



Economic evaluation of a new blood pressure target for hypertensive patients in Taiwan

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Keywords Cost-effectiveness · CVD (cardiovascular disease) · Guideline · Intensive blood pressure control · Simulation

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Aging has become a common issue in developed countries with advanced medical technology. Hypertension is considered an important risk factor for cardiovascular disease (CVD), and antihypertensive therapy has been a central strategy for CVD prevention. However, target values for blood pressure management are undergoing debate in various countries [1, 2]. Several intervention trials have shown that antihypertensive drug treatment is useful even for older adults; however, public awareness of the importance of hypertension management is considered inadequate.

Two landmark studies have been conducted in recent years. The large-scale SPRINT (Systolic Blood Pressure Intervention Trial) led by the NIH in the United States and published in 2015 showed that actively lowering blood pressure to ≤ 120 mmHg significantly reduced the risk of CVD among high-risk hypertensive patients regardless of age [3]; their findings have had a major impact on global hypertension guidelines. In 2021, the STEP (Strategy of Blood Pressure Intervention in Elderly Hypertensive Patients) trial from China, which targeted a similar number of cases, demonstrated that treatment with a systolic blood pressure (SBP) target of 130 mmHg could reduce CVD events [4].

On the basis of those two clinical trials, the Taiwan Society of Cardiology redefined the hypertension threshold to 130/80 mmHg in its 2022 Hypertension Clinical Practice Guidelines [5]; it recommends a more aggressive SBP target of < 120 mmHg for hypertensive patients at high CVD risk

or with atherosclerotic CVD (ASCVD). An increase in the prevalence of hypertension has been observed in Taiwan; despite a decline in CVD mortality, the incidence of CVD and associated medical costs are increasing. In the Taiwan study, the authors conducted a virtual cohort study using a lifetime simulation model that investigated the impact of blood pressure management on the medical economy according to the antihypertensive target of the 2022 Hypertension Clinical Practice Guidelines of the Taiwan Society of Cardiology [6].

The model assumed hypertensive patients as individuals with an SBP of ≥ 130 mmHg according to the 2022 guidelines. The authors conducted a cost-effectiveness analysis for the hypertensive population in Taiwan aged ≥ 40 years, assuming an average starting age of 60 years. They constructed a Markov simulation model to estimate lifetime CVD events, lifetime direct medical costs, and quality-adjusted life years (QALYs) for simulated hypertensive patients. The authors performed cost-effectiveness evaluation by calculating the incremental cost-effectiveness ratio (ICER) of the intensive blood pressure target for hypertensive patients.

Using the 2022 guidelines, the authors simulated the lifetime cost-effectiveness of intensive antihypertensive management. They found that the new blood pressure treatment target yielded an acceptable rise in lifetime medical costs and QALYs; subsequently, the ICER fell below Taiwan's per capita gross domestic product. A subgroup analysis showed consistently positive cost-effectiveness of blood pressure management with an intensive target among individuals of different ages and CVD risks.

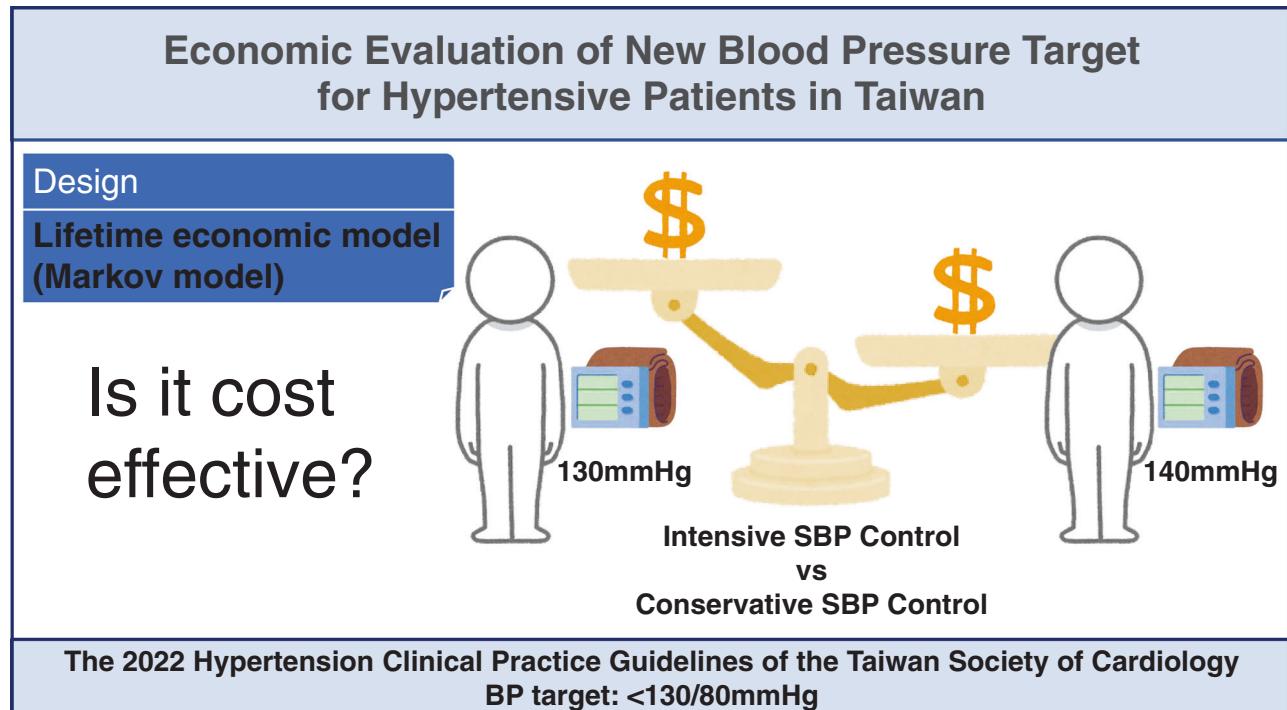
For all age groups, the ICER showed high cost-effectiveness with a probability of $>90\%$. Patients aged ≥ 70 years had the lowest ICER per 1 QALY gained; patients aged 40–49 years had the highest ICER per 1 QALY gained. Compared with conservative treatment, intensive treatment averted CVD events for 246 per 1000 individuals; hypertensive patients at high risk of ASCVD or CVD had lower ICER

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Graphical Opinion



values per 1 QALY gained. Additional medical costs were estimated at approximately US\$17.5 billion, which could cause public concern. However, the intensive target averted approximately 897,000 CVD events, yielded 1057 QALYs for the entire population, and resulted in a low ICER for the new blood pressure target.

QALYs were used to assess the patients' quality of life, and the study showed that an intensive target may reduce CVD events and extend work duration among patients with healthy life expectancy. Moreover, the increase in medical costs was within acceptable limits, and clearly, it was a highly cost-effective treatment. Furthermore, the results were consistent among individuals with different CVD risks, and a subgroup analysis indicated that the economic benefits increased somewhat with increasing CV risk. The results of medical economic evaluations are highly influenced by the uncertainty of parameters; thus, the authors performed probabilistic sensitivity analysis and constructed tornado diagrams and a Monte Carlo simulation and conducted a scenario analysis. The analyses confirmed the robustness of the study results: stricter blood pressure control evidently contributed to the achievement of therapeutic benefits with higher cost-effectiveness.

Cost-effectiveness evaluations related to pharmaceutical products have been employed in other countries, and the calculated ICER has been reflected in the prices of pharmaceutical products. Such evaluations have also been used in Japan. Interestingly, with reference to previously validated

cost-effectiveness models of hypertension treatment [7, 8], the Taiwan study evaluated the cost-effectiveness of an intensive blood pressure target for hypertensive patients, including older adults and those at a high risk of CVD, according to the 2022 guidelines. Many randomized controlled trials studying target values for antihypertensive therapy have not examined young adults at low risk of heart disease or older adults undergoing treatment for various illnesses. The causes of death become more diverse with age; thus, the motivation to actively treat hypertension alone diminishes among older adults. However, the Taiwan study successfully simulated the cost-effectiveness evaluation of intensive blood pressure management over a lifetime.

There have been concerns about the impact of a higher incidence of adult diseases, such as hypertension, due to increased longevity and the ongoing emergence of expensive drugs paid for by public medical insurance. It is in this context that cost-effectiveness evaluations have been introduced. There are differences in insurance policies, cultures, and ethnicities in different countries; however, the use of economic evaluations (such as cost-effectiveness and financial impact) is expected to increase. The 2019 Japanese Society of Hypertension Guidelines for the Management of Hypertension set an antihypertensive target of 130/80 mmHg for SBP; the antihypertensive target for individuals aged ≥ 75 years was established at < 140 mmHg SBP [9]. However, the increase in QALYs among older adults following intensive antihypertensive therapy in the Taiwan study is consistent with

recent evidence for intensive antihypertensive therapy, which indicates greater economic efficiency. The types and ratios of drugs in the Taiwan simulation model were based on previous clinical trials, and the differences in the number, types, and ratios of drugs used may affect medical cost estimates in different countries. The cost-effectiveness may differ depending on the medical system; however, it can lead to public awareness of the importance of blood pressure measurement, strict antihypertensive management, and oral antihypertensive medication. Moreover, for healthcare workers, intensive antihypertensive management may be beneficial both medically and economically, even among older adults who suffer only from hypertension.

Conducting a cost-effectiveness analysis of antihypertensive therapy for older adults demands consideration of the methods of blood pressure measurement and risks associated with complications. The main CVDs and adverse events in the Taiwan study were analyzed based on the results of the two landmark trials noted above—although those trials differed in their targets. For blood pressure measurement, SPRINT used the automated office blood pressure (AOBP) method, whereas the STEP trial employed a method that required the presence of medical staff. Regarding target cases, SPRINT excluded diabetes patients, although they were included in the STEP trial. Furthermore, the Taiwan study authors evaluated only direct medical costs; indirect costs, such as productivity loss, were not evaluated.

The Japanese Society of Hypertension has set a goal of “reducing the number of people with hypertension by 7 million in 10 years and extending healthy life expectancy” [10]; recognition, treatment, and control rates are crucial for the diagnosis and treatment of hypertension. The 2013–2016 National Health and Nutrition Examination Survey (NHANES) reported that the overall hypertension recognition rate in Taiwan was 72.1%, and 63.4% of hypertensive patients achieved a blood pressure treatment target of < 140/90 mmHg in a 2017 community survey [11]. However, blood pressure management in Japan involves lower treatment and control rates than those in Taiwan [12]. To address these issues, in addition to raising awareness of the importance of blood pressure measurement, the Japanese Society of Hypertension is promoting digital hypertension monitoring as a new academic research area. The society is working on the development of a wearable blood pressure monitoring device because the complexity of home blood pressure measurement has led to a decline in the blood pressure recognition rate [13].

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Compliance with ethical standards

Conflict of interest The authors declare no competing interests.

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