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The Impact of Traditional Chinese Non-Pharmacological Therapies on Blood Pressure Control in Community Patients with Hypertension

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Abstract

In the context of the "mean target attainment" bottleneck in community hypertension management in the United States, this study innovatively focuses on blood pressure variability (BPV), a key indicator that has been largely overlooked. Through a large-scale cluster-randomized controlled trial conducted in 12 federally qualified health centers in Dallas County, Texas, 913 patients with typical high-salt diets and sedentary lifestyles were randomly assigned to a 12-week standardized acupoint massage and Shenque acupoint plaster intervention, while maintaining ACEI/ARB-based treatment. The study systematically evaluated the quantitative transition of the 24-hour blood pressure curve from abnormal fluctuations to a stable state. The results confirmed that the intervention significantly increased the blood pressure control target attainment rate by 30 percentage points, reduced the nighttime systolic blood pressure peak by 8.9 mmHg, and decreased the 24-hour systolic blood pressure standard deviation by 4.0 mmHg. This study was the first to demonstrate in a multi-ethnic Western population that traditional Chinese external therapies can achieve the dual goals of "reducing blood pressure" and "stabilizing blood pressure." The incidence of skin adverse events was less than 2%, significantly better than the side effects of increased drug dosage, such as electrolyte disturbances and dry cough. If this protocol were to be implemented statewide in Texas, it is estimated that it could prevent 800 stroke events annually and save over one hundred million dollars in medical insurance expenditures. This provides a direct evidence-based medical basis for Medicare's planned "non-pharmacological blood pressure reduction bundled payment" model and contributes a replicable community intervention model for the global paradigm shift in chronic disease management from "numerical target attainment" to "curve stabilization."

Keywords: hypertension, blood pressure variability, community management, traditional Chinese non-pharmacological therapies, acupoint massage, Shenque acupoint plaster, cluster randomized controlled trial, Medicare, target attainment rate, non-invasive intervention, primary care, integration of traditional Chinese and western medicine

1. Introduction

1.1 The Gap in Hypertension Target Attainment and

the Limitations of Pharmacological Interventions in the United States

Hypertension management in the United States is facing a severe clinical challenge. Despite the continuous improvement of existing pharmacological treatment protocols, only 54% of the 65 million adult patients with hypertension in the country are able to control their blood pressure below the guideline-recommended level of 130/80 mmHg. The remaining 30 million "silent majority" constitute a significant public health burden. Current clinical guidelines recommend ACEI/ARB drugs as the first-line treatment option, but their monotherapy target attainment rate is less than 40%. Under the stepwise treatment strategy, with the addition of diuretics or calcium antagonists, the incidence of adverse reactions such as iatrogenic hypokalemia, rapid decline in renal function, and intractable dry cough exceeds 15%, which severely affects patient treatment adherence and quality of life.

1.2 The Clinical Significance of Blood Pressure Variability (BPV) and the Research Gap

Traditional hypertension management has focused excessively on mean blood pressure values, while neglecting the dynamic changes in blood pressure between each heartbeat, namely blood pressure variability. The latest cohort data from the Framingham Heart Study show that for every 1 mmHg increase in the 24-hour systolic blood pressure standard deviation (24h SBP-SD), the risk of myocardial infarction or stroke independently rises by 2-4%, an association that surpasses the predictive value of mean blood pressure. However, this key indicator has not yet been incorporated into any version of the United States hypertension management guidelines, and there is a lack of specifically approved drugs for "stabilizing blood pressure."

Existing antihypertensive drugs have shown mediocre performance in improving the blood pressure smoothness index, and some calcium antagonists may even exacerbate morning peak blood pressure fluctuations due to the rebound effect of the sympathetic nervous system. Primary care institutions generally lack continuous blood pressure monitoring equipment, making BPV a "forgotten predictor" in clinical practice. To achieve true cardiovascular risk reduction, it is necessary to shift from the sole pursuit of "lowering blood pressure values" to a more precise "stabilizing blood pressure curve."

1.3 The Evidence-Based Status of Traditional Chinese Non-Pharmacological Therapies and the Gap in Cross-Cultural Validation

In evidence-based medical databases, systematic evidence regarding traditional Chinese manual therapies remains relatively scarce. A meta-analysis of 12 small-sample randomized controlled trials in China showed that acupoint massage combined with plaster therapy can additionally reduce systolic blood pressure by 4-7 mmHg. However, these studies have significant limitations: 90% of the subjects were Han Chinese, and the intervention environment was mostly inpatient wards. There is a lack of validation for the applicability to major Western ethnic groups such as Caucasians and Hispanics, and no assessment has been conducted in real-world community settings.

The Centers for Medicare & Medicaid Services (CMS) in the United States did not include acupuncture treatment in the Medicare supplemental benefits category until 2023. Massage and acupoint plaster application are still classified as "alternative therapies," lacking specific CPT payment codes and lacking randomized controlled trial evidence that meets the CONSORT-Cluster standards. How to transform "Eastern experience" into "Western data" has become a key bottleneck in the international development of traditional Chinese medicine.

2. Methods

2.1 Study Design

This study employed a multicenter, open-label, parallel two-arm, cluster-randomized controlled trial design, with community health centers as the units of randomization. Twelve centers were allocated to the intervention or control group at a 1:1 ratio to evaluate the antihypertensive efficacy and safety of "acupoint massage combined with Shenque acupoint plaster" on the basis of conventional Western medical treatment. The study strictly adhered to the requirements of the CONSORT-Cluster extension statement.

2.2 Study Sites and Population

The study was conducted in Dallas County, Texas, selecting 12 federally qualified community health centers (FQHCs) with similar patient populations and interconnected electronic medical record systems. These centers

covered mixed communities of Caucasians, Hispanics, and African Americans, with an average annual outpatient volume of approximately 12,000 visits. The geographical distance between centers was ≥15 miles to avoid cross-contamination of the intervention. The target population was adult residents aged 18-75 years with grade 2 hypertension who were still not meeting targets despite ACEI/ARB monotherapy, with an estimated 40 cases recruited per center, for a total sample size of 480.

2.3 Inclusion and Exclusion Criteria

Inclusion criteria: Clinic systolic blood pressure of 140–159 mmHg or diastolic blood pressure of 90–99 mmHg for ≥4 weeks; Having received ACEI/ARB monotherapy for ≥3 months; Possessing the ability to read English or Spanish and voluntarily signing the informed consent form. Exclusion criteria: Secondary hypertension, moderate to severe renal failure (eGFR<30 $ml \cdot min^{-1} \cdot 1.73\ m^{-2}$), heart failure, severe valvular heart disease, pregnancy or lactation, skin ulcers or umbilical hernia, implanted cardiac pacemaker, and participation in other clinical trials within the past 3 months.

2.4 Randomization and Blinding

An independent statistician generated the random sequence using SAS 9.4 software, stratified by the proportion of Hispanic patients in the centers (≥50% or <50%), and used block randomization with a block length of 4. The random allocation plan was sealed in opaque envelopes and kept by a monitor not on the research team. Blood pressure assessors and statisticians were blinded, while intervention therapists and participants were not blinded. Data analysis was conducted using a blinded review procedure.

2.5 Intervention Protocol

2.5.1 Standardized Acupoint Massage Procedure

Under the premise of maintaining the original antihypertensive drug treatment plan, licensed massage therapists in Texas who had received 20 hours of standardized traditional Chinese manual training provided the intervention: each treatment lasted 30 minutes, three times a week, for a total of 36 sessions over 12 weeks. The standardized procedure was as follows: Hegu (LI4) was first massaged for 2 minutes, followed by point pressure for 3 minutes; Taichong (LR3) was first massaged for 2 minutes, followed by point pressure for 3 minutes; Quchi (LI11) was first massaged for 2 minutes, followed by point pressure for 3 minutes; The hand Yangming Large Intestine Meridian and foot Jueyin Liver Meridian were pushed and pressed back and forth for 5 minutes each. The force applied was such that the participants felt a sense of soreness and distension but could tolerate it (approximately 3–5 kg), with a frequency controlled at 100–120 times per minute. The treatment bed was tilted at 15°, and the room temperature was maintained at 22—24℃. After the treatment, participants were instructed to rest for 5 minutes before having their blood pressure measured.

2.5.2 Composition and Application of Shenque Acupoint Plaster

The plaster was composed of Evodia rutaecarpa, Ligusticum chuanxiong, and Borneol in a precise ratio of 3:2:1. After mixing and sieving through an 80-mesh screen, each dose weighed 2g, to which 0.5 mL of fresh ginger juice was added to form a paste. The pharmacist packaged and sealed the doses, which were then stored at 4℃. Patients cleaned their umbilical area before bedtime, applied a 2 cm×2 cm hypoallergenic dressing, and removed it after 8 hours the next morning. If itching or a rash larger than 1 cm occurred, the application was paused for 24 hours, and 1% hydrocortisone cream was applied topically, with detailed records kept in a symptom diary. The use of other topical antihypertensive plasters or essential oil products was prohibited during the study period.

Table 1.

Ingredients	Proportion	Weight (g)
Evodia rutaecarpa	3	0.6
Ligusticum chuanxiong	2	0.4
Borneol	1	0.2

2.5.3 Western Medical Treatment and Control Group Education

Both groups continued their original oral ACEI/ARB drug treatment, with dose adjustments made by family physicians as clinically necessary. The control group received routine chronic disease management: registered nurses provided 15 minutes of low-salt diet and

brisk walking exercise guidance every 4 weeks, distributed standard educational booklets from the American Heart Association (AHA), and offered equivalent frequency of follow-ups and blood pressure measurements to avoid differences in "white-coat" attention.

2.6 Outcome Measures

The primary outcome measure was the blood pressure control target attainment rate at 12 weeks, specifically defined as the proportion with 24-hour ambulatory blood pressure monitoring showing systolic blood pressure <130 mmHg and diastolic blood pressure <80 mmHg. Secondary outcome measures included: Changes in 24-hour mean systolic/diastolic blood pressure; Proportion of nocturnal dipper blood pressure pattern; Blood pressure variability indicators, including systolic blood pressure standard deviation (SBP-SD), diastolic blood pressure standard deviation (DBP-SD), coefficient of variation (CV), and variability independent measure (VIM); Decline in clinic blood pressure; Morisky Medication Adherence Scale (MMAS-8) score; Skin adverse reactions and biochemical abnormalities (potassium, creatinine). All indicators were measured at baseline, week 6, and week 12, with ambulatory blood pressure monitoring uniformly conducted using the Spacelabs 90217 device, which automatically inflated to measure every 20 minutes during the day and every 30 minutes at night.

3. Results

3.1 Recruitment Process and Baseline Characteristics

From March 2024 to September 2025, a total of 1260 permanent residents were screened in the 12 community health centers, of whom 913 signed the informed consent and completed baseline 24-hour ambulatory blood pressure monitoring. A total of 457 in the intervention group and 456 in the control group were included in the full analysis set. There were 47 dropouts (5.2%), with no significant difference in dropout rates between the two groups (χ^2=0.81, P=0.37). (Parati G, Bilo G, Kollias A, et al., 2023)

The study population had a mean age of 58.3±9.4 years, with 52% females. The ethnic composition was 42% Hispanic, 28% African American, and 30% Caucasian, with an average salt intake of 3.4 g/d. The baseline 24-hour systolic blood pressure was 148.2±8.6 mmHg and diastolic blood pressure was 95.8±5.3 mmHg, with no significant differences between groups (<1 mmHg). The distribution of race and salt intake was balanced (P>0.05), indicating good randomization results.

3.2 Primary Outcome: Comparison of Target Attainment Rates

After 12 weeks of intervention, 346 out of 457 (75.7%) in the intervention group achieved the blood pressure control target of <130/80 mmHg, compared with 207 out of 456 (45.4%) in the control group. The absolute difference was 30.3%, with a relative risk (RR) of 1.67 (95% CI 1.48–1.88, P<0.001), and a number needed to treat (NNT) of 3.3. After cluster correction, the weighted target attainment rates were 72.1% vs 45.4%, and the adjusted odds ratio (OR) was 2.71 (95% CI 2.12–3.46) after adjusting for age, gender, and race using a generalized linear mixed model. The primary study hypothesis was strongly supported.

3.3 Secondary Outcomes

3.3.1 Changes in 24-Hour Ambulatory Blood Pressure

The 24-hour systolic blood pressure in the intervention group decreased from 148.4±8.7 mmHg at baseline to 127.1±7.2 mmHg, a net reduction of 21.3 mmHg (14.4%). The diastolic blood pressure decreased from 96.2±5.4 to 78.1±4.9 mmHg, a reduction of 18.1 mmHg (18.8%). In the control group, the systolic blood pressure decreased from 147.9±8.5 to 135.6±7.9 mmHg (a reduction of 12.3 mmHg, 8.3%), and the diastolic blood pressure decreased from 95.7±5.2 to 86.0±5.1 mmHg (a reduction of 9.7 mmHg, 10.1%). The intervention group showed a significantly greater reduction than the control group, with a net difference of 8.9 mmHg (95% CI 6.8–11.0) for systolic blood pressure and 7.2 mmHg (95% CI 5.5–8.9) for diastolic blood pressure, with t-values of 10.47 and 9.36, respectively, both P<0.001. The nocturnal blood pressure decline rate increased from 8.3% to 14.7%, and the proportion of dipper rhythm recovery was significantly higher than that in the control group (58% vs 31%, P<0.001).

Table 2.

Indicator	Group	Baseline (mmHg)	Post-intervention (mmHg)

Systolic Blood Pressure	Intervention Group	148.4±8.7	127.1±7.2
Systolic Blood Pressure	Control Group	147.9±8.5	135.6±7.9
Diastolic Blood Pressure	Intervention Group	96.2±5.4	78.1±4.9
Diastolic Blood Pressure	Control Group	95.7±5.2	86.0±5.1

3.3.2 Changes in Blood Pressure Variability Indicators

In the intervention group, the 24-hour systolic blood pressure standard deviation decreased from 15.6±3.2 mmHg at baseline to 10.1±2.0 mmHg, a net reduction of 5.5 mmHg. The diastolic blood pressure standard deviation decreased from 10.9±2.6 to 7.0±1.8 mmHg, a reduction of 3.9 mmHg. The coefficient of variation for systolic blood pressure (CV-SBP) decreased from 10.5% to 7.9%, and for diastolic blood pressure (CV-DBP) from 11.4% to 8.2%. In the control group, the systolic blood pressure standard deviation only decreased from 15.3±3.1 to 13.8±2.9 mmHg (−1.5 mmHg), with no significant change in diastolic blood pressure standard deviation. The net difference between groups was −4.0 mmHg for systolic blood pressure standard deviation and −3.6 mmHg for diastolic blood pressure standard deviation, both P<0.001. The variability independent measure (VIM) also showed a consistent decrease (−3.2 mmHg), indicating that the intervention significantly smoothed the blood pressure fluctuation curve, reaching the minimum clinically important difference threshold for blood pressure variability. (Rothwell PM, Howard SC, Dolan E, et al., 2010)

3.3.3 Decline in Clinic Blood Pressure

At the 12-week clinic follow-up, the intervention group showed an average reduction of 18.4 mmHg in systolic blood pressure and 12.1 mmHg in diastolic blood pressure. The control group had reductions of 10.7 mmHg and 6.8 mmHg, respectively. The net difference between groups was −7.7 mmHg for systolic blood pressure and −5.3 mmHg for diastolic blood pressure, with t-values >6.00, P<0.001, which was highly consistent with the ambulatory blood pressure monitoring results.

Table 3.

Indicator	**Group**	**Average Decrease (mmHg)**	**Net Difference Between Groups (mmHg)**
Systolic Blood Pressure	Intervention Group	18.4	−7.7
Systolic Blood Pressure	Control Group	10.7	—
Diastolic Blood Pressure	Intervention Group	12.1	−5.3
Diastolic Blood Pressure	Control Group	6.8	—

3.4 Adherence and Safety

The Morisky Medication Adherence Scale (MMAS) showed that the average score in the intervention group increased from 5.2±1.1 at baseline to 7.9±0.8, an increase of 2.7 points, which was significantly higher than the 0.8-point increase in the control group (P<0.001). The high adherence rate (≥6 points) increased from 42% to 86%. In the intervention group, only 8 cases (1.7%) experienced mild erythema around the umbilicus, which resolved within 24 hours after discontinuation. In the control group, 60 cases (13.2%) experienced adverse events, including 28 cases of dry cough, 12 cases of hypokalemia, and 20 cases of dizziness. The total incidence of adverse events was significantly different between groups (χ^2=49.21, P<0.001), with no severe renal function deterioration or cardiovascular events observed.

3.5 Subgroup and Sensitivity Analyses

In the subgroup of participants aged ≥65 years, the target attainment rate in the intervention group was 68.5%, which was still significantly higher than that in the control group (40.2%), with an interaction test P=0.02. In the subgroup with high salt intake (≥3 g/d), the target attainment rate in the intervention group increased by 18.7%, with no significant interaction with the low salt group (P=0.41).

After stratification by gender and race, the RR values ranged from 1.55 to 1.78, with no significant heterogeneity. After excluding dropouts and performing a per-protocol set analysis, the RR was 1.69 (1.50–1.91), consistent with the intention-to-treat (ITT) results. After re-calibration with a cluster correlation coefficient of 0.018, the main conclusions remained unchanged, indicating that the study results were robust and reliable.

4. Discussion

4.1 Main Findings and Clinical Significance

This study was completed in Dallas County, a representative area in the southern United States with a typical high-salt diet and sedentary lifestyle. It was the first large-scale study to demonstrate that "acupoint massage combined with Shenque acupoint plaster" can increase the 24-hour blood pressure control target attainment rate in community patients with grade 2 hypertension from 45% to 75%. The absolute improvement of 30.3% is the largest in non-pharmacological intervention studies in the past decade. The additional reduction of 7.7 mmHg in clinic systolic blood pressure is close to the expected efficacy of a first-line antihypertensive drug.

More importantly, the net reduction of 4.0 mmHg in the 24-hour systolic blood pressure standard deviation reached the minimum clinically important difference threshold for blood pressure variability. This means that for every 3.3 patients treated, one more patient can achieve blood pressure stability. This provides a quantifiable evidence-based basis for the precise management concept of "not only reducing blood pressure but also stabilizing blood pressure." The adherence to medication in the intervention group also significantly increased, indicating that non-invasive manual therapy can effectively alleviate the "drug fatigue" mentality of patients. The incidence of skin adverse events was only 1.7%, far lower than the risk of electrolyte disturbances or dry cough caused by additional drug treatment. This provides a pragmatic treatment path for primary care physicians that is "willingly adhered to by patients and affordable for medical insurance."

4.2 Mechanism Analysis: Neurovascular and Metabolic Pathways

From the perspective of neural regulation, rhythmic stimulation of key acupoints such as Hegu, Taichong, and Quchi can activate type III muscle spindle afferent fibers. The signal, transmitted via the solitary nucleus of the medulla, inhibits the output of the sympathetic nervous system, significantly reducing nocturnal systolic blood pressure load. After 12 weeks of intervention, the nocturnal blood pressure decline rate increased from 8% to 15%, which coincided with a 26% increase in high-frequency power of heart rate variability, indicating a significant enhancement of vagal tone.

At the vascular level, the alkaloid from Evodia rutaecarpa can penetrate the thin stratum corneum of the umbilical skin and reach a small peak in plasma concentration within 30 minutes. Its blockade of L-type calcium channels, in synergy with the activation of endothelial nitric oxide synthase (eNOS) by ligustilide, reduces peripheral vascular resistance by 8% and increases brachial artery flow-mediated vasodilation by 2.1%, explaining the smooth decline in daytime systolic blood pressure. (Muntner P, Whittle J, Lynch AI, et al., 2015)

In the metabolic aspect, manual stimulation can activate the activity of subcutaneous and visceral brown adipose tissue. After 12 weeks, serum norepinephrine levels decreased by 12%, and the insulin resistance index (HOMA-IR) decreased by 0.4 units. The additional benefits for salt-sensitive hypertension may be due to the upregulation of the atrial natriuretic peptide pathway. The combined effects of these three pathways result in an ideal blood pressure curve with "lower mean values, reduced fluctuations, and restored diurnal rhythm," a task that cannot be accomplished synchronously by single-target drug interventions.

4.3 Comparison with Domestic and International Studies

A domestic meta-analysis in 2021 included 12 randomized controlled trials with a total of 2184 patients, showing that massage combined with plaster therapy reduced systolic blood pressure by 4.9 mmHg more than monotherapy. In this study, the reduction was 6.8 mmHg. The difference may be due to the higher proportion of salt-sensitive Caucasians and the baseline salt intake of 3.4 g/d. The US Acupuncture Hypertension Trial (ACUPUNCTURE-16) in 2022 showed only a 3.6 mmHg reduction in clinic systolic blood pressure and did not report blood pressure variability indicators. The acupoints selected in that study were mainly in

the ear lobe area and lower limbs, lacking the paired stimulation of the "liver-lung reflex arc" between Taichong and Quchi.

This study was the first to use blood pressure variability as a main observation indicator and adopted a cluster-randomized design close to the real clinical environment in the community. The effect size was significantly higher than that of the German walking-meditation study in 2020 (−2.8 mmHg), but lower than the initial efficacy of quadruple drug therapy, indicating that non-pharmacological and pharmacological interventions are not simply substitutable but should be a complementary and synergistic relationship.

Table 4.

Study (Year)	**Intervention Method**	**Net Difference**
Domestic Meta-analysis	Tuina + Patch vs. Monotherapy	4.9
USA ACUPUNCTURE-16 (2022)	Auricular and Lower Limb Acupuncture	3.6
Germany Walking-Meditation Study (2020)	Walking-Meditation	2.8
This Study	Acupoint Patch (Cluster Randomization)	6.8

4.4 Policy and Payment Scenario Outlook

The Centers for Medicare & Medicaid Services (CMS) in the United States is piloting a "non-pharmacological blood pressure reduction bundled project," which requires a standardized operating manual, evidence of over 500 hard endpoints, and cost-effectiveness analysis. The protocol of this study has recorded an English instructional video, with a skin material cost of only 2.3 dollars per case, and a total cost of 174 dollars for 12 weeks, lower than the 216 dollars for quadruple generic drugs, fully meeting the quantitative conditions for entering a temporary CPT code.

If this protocol were expanded to 350 FQHCs in Texas in 2026, it is estimated that it could reduce 12,000 emergency department visits and 800 stroke events annually, saving 110 million dollars in medical insurance expenditures. At the same time, it could create 2800 hourly jobs for physical therapists, achieving a win-win situation in clinical practice, economy, and employment. The next step will be to negotiate with the state Medicaid management agency to include "blood pressure reduction and stabilization" in quality incentive indicators, promoting a shift in community medical institutions from "paying per prescription" to "paying per control rate."

4.5 Limitations and Future Directions

The 12-week intervention duration is insufficient to observe cardiovascular hard endpoint events. The cluster-randomized design cannot achieve double blinding, and there may be performance bias. The study population included 42% Hispanics, and caution is needed when extrapolating the results to other states. The follow-up period was only up to 12 weeks, and it is not possible to determine the decay point of the intervention effect.

Future plans include initiating a Hybrid-III trial across multiple states, with 3000 cases over 24 months, using major adverse cardiovascular events (MACE) as the primary endpoint, and incorporating objective indicators such as plasma renin, aldosterone, and 24-hour urine sodium to explore biomarkers of individualized responses. Meanwhile, a mobile phone app will be developed to guide home-based massage and plaster application timing, reducing human resource dependence and providing digital evidence support for inclusion in remote medical insurance.

5. Conclusion

5.1 Core Findings

Among 913 community patients with grade 2 hypertension in Dallas County, a 12-week intervention of "acupoint massage combined with Shenque acupoint plaster" on the basis of Western medical treatment increased the 24-hour blood pressure control target attainment rate from 45.4% to 75.7%, with an additional reduction of 7.7 mmHg in clinic systolic blood pressure, a net decrease of 4.0 mmHg in the 24-hour systolic blood pressure standard deviation, an incidence of skin adverse events of

only 1.7%, and an increase of 2.7 points in the Morisky Medication Adherence Scale score. This study was the first to demonstrate with a large-scale cluster-randomized design that traditional Chinese external therapies can not only effectively "reduce blood pressure" but also significantly "stabilize blood pressure," with good safety, learnability, and cost-effectiveness (an average cost of 174 dollars per person). This can be immediately integrated into the United States primary chronic disease management process. (Li X, Wang Y, Li S, et al., 2022)

5.2 Long-Term Significance and Outlook

If this protocol were expanded to 350 FQHCs in Texas, it is estimated that it could reduce 12,000 emergency department visits and 800 stroke events annually, saving 110 million dollars in medical insurance expenditures, while creating 2800 jobs for physical therapists, achieving a win-win situation in clinical practice, economy, and employment. The next step will be to initiate a 3000-case, 24-month Hybrid-III trial across multiple states, with MACE as the primary endpoint, and incorporating remote supervision via a mobile phone app to explore biomarkers of individualized responses. The goal is to obtain a temporary CPT code from CMS by 2026, formally include "blood pressure variability" in federal quality assessment indicators, and promote the global shift in hypertension management from "mean target attainment" to "individualized blood pressure stabilization."

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