNY), incremental effectiveness (QALY or life-year), ICER expressed with CNY per life-year, additional cost of CV events, and additional cost of SAEs. Following the recommendations of the China Guidelines for Pharmacoeconomic Evaluations (21), the intensive BP intervention conducted by nonphysician community healthcare providers was considered dominant if it resulted in lower costs alongside greater effectiveness. It was regarded as highly cost-effective if the ICER remained below the willingness-to-pay (WTP) threshold of one times the per capita gross domestic product (GDP) in China for 2021, which was 80,976 CNY. If the ICER ranged between one to three times the GDP per capita, the intervention was classified as cost-effective. However, if the ICER exceeded three times the GDP per capita, the intervention was deemed not cost-effective.

Model validation

For short-term validation of our model, we compared the predicted 3-year CV event rate with the observed rate during follow-up in the CRHCP study. To assess the model's long-term performance, we compared its predictions of 10-year all-cause mortality and CV event rates with corresponding data from the Kailuan cohort study in China.

https://doi.org/10.1017/S0266462324000461 Published online by Cambridge University Press

Table 1. Main input parameters of base case and sensitivity analysis

Input parameters	Data	Distribution	Source
Annual transition probabilities in intervention			
MI	0.00201 (0.00163–0.00240)	β	Ref (11)
Stroke	0.01241 (0.01145–0.01337)	β	Ref (11)
HF	0.00090 (0.00064–0.00116)	β	Ref (11)
CV death	0.00747 (0.00673–0.00821)	β	Ref (11)
All cause death	0.01341 (0.01242–0.01441)	β	Ref (11)
Annual transition probabilities in usual care			
MI	0.00260 (0.00215–0.00305)	β	Ref (11)
Stroke	0.01846 (0.01742–0.01986)	β	Ref (11)
HF	0.00149 (0.00115–0.00183)	β	Ref (11)
CV death	0.00982 (0.00899–0.01075)	β	Ref (11)
All cause death	0.01584 (0.01485–0.01710)	β	Ref (11)
Background mortality in rural China in 2022			
60–64	0.00833	/	Ref (15)
65–69	0.01358	/	Ref (15)
70–74	0.02436	/	Ref (15)
75–79	0.04305	/	Ref (15)
80–84	0.06999	/	Ref (15)
Annual transition probabilities of SAEs in intervention			
Injurious falls	0.00178 (0.00142–0.00215)	β	Ref (11)
Hypotension	0.00588 (0.00522–0.00653)	β	Ref (11)
Syncope	0.00138 (0.00106–0.00170)	β	Ref (11)
Annual transition probabilities of SAEs in control			
Injurious falls	0.00165 (0.00129–0.00201)	β	Ref (11)
Hypotension	0.00298 (0.00251–0.00347)	β	Ref (11)
Syncope	0.00129 (0.00097–0.00160)	β	Ref (11)
Cost of CV events (CNY)			
MI	30171 (15085.5–60,342)	γ	Ref (24;29)
Stroke	9823.9 (4912–19,647.8)	γ	Ref (27;29)
HF	9176 (4588–18352)	γ	Ref (24;29)
Annual cost of CVD state (CNY)			
MI	17,644 (8822–35,288)	γ	Ref (24;29)
Stroke	13,265.9 (6632.9–26,531.7)	γ	Ref (24;29)
HF	15,872.4 (7,936.2–31,744.8)	γ	Ref (24;29)
Annual costs per person in the CRHCP trial (CNY)			
Training of village doctors	7 (3.5–14)	γ	Ref (11)
Patient education materials	1.3 (1–2)	γ	Ref (11)
BP monitors	42 (21–84)	γ	Ref (11)
Medications	196 (98–392)	γ	Ref (11)
Salaries of village doctors	68 (34–136)	γ	Ref (11)
Incentives for village doctors	14.3 (10–20)	γ	Ref (11)
Salaries of physicians	10 (5–20)	γ	Ref (11)
Other cost	171.7 (86–343)	γ	Ref (11)

(*Continued*)

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Table 1. (*Continued*)

Input parameters	Data	Distribution	Source
Total intervention costs	510 (256–1021)	γ	Ref (11)
Total cost in the usual care	0.7 (0–2)	γ	Ref (11)
Cost of SAEs			
Injurious falls	15801 (7900.5–23701.5)	γ	Ref (24;29)
Hypotension	484 (161.3–1452)	γ	Ref (24;29)
Syncope	1697 (848.5–2545.5)	γ	Ref (24;29)
Utility			
Hypertension state			
Aged 55–64	0.893 (0.534–1)	β	Ref (16;17)
Aged ≥65	0.803 (0.313–1)	β	Ref (16;17)
MI event	0.6 (0.57–0.63)	β	Ref (24;29)
Stroke event	0.55 (0.53–0.58)	β	Ref (24;29)
HF event	0.63 (0.6–0.66)	β	Ref (24;29)
Poststroke state	0.69 (0.57–0.89)	β	Ref (18)
Post-MI state	0.7 (0.67–0.74)	β	Ref (24;29)
Post-HF state	0.73 (0.69–0.77)	β	Ref (24;29)
Disutility of SAEs	−0.01	/	Ref (24;29)
Discount rate	0.05 (0–0.08)	/	Ref (21)

MI, myocardial infarction; HF, heart failure; CV, cardiovascular; CVD, cardiovascular disease; CNY, Chinese Yuan; SD, standard deviation; CRHCP, China Rural Hypertension Control Project; BP, blood pressure; SAE, serious adverse event.

Sensitivity analysis

In the one-way sensitivity analysis, the input parameters were varied within specified intervals, resulting in fluctuations in the ICER based on these input changes. The outcomes of the one-way sensitivity analysis were visually presented using a Tornado diagram, which illustrated the relative impact of each parameter on the ICER.

For the probabilistic sensitivity analysis (PSA), 10,000 Monte Carlo simulations were performed using probabilistic sampling. The cost parameters followed a gamma distribution, the transition probabilities and utility values followed a beta distribution. The results of the PSA were graphically displayed through a scatter plot and an acceptability curve, providing a comprehensive understanding of the uncertainty surrounding the ICER estimates.

Results

Model validation

As presented in Supplementary Table S1, the comparison between the simulation and the CRHCP trial revealed consistent 3-year rates for all-cause death, MI, HF, and stroke. Additionally, the evaluation of 10-year CV event rates indicated similar results in both all-cause mortality and MI rates between the Markov simulation and the Kailuan cohort study, which predominantly enrolled Chinese participants.

Base case analysis

In the base case analysis, the intensive BP intervention administered by nonphysician community healthcare providers incurred a cost of 25,129 CNY per rural individual, with an average age of 63 years old, who had hypertension in China. In comparison, the cost per individual receiving usual care was calculated at 26,709 CNY. The corresponding effectiveness measured in QALY was 8.09 and 7.94, respectively. Over a simulation spanning 20 years, the intensive BP intervention demonstrated dominance (Table 2).

It is evident that the largest portion of the total cost was attributed to stroke-related expenses in both the intervention and usual care groups. In the intervention group, the costs primarily consisted of those related to intensive BP intervention and MI, whereas in the usual care group, MI-related costs and HF-related costs were predominant. In terms of effectiveness, stroke resulted in the greatest loss of QALYs, followed by MI and HF in both groups. Additionally, the impact of SAEs-related costs and effectiveness on the overall cost and effectiveness was minimal (Table 2).

Sensitivity analysis

In the one-way sensitivity analysis conducted for the CRHCP trial, it was found that the annual cost of stroke, medication expenses, and other project-related costs within the CRHCP emerged as the primary factors significantly influencing the variability of the ICER. These factors had the potential to elevate the ICER to levels greater than 0 but lower than 5,000. Conversely, variations in other input parameters did not yield ICER values exceeding 0 (Figure 2).

The scatter plot revealed that approximately 92 percent of the dots were situated in the fourth quadrant, with 8 percent lying in the first quadrant, all significantly below the WTP threshold line (Figure 3). Furthermore, the cost-effectiveness acceptability curve demonstrated that the intensive BP intervention exhibited higher acceptability regardless of the WTP threshold set (Supplementary Figure S1).

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Table 2. The simulated cost and effectiveness for each participant in the CRHCP trial with a timeframe of 3 years

Base case	Intervention	Usual care
Total cost (CNY)	25,129	26,709
Intervention/Usual care	5,546	7
MI-related	3,634	4,455
Stroke-related	14,214	19,895
HF-related	1,214	1,896
SAE-related	522	456
Total effectiveness (QALY)	8.19	7.94
Intervention/Usual care	8.5	8.37
MI-related	−0.04	−0.05
Stroke-related	−0.26	−0.36
HF-related	−0.02	−0.03
SAE-related	0	0
Total effectiveness (LY)	10.43	10.27
Incremental cost	−1,580	—
Incremental effectiveness (QALY)	0.25	—
Incremental effectiveness (LY)	0.16	—
ICER (CNY/QALY)	−6,316	—
ICER (CNY/LY)	−9,839	—

CNY, Chinese Yuan; MI, myocardial infarction; HF, heart failure; SAE, serious adverse events; QALY, quality-adjusted life-year; CV, cardiovascular; LY, life-year; ICER, incremental cost-effectiveness ratio.

Discussion

CRHCP, the initiative spearheaded by nonphysician community healthcare providers, is dedicated to the comprehensive and intensive management of BP for individuals with hypertension residing in rural regions of China (11;13). Its primary objective is to advance the efficacy of hypertension management and treatment through the efforts of nonphysician professionals embedded within rural communities. This initiative had a substantial improvement in the level of hypertension management and treatment within rural areas, along with a notable enhancement in the rate of BP control. Furthermore, CRHCP exhibits a valuable potential for mitigating the occurrence and advancement of CVD (11;13).

In our study, we pioneered the economic evaluation of CRHCP for the first time and presented compelling evidence of its significant advantages in terms of cost-effectiveness. Specifically, the implementation of CRHCP resulted in lower costs and increased effectiveness, rendering it a dominant approach. Several factors contribute to CRHCP's dominance. Firstly, the total project cost was economical, amounting to 510 CNY (approximately $70) per individual with hypertension in rural areas of China. Secondly, CRHCP substantially reduced the incidence of CVD, including HF, MI, and stroke, thereby reducing costs associated with acute CV events and chronic phases. Thirdly, CRHCP contributed to a decrease in CV-related and all-cause mortality, enhancing its effectiveness.

Numerous measures have been implemented in China to enhance the treatment and management of hypertension. One such measure, as noted in the Strategy of Blood Pressure Intervention trial in older hypertensive patients, involves intensive BP control for older patients with hypertension. The study's author discovered that older patients with hypertension who received intensive treatment, targeting a systolic BP of 110 to less than 130 mm Hg, experienced a lower incidence of CV events compared to those who received standard treatment with a target of 130 to less than 150 mm Hg. These findings suggest that intensive BP control is beneficial for older patients with hypertension (22;23). Furthermore, the health economic evaluation conducted on STEP revealed that intensive BP control not only offers clinical benefits to patients with hypertension but is also deemed to be cost-effective in economic evaluations (24). In addition, other scholars have demonstrated that intensive BP reduction is cost-effective not only in China but also in other countries, such as the United States, South Korea, and China (Taiwan) (19;20;25). In fact, some guidelines have adopted 130/80 as the latest standard for hypertension control, with the aim of achieving earlier hypertension management (26). The management of hypertension involves a multifaceted approach that encompasses various aspects, including medication, lifestyle improvements, increased adherence, and so on (27;28). Regarding drug treatment, China's centralized procurement system has resulted in significantly lower prices for drugs, with some antihypertensive medications experiencing a price drop of up to 67 percent (29). Various investigations, including those exploring Olmesartan and Sacubitril-valsartan (29;30), have substantiated that specific antihypertensive medications exhibit cost-effectiveness in China. Moreover, the pharmacoeconomic assessment carried out in the Chinese setting has demonstrated the cost-effectiveness of inexpensive antihypertensive medications (31). Chen et al. found that drug treatment was more cost-effective for patients with prehypertension (130–139/85–89 mm Hg) compared to placebo treatment, with an ICER of $12,994 per QALY over the course of a lifetime (32). Nevertheless, the cost-effectiveness of drug treatment was found to be lower when compared to nondrug treatment for individuals aged 65 years and older with stage I hypertension and no history of CVD in China (33). In our analysis, we discovered that the intensive BP control program administered by nonphysician community healthcare providers was dominant for rural hypertensive individuals in China. This finding sheds light on hypertension control from alternative perspectives beyond solely focusing on medication costs.

At present, the hypertension awareness rate, treatment (medication) rate and grasp rate (defined as BP lower than 140/90 mmHg by treatment) of Chinese population hypertension patients is 70 percent, 59 percent, and 34 percent, respectively, according to the Guidelines for hypertension prevention and treatment in China 2023. In addition, the above rates are lower in rural areas than in urban areas, lower in men than in women, and lower in less economically developed areas than in more developed areas. Hence, for individuals with hypertension residing in rural regions, the paramount approach for this cohort could be to enhance their adherence. The CRHCP initiative has the potential to ameliorate this predicament to a certain extent. In the CRHCP investigation, the mean systolic BP exhibited a reduction of −26.3 mm Hg (95% CI, −27.1 to −25.4) in the intervention group from the baseline to 18 months, whereas it decreased by −11.8 mm Hg (−12.6 to −11.0) in the control group. The inter-group difference was −14.5 mm Hg (95% CI, −15.7 to −13.3 mm Hg; $p < .0001$). Correspondingly, the mean diastolic BP decreased by −14.6 mm Hg (−15.1 to −14.2) in the intervention group and by −7.5 mm Hg (−7.9 to −7.2) in the control group, with a group difference of −7.1 mm Hg (−7.7 to −6.5 mm Hg; $p < .0001$) (13). Neither group reported any significant treatment-related adverse events, which implies that the potential

https://doi.org/10.1017/S0266462324000461 Published online by Cambridge University Press

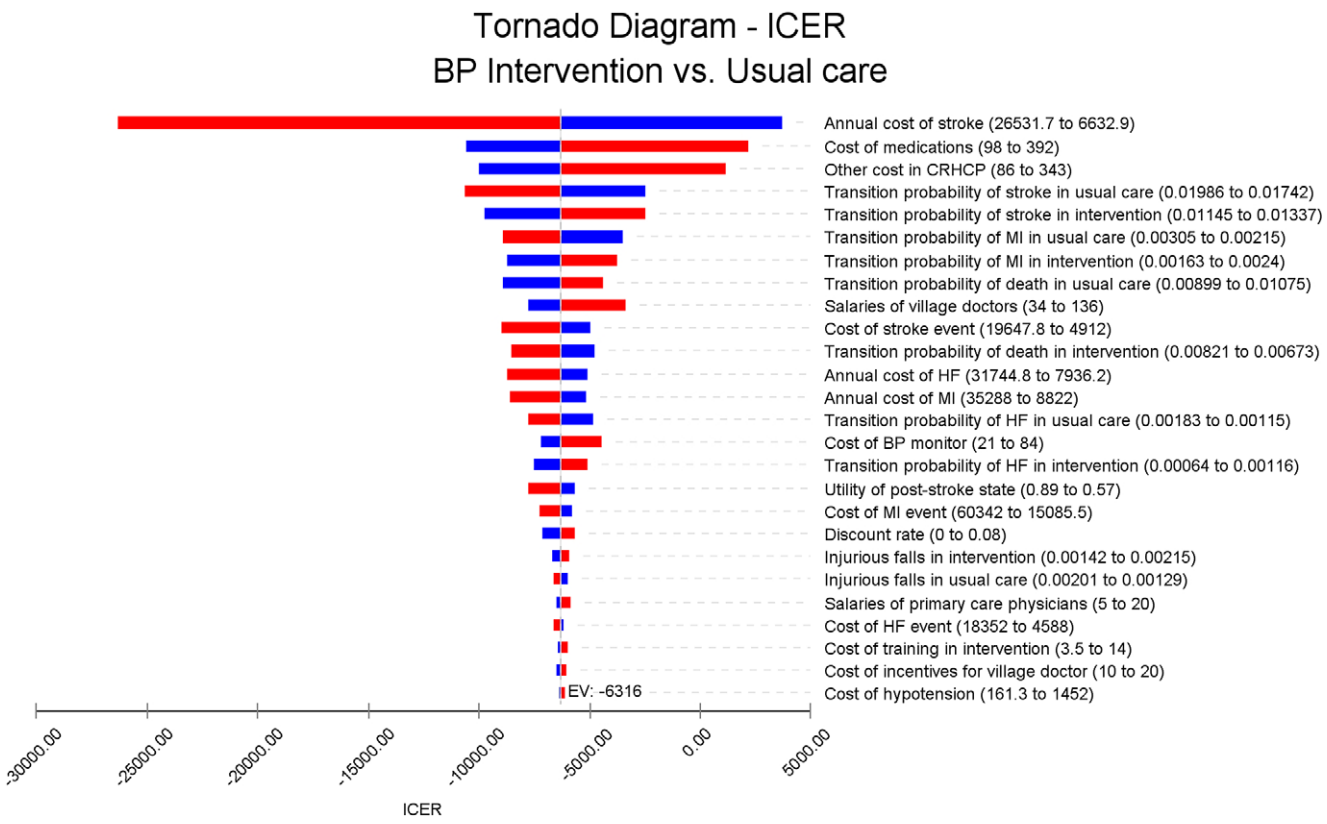

Figure 2. Tornado diagram of ICER. Red is used to represent the upper range of the variables, whereas blue indicates the lower range of the variables. It is evident that the annual cost of stroke, cost of medications, and other cost in the CRHCP had the most significant impact on the fluctuation of ICER. None of the input parameters resulted in an ICER exceeding the willingness-to-pay threshold of one time the per capita GDP in China for the year 2021. ICER, incremental cost-effectiveness ratio; BP, blood pressure; MI, myocardial infarction; HF, heart failure; SAE, serious adverse event.

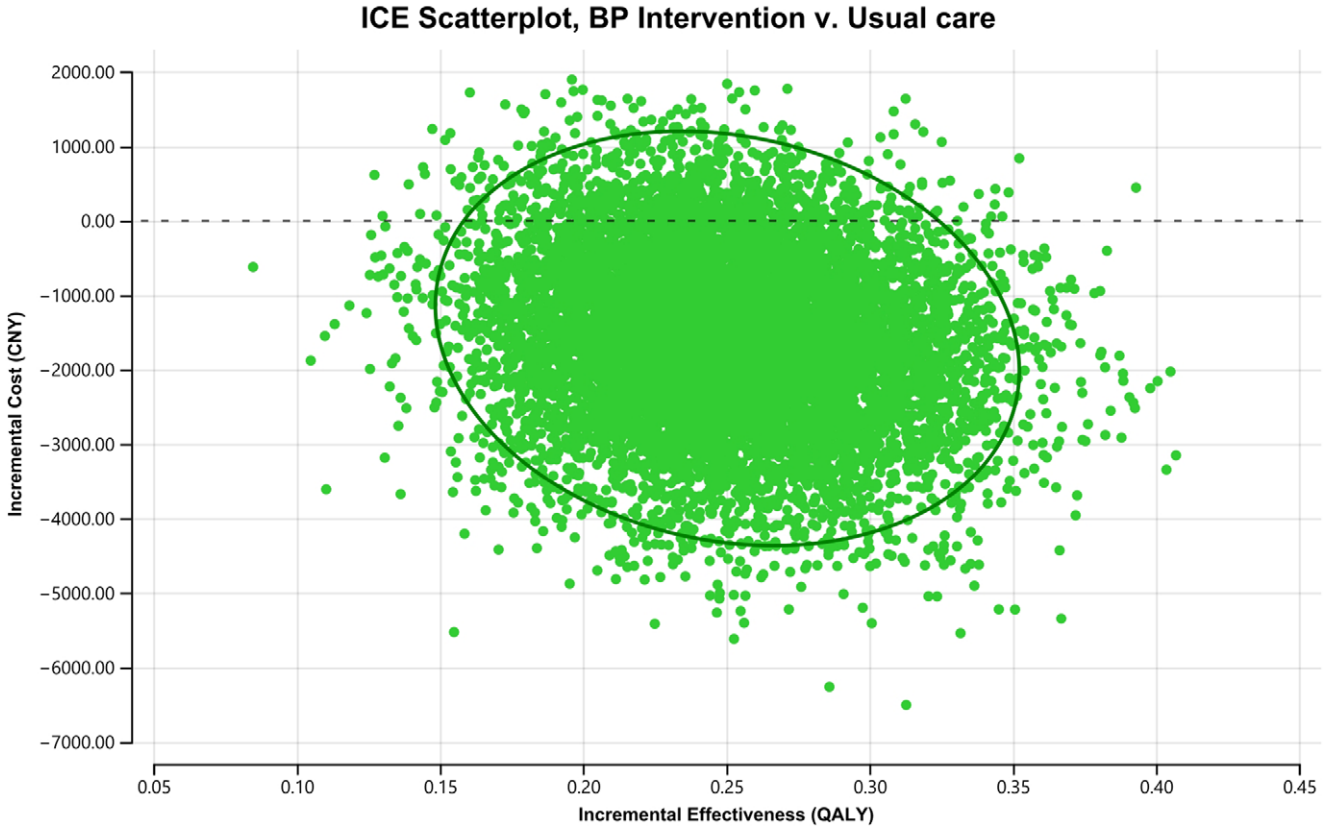

Figure 3. Scatter plot of incremental cost and incremental effectiveness. Approximately 92% of the points are in the fourth quadrant, whereas the remaining 8 percent were situated in the first quadrant. ICE, incremental cost effectiveness; BP, blood pressure; CNY, Chinese Yuan; QALY, quality-adjusted life-year.

https://doi.org/10.1017/S0266462324000461 Published online by Cambridge University Press

advantages of enhancing compliance among hypertensive patients are substantial.

Furthermore, the CRHCP study revealed that the most significant effect of antihypertensive therapy was the reduction in stroke events, as China experiences approximately 3.94 million new strokes annually (34), and hypertension is one of the major risk factors for stroke. Therefore, implementing CRHCP can significantly improve the incidence of stroke to some extent, which is a key factor contributing to the cost-effectiveness of the intervention. Moreover, the success of the CRHCP studies can also be attributed, in part, to the use of low-cost antihypertensive drugs. In China, the prices of drugs have significantly decreased due to centralized procurement, which has helped to reduce the cost of interventions to a certain extent.

According to a randomized controlled trial, an intervention delivered by a team of nurse practitioners and community health workers utilizing individualized treatment regimens based on treat-to-target algorithms can be an effective approach to reducing BP in patients with hypertension compared to enhanced usual care (35). Unlike them, CRHCP is a nonphysician-led community-based hypertension intervention program that aims to examine the effectiveness of a multifaceted intervention led by village doctors in controlling BP. CRHCP has demonstrated that a village doctor-led intervention can significantly reduce BP and lower the incidence of HF, stroke, MI, CV death, and all-cause death in China (13).

The implementation of an intervention depends not only on its effectiveness but also on its cost-effectiveness. CRHCP programs have demonstrated the ability to reduce the incidence of CV events while also to be dominant in China. Therefore, our research can provide policy makers with a basis for decision making when it comes to implementing such programs.

Our study has several limitations. Firstly, it relied on a Markov model utilizing data from public sources. Although cost and clinical data were derived from the CRHCP program, employing within-trial modeling could potentially offer more accurate data on cost and effectiveness. Secondly, although the follow-up period in the CRHCP was 3 years, our simulation extended over 20 years, which might lead to an overestimation of both cost and effectiveness. Thirdly, the participants in the CRHCP trial were drawn from villages in three provinces in China. Although they represented various locations within China, they may not fully represent rural individuals across the entire country. Lastly, the cost and clinical data were obtained from Chinese rural individuals, so caution should be exercised when extrapolating the conclusions to other countries or regions.

Conclusion

Our study suggests that implementing intensive BP intervention by nonphysician community healthcare providers could enhance effectiveness while reducing costs for rural individuals with hypertension in China. The CRHCP project emerged as dominant from the perspective of Chinese healthcare system.

Supplementary material. The supplementary material for this article can be found at http://doi.org/10.1017/S0266462324000461.

Data availability statement. The original research findings are provided within the article, and further inquiries can be directed to the corresponding author.

Acknowledgement. We thank Dr Yuhong Zeng for her help in the model construction during the revision process.

Author contribution. The idea and protocol for the study were developed by YL and TH. QL and TX synthesized the data and drafted the manuscript. Data collection and analysis were performed by QL, YL, and TX. All authors contributed to and approved the final version of the manuscript. QL and TX contributed equally to this article.

Funding statement. This research received no specific grant from any funding agency, commercial, or not-for-profit sectors.

Competing interest. The authors affirm that the research was carried out without any financial or commercial conflicts of interest that could potentially influence the results or interpretation of the study.

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https://doi.org/10.1017/S0266462324000461 Published online by Cambridge University Press