



An integrative framework for precision medication in hypertension: Applying a dialectical perspective to traditional Chinese and Western medicine

Jinliang Liu^a, Jiena Xiao^a, Zhongwei Lin^b, Mingzhu Xiao^{a,b,*}

^a Laboratory of Oncology and Immunology, School of Basic Medical Sciences, Guangdong Pharmaceutical University, Guangzhou, 510006, China

^b Department of Cardiology, The First Affiliated Hospital of Guangdong Pharmaceutical University, Guangzhou, 510062, China

ARTICLE INFO

Keywords:

Hypertension
Precise medication
Traditional Chinese and Western medicine
Integrative pharmacy

ABSTRACT

Hypertension is the most common cardiovascular disease. In terms of diagnosis and treatment, Traditional Chinese Medicine (TCM) and Western medicine each have their own strengths, but also have certain limitations. Affected by the combined effects of genetic and environmental factors, the pharmacotherapy of hypertension shows significant individual differences. Therefore, how to integrate the advantages of TCM and Western medicine to achieve precision medication has become an important research topic. A single diagnostic and therapeutic model is difficult to take into account both the characteristics of TCM's "holistic regulation" and Western medicine's "precision intervention": TCM focuses on holistic syndrome differentiation and the restoration of bodily balance, yet it is relatively vague in the analysis of disease mechanisms and the identification of drug targets; Western medicine excels in targeted therapy, but often overlooks the patient's overall physiological state and the holistic progression of the disease. In the current development of precision medication, the concept of integrative pharmacy provides important support. By systematically integrating multi-source knowledge and technical means, it is committed to combining the macro-holistic perspective with micro-precision intervention, and provides a practical framework for the integration and innovation of TCM and Western medicine. Against this background, TCM takes "holistic concept" and "syndrome differentiation and treatment" as its fundamentals, and devotes itself to maintaining the dynamic balance of human body functions; Western medicine, relying on advanced tools such as genomics and proteomics, emphasizes the precise identification of etiologies and targeted therapy. The two show a dialectical unity in concepts and methods, and jointly serve the realization of the goal of individualized treatment for hypertension. With "principle, method, prescription, and medicine" as the logical main line, this paper systematically explores the diagnostic and therapeutic ideas and practical strategies of TCM and Western medicine for hypertension, and expounds on how to take integrative pharmacy as a bridge to incorporate the holistic thinking of TCM into the modern precision medication system, thereby providing theoretical references and practical paths for promoting the integrated diagnosis and treatment of hypertension with TCM and Western medicine and the implementation of precise drug intervention.

1. Introduction

Hypertension is primarily characterized by increased systemic arterial pressure, which can induce severe damage to target organs such as the heart, brain, kidneys, and retina when severe, affecting 1.28 billion people worldwide,^{1,2} making it one of the most common chronic diseases. It is influenced by various factors, including genetics and

environment, and the efficacy and safety of drugs vary from person to person.³ In recent years, the limitations of Western reductionism have become increasingly evident as it overly focuses on the microstructure of diseases while neglecting the patients' overall condition. The medication plans for treating the same disease are generally similar, with drug selection, dosage, and administration time roughly the same. Yet, the effects vary greatly, and some patients may experience severe adverse

* Corresponding author. Laboratory of Oncology and Immunology, School of Basic Medical Sciences, Guangdong Pharmaceutical University, Guangzhou, 510006, China.

E-mail address: 618xiaomingzhu@gdpu.edu.cn (M. Xiao).

Peer review under the responsibility of Editorial Board of Journal of Holistic Integrative Pharmacy.

<https://doi.org/10.1016/j.jhip.2025.09.001>

Received 2 May 2025; Received in revised form 3 September 2025; Accepted 4 September 2025

2707-3688/© 2025 The Authors. Publishing services by Elsevier B.V. on behalf of KeAi Communications Co. Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

reactions.^{4,5} In 2011, the National Research Council of the United States proposed a broader concept of precision medicine based on the premise that determinants of an individual's genome and epigenome can make disease prevention and treatment measures more personalized.

Precision medicine is a medical model that customizes medical approaches according to patient differences. Under this model, the original "one-size-fits-all" treatment method is abandoned, and disease prevention and treatment methods are adjusted based on the individual differences of each patient. Examinations delve into the most minute molecular and genomic information, and medical personnel make appropriate adjustments and changes to diagnostic and therapeutic methods based on these subtle differences in the patient's information. The concept of "precision medication" included here aims to enable everyone to obtain individual genetic information to achieve the purpose of precise individualized drug therapy.⁶ The concept of "precision medication" in Western medicine coincides with the TCM philosophy of "personalized medicine". The *Suwen* "Wuchang Zheng Dalun" (Basic Questions: The Great Treatise on the Governance of the Five Constants) states, "The Qi of the northwest is dispersed and cold, while the Qi of the southeast is collected and warm, which is what is meant by treating the same disease with different methods". This reflects the TCM emphasis on "one person, one prescription" which is to prescribe medicine based on individual differences, including personalized diagnosis and treatment approaches such as "adapting measures to local conditions", "treating different diseases with the same method", and "treating the same disease with different methods". Both the concept of "Precision Medication" in Western medicine and the "one person, one prescription" in TCM consider individual differences, the different effects and states of other drugs acting on the human body, formulating a "tailor-made" personalized, precise medication plan,⁷ which is of great significance for promoting individualized drug use and rational clinical drug use.

Currently, the work on precision drug therapy mainly focuses on genomic sequences. Although genetic sequencing has been effective in congenital diseases and cancer, for complex diseases with multiple factors and genes, such as hypertension, genomic sequences alone cannot explain the impact of non-genetic factors such as environment and lifestyle.^{1,8} Therefore, there is an urgent need to go further with existing technologies, to integrate approaches to prevent and treat hypertension, and to explore new ways to address the global problem of hypertension. Greater consideration of an individual's genetics, lifestyle, and exposure to important factors that influence their cardiovascular health and disease phenotype over time, such as the fields of epigenomics, metabolomics, and proteomics.^{9,10} With the development of TCM, many scholars have applied it to the diagnosis and treatment of hypertension, using a combination of Chinese and Western medicine to improve the therapeutic effects of hypertension and providing new ideas for clinical treatment. Traditional Chinese and Western medicine have unified and focused on precision treatment. This paper holds that precision medicine and integrated medicine are in a relationship of "one entity with two wings", dialectically unified. The "precision" of Western medicine provides microscopic anchor points and standardized tools for the "integration" of TCM. Conversely, the "integration" thinking of TCM offers a macroscopic perspective and an individualized framework for the "precision" practice of Western medicine. Based on this, this paper aims to go beyond the additive thinking implicitly contained in the traditional "integration of Chinese and Western medicine". It attempts to start from the core cognitive framework of TCM, namely "principle, method, prescription, and medicine", to conduct in-depth dialogue and integration with Western medicine regarding the etiological classification, diagnostic techniques, treatment regimens, and drug action mechanisms of hypertension. By recognizing the distinct characteristics of TCM and Western medicine, and fostering mutual support, complementarity, and integration, our goal is to attain a harmonious synthesis. This will facilitate the gradual amalgamation of TCM's holistic perspective with the analytical approach of Western medicine.¹¹ Ultimately, this offers a fresh theoretical foundation for precise medication

in the treatment of hypertensive disease, leveraging the strengths of both traditional Chinese and Western medicine.¹²

2. Understanding of hypertensive disease in traditional Chinese and Western medicine (principle)

"Principle" refers to understanding disease, its etiology, and pathogenesis, which forms the basis and rationale for diagnosis and treatment. It includes the distribution characteristics of syndrome elements in various hypertensive diseases and the common combinations of syndrome elements in clinical practice, which are essential for clinical diagnosis.

Modern medicine's understanding of its etiology and pathological mechanisms remains unclear. In TCM literature, no exact disease name corresponds to "hypertension." Still, TCM mainly bases its understanding on holism, emphasizing the interconnection and interaction of various parts of the human body and individual differences to understand the nature of diseases comprehensively. According to the pathogenesis and syndrome characteristics of hypertension, TCM classifies it as "Dizziness", "Liver Wind", "Yu Mao", "Dizziness", "Black Pulse Disease (vascular damage)", "blood heat syndrome", and "pulse distention", and applies syndrome differentiation and treatment.^{13–15} *The Guiding Principles for Clinical Research on New Traditional Chinese Medicines* categorizes hypertension into 4 primary syndrome types, namely liver-fire hyperactivity, Yin deficiency with Yang hyperactivity, dual Yin and Yang deficiency, and phlegm-dampness accumulation. This classification approach emphasizes standardized diagnosis in the context of new drug development and clinical evaluation. In contrast, the textbook *Chinese Internal Medicine* under the 14th Five-Year Plan employs a 5-type classification, specifically including liver-Yang hyperactivity, phlegm-dampness obstructing the middle energizer, blood stasis blocking the orifices, Qi and blood deficiency, and kidney essence insufficiency.¹⁶ This latter classification is more aligned with the systematicness and practicality of clinical diagnosis and treatment. Despite the aforementioned discrepancies in classifications across different periods and standard specifications, these classification methods all take zang-fu organ differentiation and the eight-principle differentiation as their core frameworks. Their purpose is to comprehensively elaborate on the characteristics of TCM pathogenesis of hypertension through syndrome induction. Among them, the deficient syndrome elements consist of 5 items: essence deficiency, Qi deficiency, blood deficiency, Yin deficiency, and Yang deficiency. The excessive syndrome elements encompass 10 items: Yang hyperactivity, fire, phlegm turbidity, liver wind, blood stasis, Qi stagnation, Qi rebellion, water-dampness, static blood toxin, and internal dryness, amounting to a total of 15 basic syndrome elements. These 15 syndrome elements can form 56 compound syndrome differentiations through various combinations, to adapt to the complex and diverse clinical manifestations of the disease. From the perspective of the disease location, the zang-fu organs primarily involved in hypertension are the liver and the kidneys.

Under the interaction of multiple factors, this disease is characterized by a deficiency in origin and excessive symptoms. The deficiency in origin is the most common, while the excess in symptoms is "wind, fire, phlegm, and stasis", with liver wind stirring internally being the main factor. In addition, the pathological factors of phlegm turbidity and blood stasis also play essential roles in its pathogenesis. This holistic thinking emphasizes the unity of various parts of the human body and the principle of balance and harmony in treatment, which helps in a more comprehensive understanding of the nature of the disease and improves treatment effectiveness.

Western medicine is primarily based on reductionism. It integrates clinical symptom and sign data through molecular detection and quantifies standards. Notably, there are variations in diagnostic thresholds across major global clinical guidelines. The current criteria outlined in the latest guidelines by the Chinese Society of Cardiology (CSC) define hypertension in such untreated individuals as an office

systolic blood pressure (SBP) ≥ 140 mmHg or a diastolic blood pressure (DBP) ≥ 90 mmHg.¹⁷ However, this threshold differs from the updated standard established by the American Heart Association (AHA) in its 2017 guideline revision, which sets the diagnostic cutoff for untreated patients at an office SBP ≥ 130 mmHg or DBP ≥ 80 mmHg. This divergence reflects ongoing debates in cardiovascular medicine regarding optimal blood pressure targets for disease prevention and risk stratification. The Chinese guideline maintains the traditional threshold, emphasizing individualization and precision in blood pressure management. At the same time, the AHA adopts a more stringent criterion to highlight early intervention in populations with pre-hypertension or mild hypertension.

The pathogenesis of hypertension is complex and may involve multiple systems, such as the imbalance in the regulation of the renin-angiotensin-aldosterone system (RAAS), which is related to the onset and development of hypertension.^{18,19} Moreover, genetic factors also play a significant role in the development of hypertension, with multiple genes closely related to its occurrence and development, including genes related to RAAS, the sympathetic nervous system, cell division, and cell survival factors. Therefore, Western medicine reveals the root causes of diseases by delving into the basic structures and functions of the human body, providing a theoretical foundation and practical guidance for precision medication.

Although the descriptions of hypertension by traditional Chinese and Western medicine differ, there are similarities in their fundamental expressions. Key Western biomarkers like lipid profiles and endothelial dysfunction functionally parallel TCM's diagnostic indicators, such as Qi-Blood imbalance. TCM's holistic approach enables early intervention to restore balance before critical physiological thresholds are breached.¹⁹ (as shown in Table 1).

In the management of early-stage hypertension and pre-hypertensive states, Western medicine operates within specific constraints shaped by its evidence-based framework. Rather than exhibiting inadequacy in diagnosis or treatment, Western medicine adheres to standardized protocols: in the pre-hypertensive stage (defined as SBP 120–139 mmHg or DBP 80–89 mmHg), interventions primarily focus on lifestyle modifications (e.g., dietary adjustments, physical activity, and weight management), which are well-validated through clinical research. For early-stage hypertension, pharmacotherapeutic initiation is typically guided by predefined blood pressure thresholds and consideration of

comorbidities or target organ damage, a strategy designed to balance therapeutic efficacy with the avoidance of overtreatment. This threshold-based approach, while rooted in rigorous evidence, may lead to relative delays in pharmacotherapeutic initiation compared to symptom-driven interventions, with potential clinical implications—such as missed opportunities for early mitigation of subclinical target organ damage (e.g., incipient left ventricular hypertrophy or microalbuminuria)—in specific patient subgroups. In contrast, TCM approaches these stages through its holistic theoretical system, emphasizing syndrome differentiation and restoring systemic balance. By targeting underlying disharmonies (e.g., Qi stagnation, Yin deficiency, or phlegm-dampness), TCM interventions may alleviate early clinical manifestations (e.g., headache, dizziness) and potentially mitigate progressive organic impairment, offering a complementary pathway for managing subthreshold or early-stage elevations in blood pressure.

It is important to emphasize that neither system is inherently superior; instead, they operate within distinct theoretical frameworks with unique strengths and limitations. Liu Conggen's research on treating patients with primary hypertension found that combining Chinese and Western medicine is more conducive to controlling blood pressure and restoring the body's balanced and coordinated state.²⁶ Western medicine excels in evidence-based risk stratification, precise blood pressure monitoring, and targeted drug therapies with well-defined efficacy. At the same time, TCM specializes in individualized syndrome regulation and management of subjective symptoms. The integrated diagnosis and treatment of Chinese and Western medicine, adhering to the science-based and patient-centered medical philosophy, recognizes the complementary advantages of these two therapeutic approaches, which is crucial for optimizing the comprehensive management strategies throughout the entire process of hypertension diagnosis and treatment.

3. The principles and specific methods of syndrome differentiation and treatment in traditional Chinese and Western medicine for hypertension (method)

"Method" refers to the principles and specific approaches for treating diseases. This involves using various diagnostic methods to determine the nature of the disease, pathogenic factors, lesion locations, the strength or weakness of the constitution, the abundance or deficiency of body fluids, and the rise and fall of pathogenic and healthy factors,

Table 1
The etiology and pathogenesis of hypertension in traditional Chinese and Western medicine.

Similarities and differences		Traditional Chinese medicine	Western medicine
Differences	Theoretical Foundation Definition	Holism Categories such as "dizziness", "liver wind", "depression and dizziness", "Vertigo", "black blood disease (blood vessel damage)", "blood heat syndrome", "pulse distention", etc. ²⁰	Reductionism Office SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg without the use of antihypertensive drugs. ²¹ (Note: The U.S. guidelines define the diagnostic criterion for hypertension as a blood pressure $> 130/80$ mmHg.)
	Etiology	Liver disease: In liver disease, the first symptom is dizziness, and the ribs are full. Phlegm-fire: Dizziness is usually associated with phlegm. ¹⁵ Upper excess and lower deficiency: Yang Qi goes up but not down, so it is a deficiency of the upper body and lower body, the top headache disease. ^{22,23} Other: Internal fire, Yin deficiency, Yang hyperactivity, phlegm syndrome, internal wind, internal heat, blood deficiency, Qi deficiency, congenital abnormal endowment, emotional and mental disorders, irregular diet and rest, excessive labor and housing, external evil invasion, etc. ^{21,22,24,25}	Physiological factors: Physiological systems, genetics, and obesity. External factors: diet, mental stress, alcohol consumption, smoking, age. ²⁵ Other: Sleep apnea syndrome, medication, weight, etc.
Similarities	Essential Manifestations	Qi stagnation and blood stasis, blood stasis blocking the collaterals, phlegm, and stasis mutually obstructing. Exuberant liver fire, internal disturbance of phlegm turbidity. Internal retention, spleen deficiency with dampness encumbrance. Damp-heat, kidney Yang deficiency, kidney Yin deficiency, and kidney Qi deficiency.	Arterial sclerosis, thrombosis, and other vascular organic lesions. Chronic inflammatory response and abnormal regulation of fluid balance. Metabolic disorders, endocrine disorders. Kidney dysfunction or chronic kidney disease.

Table 2
Symptoms and treatment methods of some hypertensive diseases in traditional Chinese and Western medicine.

	Type	Diagnostic information	Corresponding treatment methods
Western medicine	Elevated systolic blood pressure type ³¹	Poor peripheral circulation due to slight artery constriction or spasm. Increased left ventricular contractile load with relatively reduced blood volume is more common in thin individuals.	Vasodilators and beta-blockers can be used mainly, but diuretics should be used sparingly or avoided.
	Diastolic hypertension type (high blood volume type)	Increased blood volume and increased left ventricular volume load. Therefore, diuretics are the first choice. However, long-term use of thiazide diuretics may lead to a series of biochemical abnormalities and electrolyte disorders, such as hypokalemia, hyperglycemia, and hyperlipidemia.	Advocates state that combined medication can be used with potassium-sparing diuretics or angiotensin-converting enzyme inhibitors (ACEI) to reduce side effects and enhance therapeutic effects.
	Mixed systolic and diastolic hypertension type	Variable blood pressure, different degrees of increase in systolic and diastolic pressure, often overweight, and main complaints of headache, dizziness, and memory decline.	Diuretics, β -blockers, calcium channel blockers (CCB), or ACEI should be chosen, with the specific selection based on the degree of blood pressure elevation, body shape, and medical history of the patient.
	Hypertension caused by hyperthyroidism Hypertension caused by excessive adrenal cortex hormone secretion	Hyperthyroidism, elevated thyroid hormone levels causing hypertension. Elevated levels of adrenal cortex hormones, possible presence of tumors or pathological tissues.	Through anti-thyroid drugs, surgery, or radioactive iodine treatment. Using medication or surgery, including anti-adrenal cortex hormone drugs, surgical removal of tumors or pathological tissues.
Traditional Chinese medicine	Yin-Yang (Qi-Blood) deficiency syndrome ^{32,33}	Dizziness and headache, tinnitus like cicadas, insomnia with excessive dreaming, lumbar soreness and leg weakness, palpitations and shortness of breath, frequent night urination, muscle twitching, fear of cold and cold limbs, pale or red tongue, white coating, deep and thin or thin and rapid pulse.	Mainly focus on replenishing Qi and blood and regulating the heart and spleen.
	Liver fire exuberance syndrome	Red face and eyes, irritability, dizziness and headache, constipation with dark urine, dry and bitter mouth, red tongue with yellow coating, and wiry rapid pulse.	Mainly to extinguish windclear fire and subdue Yang to soothe the liver.
	Syndrome of intermingled phlegm and blood stasis	Main symptoms include a heavy or painful head. Secondary symptoms: For those disturbed by wind-phlegm, symptoms include a heavy head as if wrapped, chest and epigastric fullness, poor appetite, nausea, heavy limbs, and fatigue. For those with blood stasis blocking the channels, symptoms include stabbing headache with a fixed location, chest pain, palpitations, and numbness in hands and feet. The tongue appears dark red with a yellow or white greasy coating, and the pulse is wiry and rapid.	Mainly to eliminate phlegm, resolve stasis, activate blood, and unblock the collaterals.
	Excessive phlegm-dampness syndrome	Dizziness and headache, tinnitus like cicadas, insomnia with excessive dreaming, lumbar soreness and leg weakness, palpitations and shortness of breath, frequent night urination, muscle twitching, fear of cold and cold limbs, pale or red tongue, white coating, deep and thin or thin and rapid pulse.	Mainly focus on replenishing Qi and blood and regulating the heart and spleen.
	Yin deficiency Yang hyperactivity syndrome	Red face and eyes, irritability, dizziness and headache, constipation with dark urine, dry and bitter mouth, red tongue with yellow coating, and wiry rapid pulse.	Mainly to extinguish windclear fire and subdue Yang to soothe the liver.

thereby analyzing and summarizing to establish treatment principles.

In clinical practice, TCM employs four diagnostic methods: observation, listening, questioning, and pulse assessment. These methods facilitate syndrome differentiation by evaluating various factors, including the patient's complexion, body shape, voice, body odor, medical history, and pulse condition.^{27,28} Following a comprehensive analysis of the patient's state, individuals are classified according to distinct disease patterns. This process ultimately guides the formulation of tailored treatment plans.^{29,30} On the other hand, Western medicine primarily relies on clinical data and signs obtained from medical technologies such as blood pressure measurement, electrocardiograms, X-ray examinations, and laboratory test results for diagnosis and treatment. The condition and disease state are evaluated by assessing the differences in cardiovascular function, organ structure, and biochemical indicators among various patients, and treatment plans are formulated to precisely guide therapeutic decisions (as shown in Table 2).

Blood pressure values are an absolute basis for diagnosis; precise blood pressure readings can diagnose patients definitively.³⁴ Hypertension is traditionally divided into primary and secondary hypertension. Primary hypertension accounts for over 90% of all hypertension patients, with mostly unclear. According to the latest clinical guidelines,^{35–37} the classification of hypertension requires a multi-dimensional assessment framework: first, the degree of blood pressure elevation, which is

specifically divided into three grades (Grade 1: SBP 140–159 mmHg or DBP 90–99 mmHg; Grade 2: SBP 160–179 mmHg or DBP 100–109 mmHg; Grade 3: SBP $\geq$ 180 mmHg or DBP $\geq$ 110 mmHg); second, risk stratification, which is categorized into four levels (low risk, moderate risk, high risk, and very high risk) based on age, smoking status, dyslipidemia, family history of premature heart disease, target organ damage (e. g., left ventricular hypertrophy, carotid atherosclerosis, micro-albuminuria), and other risk factors such as diabetes mellitus, chronic kidney disease, and cardiovascular disease; third, comorbid conditions, including cerebrovascular disease, heart disease, kidney disease, diabetes mellitus, etc (as shown in Table 3). Despite the complexity of this classification system, it can provide a scientific basis for medical staff to formulate individualized treatment plans, thereby optimizing the overall management level of hypertensive patients and improving their prognosis.

However, the latest research has proposed a hypothesis known as the REASON classification, which categorizes the causes of hypertension into six types: renin-dependent hypertension, arteriosclerotic hypertension in the elderly, sympathetic nervous system hypertension, secondary hypertension, salt-sensitive hypertension, and hyperhomocysteinemia hypertension.³⁸ This suggests that a thorough and detailed classification of disease types can help make differential treatment choices for patients and enable precise medication use.

Table 3
Cardiovascular risk stratification for patients with elevated blood pressure.

Clinic blood pressure	Normal high value	I Hypertension	II Hypertension	III Hypertension
Risk factors				
No other risk factors	Low risk	Low risk	Moderate risk	High risk
1 - 2 Other risk factors	Low Risk	Moderate Risk	Moderate to high risk	Very high risk
≥3 Risk factors, target organ damage, stage 3 chronic kidney disease or diabetes mellitus	Moderate to high risk	High risk	High risk	Very high risk
Clinical complications, or stage ≥4 chronic kidney disease, diabetes mellitus with complications	High to very high risk	Very high risk	Very high risk	Very high risk

TCM has accumulated rich experience in treating hypertension, and currently, "phlegm and blood stasis" has become a universal pathological

mechanism for the occurrence of hypertension. The core of this mechanism is the dysfunction of the spleen and stomach, which is closely related to the function of the gut microbiota.³⁹ Recent studies suggest that gut microbiota is a critical factor influencing population heterogeneity, emerging as a potential new therapeutic target for hypertension.^{40,41} By assessing the gut microbiota's composition and quantity, TCM enables precise diagnosis and prognosis of cardiovascular conditions.⁴² Furthermore, harnessing the gut microbiota to craft tailored interventions promises to realize precision nutrition and healthcare, thus addressing some of the current limitations of antihypertensive drugs.^{43,44} Furthermore, in the comparison of the connotations of precision medicine between Chinese and Western medicine (as shown in Fig. 1), it has been found that proteomics involved in Western precision medicine has characteristics of wholeness, systematicity, dynamic complexity, and stage stability, which are similar to the holistic concepts and syndromes in TCM theory.⁴⁵ The uniqueness of diseases like hypertension lies in the varying degrees of influence that different factors have on individual phenotypes, resulting from the interaction between genetics and the environment, and may change over time. Precisely describing the molecular composition of an individual at a specific point in time is one of the difficulties in treating hypertension. Proteomics is ideal for this problem; it can discover common pathophysiological characteristics and detect many proteins in tissue samples or body fluids. This helps define specific disease phenotypes and guides prevention and treatment measures under precision medicine.² Furthermore, several

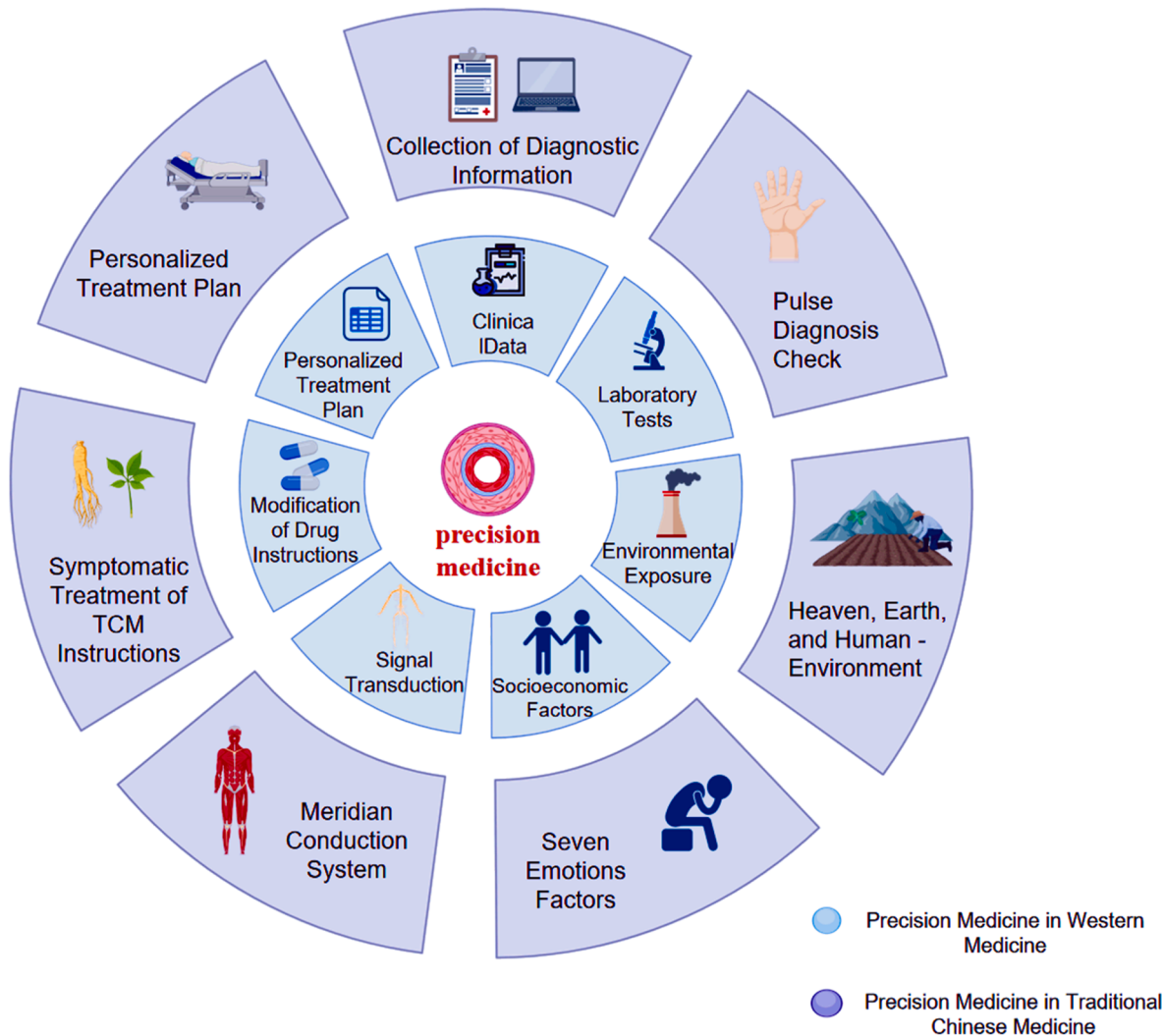


Fig. 1. Comparison of the connotations of precision medicine in traditional Chinese and Western medicine.

studies^{46,47} have suggested that examining marker proteins across various TCM syndromes offers a viable approach to quantifying these syndromes. Identifying distinctively expressed proteins that differentiate among TCM syndromes in hypertension holds significant importance for the condition's prevention, diagnosis, and prognosis. Both Chinese and Western medicine have their strengths in diagnosing diseases, and by integrating their methods and technologies, based on precise clinical phenotypes combined with biomarkers and omics data, hypertension can be more precisely defined. Working together, they provide powerful tools for predicting patient risks and help us provide the proper prevention and treatment methods for patients at the lowest cost.

4. The principles and specific methods of syndrome differentiation and treatment in traditional Chinese and Western medicine for hypertension (prescription)

The so-called prescription refers to prescription formulas and combinations. It is about reasoning through syndrome differentiation (disease), establishing principles, and formulating a prescription suitable for the patient's condition.

In TCM, the prescription treatment for hypertension typically involves the physician integrating personal experience and factors such as the patient's condition, constitution, age, gender, and lifestyle habits. After a comprehensive analysis, the physician employs syndrome differentiation and treatment to match the herbs according to the "The Seven Types of Prescriptions" and the "monarch, minister, assistant, and guide" model. After this analysis, syndrome differentiation and treatment are applied, where drugs are precisely combined according to the "Seven Formulae of Drug Compatibility" and the roles of "Chief, Deputy, Assistant, and Envoy" (i.e., through rational organization and organic combination of drugs, adjusting their biases, controlling their toxicity, enhancing or altering original functions, eliminating or alleviating adverse factors to the human body, and exerting a complementary or opposing combined effect, thereby forming a new organic whole from a group of drugs with distinct characteristics) to create a prescription formula.⁴⁸ This method is used to provide targeted Chinese medicine prescription treatment. TCM classifies hypertensive disease into syndromes differentiated by their pathogenesis, with Yin Deficiency and Yang Hyperactivity being predominant. TCM believes that the occurrence of Yin Deficiency and Yang Hyperactivity type hypertension is closely related to the imbalance of Yin-Yang in the liver, kidneys, and heart. Therefore, the goal of TCM prescriptions for treating hypertension is not limited to the cardiovascular system but primarily focuses on nourishing the liver and kidneys, supplemented by calming liver Yang, clearing liver fire, activating blood circulation, promoting diuresis, and transforming phlegm and dampness.⁴⁹ Based on this, prescriptions such as Zhen Gan Xi Feng Tang,⁵⁰ modified Zhi Bai Di Huang Wan, and modified Da Bu Yuan Jian are formulated.⁵¹ Additionally, based on the patient's constitution, the symptoms and signs of hypertension vary, allowing for tailored prescriptions. If the patient experiences a frontal headache, irritability with a preference for vomiting, and fullness, Zhen Gan Xi Feng Tang can be combined with Qing Zhen Tang. Suppose the patient exhibits weakness of the waist and knees, tinnitus, ear deafness, night sweats, seminal emission, five heart vexation and fever, a red tongue with little coating, and a deep, thin, rapid pulse. In that case, the Liuwei Dihuang Pill should be used in combination. TCM prescribes treatments by comprehensively considering various patient factors to achieve the best therapeutic effect. This reflects the personalization and principle of syndrome differentiation and treatment in TCM, a concrete manifestation of the "personalized medicine" theory, emphasizing "treatment based on individual and disease characteristics".

In Western medicine, prescription treatment is primarily guided by Western medical theories, targeting symptomatic treatment based on the type of disease. The use of multiple Western drugs in combination has a similar effect to TCM prescriptions, which is to rationally combine

various drugs based on the characteristics of the condition and the nature of the drugs. This enhances efficacy, reduces toxicity, and expands the scope of treatment to achieve more precise therapy. For hypertension, Western medicine combines different classes of antihypertensive drugs based on the diagnosed subtype of hypertension. The combination of two, three, or four drugs is applicable across various classes of antihypertensive drugs. Deng Yunpeng et al.⁵² surveyed and analyzed antihypertensive combination therapy in some domestic public hospitals. They found that monotherapy is more suitable for patients with grade 1 hypertension. Grade 2 hypertension patients should choose a single-pill combination (SPC), and grade 3 hypertension patients should opt for a free combination of multiple drugs. SPC can balance efficacy and compliance and is one of the critical essential choices for improving the blood pressure control rate. For SPC, doctors believe patients with grades 1, 2, and 3 hypertension should primarily choose CCB + beta-blockers (B), angiotensin II receptor blockers (ARB) + CCB, and ARB + CCB, respectively. Two classes of antihypertensive drug combinations can be used according to the actual situation of the patient, such as C + A for hypertension combined with other cardiovascular and cerebrovascular diseases; A + D for hypertension combined with renal insufficiency, diabetes, heart failure, and other diseases; C + B for symptoms such as heart failure, edema, increased sympathetic nerve activity, and rapid heart rate. Combinations of three and four classes of antihypertensive drugs (including one diuretic) are mainly used to treat refractory hypertension (despite the application of tolerable, adequate doses of three rationally combined antihypertensive drugs for at least 4 weeks based on lifestyle improvements, blood pressure in and out of the clinic remains uncontrolled, or ≥ 4 drugs are needed to achieve blood pressure control⁵³), and five classes of antihypertensive drug combinations are used to treat intractable hypertension^{54,55} (5%–20% of hypertensive patients, after improving lifestyle, using a sufficient and reasonable combination of three kinds of antihypertensive drugs, blood pressure is still above the target level, or at least four types of antihypertensive drugs are needed to make blood pressure up to standard^{56,57}) (as shown in Fig. 2)

In the realm of combination drug therapy and clinical research, several key studies have been conducted. The NCLUSIVE⁵⁸ study explored the combination of ARB (irbesartan) and a diuretic (hydrochlorothiazide). It was found that the achievement rate of blood pressure control was 30% with monotherapy and 77% with combination therapy. The EVALUATE⁵⁹ and Val-DICTATE⁶⁰ studies compared different regimens. The EVALUATE study looked at ARB (valsartan) versus diuretic (hydrochlorothiazide) and ARB + diuretic versus CCB (amlodipine). Results showed that valsartan + hydrochlorothiazide had a significantly better antihypertensive effect than either hydrochlorothiazide or valsartan alone. In comparing ARB + diuretic and ARB + CCB groups, their antihypertensive efficacies were comparable, but the ARB + diuretic group had a significantly lower incidence of adverse reactions. The ASCOT - BPLA⁶¹ study compared CCB (amlodipine) + ACEI (perindopril) with β -receptor blocker (atenolol) + diuretic (bendroflumethiazide). It was revealed that the CCB + ACEI combination resulted in a more significant reduction in blood pressure and a substantial decrease in the composite endpoint of cardiovascular events.

Hypertension is also a polygenic disease, and the low efficacy of some treatment methods is related to genetic variations among individuals.⁶² A genetic analysis study of hypertension in family pedigrees suggests that 30%–50% of an individual's risk of developing hypertension comes from genetic factors. Therefore, for individuals who respond differently to medications, gene sequencing methods are used to specify the use of drugs. For instance, patients with mutations in CYP2D610, ADRB1(1165G > C), CYP2C93, AGTR1(1166A > C), and ACE (I/D) are more sensitive to beta-blockers and have a normal response to ACEI and ARB⁶³; carriers of the CYP2C19*2 and *3 genes do not efficiently convert clopidogrel into the active product, metabolism of ticagrelor, prasugrel, etc., and platelet inhibition are not affected by cytochrome P450 gene polymorphisms. In contrast, the CYP2C19*17 gene is

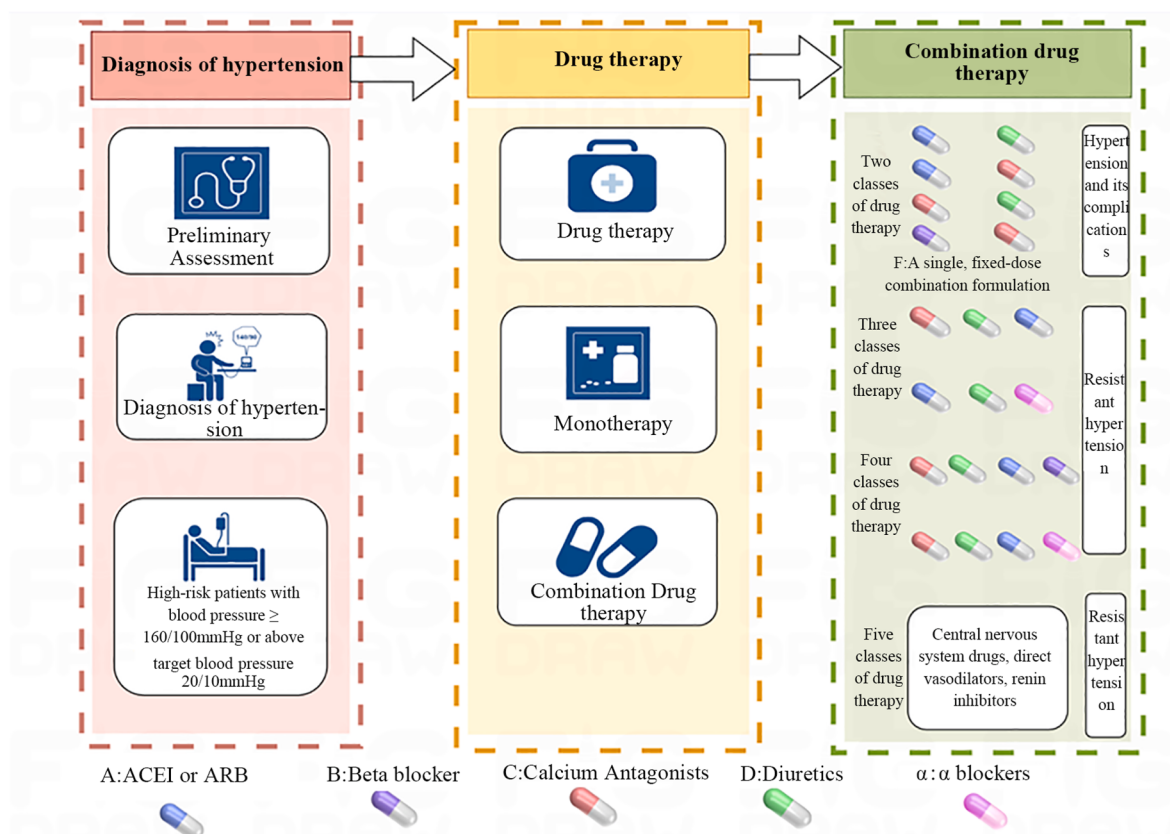


Fig. 2. Reference flowchart for drug selection in combined antihypertensive treatment.

associated with an increased risk of bleeding.^{64–66} Therefore, after gene sequencing, the selection or combination of individual antiplatelet drugs can be considered to reduce the probability of cardiovascular events. Warfarin dosage is influenced by the polymorphisms of the CYP2C9 gene, with carriers of CYP2C9^{*3}, and other rare CYP2C9 alleles typically requiring lower doses to achieve similar anticoagulation levels.⁶⁷ After genetic testing, the study comprehensively considers the polygenic medication standards of multiple common genetic variations and rare genetic variations with significant disease impact. This allows for timely adjustments to drug dosages, meeting the requirements for precision medicine. This has important clinical implications for enhancing drugs' therapeutic effects, reducing adverse reactions, and lowering medical costs.^{68–70} In addition, the latest research indicates that artificial intelligence has the potential to transform the clinical practice of hypertension treatment by integrating personalized prevention and treatment methods. This includes identifying optimal and patient-specific blood pressure qualities, determining the most effective antihypertensive medication regimen for individuals, and developing interventions targeting modifiable risk factors.⁷¹ But there are still problems to overcome. Artificial intelligence has not yet established a golden standard for selecting the best algorithm for specific databases. Moreover, slight changes in the database can lead to significantly different final results.⁷²

Modern studies validate TCM's multi-target mechanisms. For instance, *Salvia miltiorrhiza* reduces vascular stiffness by inhibiting TGF- β /Smad signaling, similar to ACE inhibitors. However, current TCM trials often lack large-scale validation and mechanistic depth. Future research should integrate multi-omics approaches to decode its 'multi-component, multi-target' paradigm, transitioning from generality to individuality.⁷³ Western medicine focuses on the treatment at the molecular target level of the disease, while TCM emphasizes regulating the overall Yin-Yang balance of the body. Both have their strengths. Studies^{74–80} show that combining the advantages of both and regulating

treatment from local to overall, better efficacy can be achieved than using only one type of medicine.

5. Medications for treating hypertensive disease with traditional Chinese and Western medicine (medicine)

"Medicine" is the basis of a prescription and the fundamental unit of formula composition. There are pharmacological relationships between various medicines, such as the four natures and five flavors of medicines and the rules of medicinal compatibility. Different combinations lead to changes in pharmacological effects. The effects of medicines vary with different dosages; the more complex the condition, the more precise the medication needs to be.

Multiple components, targets, and pathways characterize the clinical use of medicine in TCM. The ancient saying goes, "Formulas are made up of medicines". In clinical practice, Chinese medicine often adjusts the dosage according to the severity and urgency of the condition, using different preparation/decocting methods to stimulate the medicinal properties to achieve precise medication. For example, other medicines are used for hypertension caused by various reasons. *Uncariae Ramulus Cum Uncis* (UR) and centipede both have the effect of calming the wind and alleviating spasms, but their properties differ in terms of their cold and warm natures. UR is calm, while the centipede is warm. In formulation, they are used respectively for treating hypertension caused by liver Yang rising and cold coagulation, causing vascular spasms. At the same time, different Chinese medicines/prepared products are added to the base medicine according to different concurrent symptoms. For example, if a hypertension patient also has diarrhea, roasted *Atractylodes* can be added to enhance the effect of strengthening the spleen and stopping diarrhea. If the patient has abdominal distension and poor appetite, charred *Atractylodes* can be added to avoid the disadvantages of stagnation and stimulate appetite and digestion. However, due to the complexity of Chinese medicine components and their complex

interactions with biological systems, the molecular mechanisms of Chinese medicine components need to be elucidated. Li Ling and others⁸¹ have established the connection between Chinese medicine and biological networks at the molecular level through network pharmacology research, providing adequate, compelling evidence for deciphering the corresponding biological markers and mechanisms of drug interactions for the disease. Subsequently, this can be applied to large-scale clinical trials and verified for efficacy. By exploring the pharmacodynamic substances and active mechanisms at the molecular level of Chinese medicine, TCM promotes precise targeting of pathogenic factors and opens up a new path for the personalized and accurate use of Chinese medicine.

Western medicine traditionally follows the "one drug, one target, one disease" approach. Common antihypertensive medications include

CCBH, ACEI, ARB, diuretics, etc., primarily acting as single-target antagonists. For instance, ARB, represented by losartan, works by selectively blocking the binding of angiotensin II to its receptor subtype AT1 in vascular smooth muscle and the adrenal glands, thereby blocking vasoconstriction and aldosterone secretion. However, single-target drugs have been successful, and it is now undeniably clear that for complex, multifactorial diseases like hypertension, highly selective treatments targeting a single target have proven to be limited in efficacy and therapeutic outcomes. Long-term use inevitably leads to varying degrees of adverse reactions. For example, ACEI and ARB, which lower blood pressure by dilating blood vessels, can lead to the deposition of drug metabolites in the vessel walls. The more they are taken, the more deposits accumulate, leading to vascular hardening, thinning, and fragility, causing more severe damage to vital organs such as the heart,

Table 4
Traditional Chinese and Western medicines acting on hypertension.

Classification	Specific type	Pathogenesis	Mechanism of action	Therapeutic drugs
TCM	Hyperactivity of liver Yang syndrome	Yin deficiency of liver and kidney, hyperactivity of liver Yang, disturbing the clear orifices	Calm liver and suppress Yang, clear heat and purge fire; inhibit liver Yang hyperactivity and purge liver fire.	Tianma Gouteng Decoction, Longdan Xiegan Decoction, Songling Xuemaikang Capsules, Qinggan Jiangya Capsules, Zhenju Jiangya Tablets
	Phlegm-damp obstructing Middle-Jiao syndrome	Exuberant internal phlegm-damp, obstructing the Middle-Jiao, failure of clear Yang to ascend and turbid Yin to descend	Dry dampness and resolve phlegm, invigorate spleen and harmonize stomach; eliminate phlegm-damp, restore spleen and stomach function to ascend clear and descend turbid	Banxia Baizhu Tianma Decoction, Erchen Decoction, Xuanyunning Tablets, Wendan Pills, Kulao Jiangya Pills
	Blood stasis obstructing orifices syndrome	Blood stasis obstructs the brain's orifices, abnormal Qi-blood circulation, failure of the brain to be nourished.	Activate blood circulation to remove stasis, open orifices and relieve pain; dredge blood vessels, remove stasis and open orifices to improve blood supply to the brain orifices.	Xuefu Zhuyu Decoction, Tongqiao Huoxue Decoction, Xinmaitong Tablets, Xinaning Tablets
	Kidney essence deficiency syndrome	Deficiency of kidney essence, insufficiency of marrow sea, or decline of kidney Yang, failure of warming function	Tonify the kidney and replenish essence, warm Yang and benefit Yin; nourish the kidney essence, warm the kidney Yang to replenish the marrow sea	Zuogui Pill, Yougui Pill, Jiannao Bushen Pills, Yilingjing, Qiju Dihuang Pills, Yougui Pills
	Qi-blood deficiency syndrome	Insufficiency of Qi and blood, failure to nourish the head and eyes, failure of the brain to be nourished	Replenish Qi and blood, invigorate spleen and ascend Yang; tonify Qi and blood, strengthen spleen function to nourish brain orifices.	Guipi Decoction, Buzhong Yiqi Decoction, Bazhen Capsules, Renshen Yangrong Pills, Shiquan Dabu Pills
	Liver-kidney Yin deficiency syndrome	Yin deficiency of the liver and kidney, failure of Yin to control Yang, upward disturbance of deficient fire	Nourish liver and kidney, calm liver and extinguish wind; tonify liver-kidney Yin, calm deficient fire to relieve Yang hyperactivity symptoms.	Qiju Dihuang Decoction, Zhengan Xifeng Decoction, Liuwei Dihuang Pills, Angong Jiangya Pills, Qinggan Jiangya Capsules
Western medicine	Abnormal activation of Calcium channels	Abnormal activation of calcium channels in vascular smooth muscle cells, leading to enhanced vascular contraction	Block Calcium channels in vascular smooth muscle, dilate blood vessels; non-dihydropyridine agents also have adverse chronotropic and inotropic effects.	Dihydropyridines: Amlodipine, Nifedipine Controlled-release Tablets; Non-dihydropyridines: Verapamil, Diltiazem
	Excessive activation of RAAS	Excessive activation of RAAS, increased angiotensin II, leading to vascular contraction.	Inhibit angiotensin-converting enzyme, block angiotensin II production; promote ACE2 activity, dilate blood vessels and inhibit proliferation.	Angiotensin-converting enzyme inhibitors (ACEI): Captopril, Enalapril, Benazepril
		Angiotensin II mediates vascular contraction through AT1 receptors	Block AT1 receptors; angiotensin II activates AT2 receptors to produce vasodilation and anti-proliferation effects	Angiotensin receptor blockers (ARB): Losartan potassium, Irbesartan, Telmisartan
	Sodium and water retention	Sodium and water retention leading to increased blood volume and elevated blood pressure	Promote natriuresis and diuresis, reduce volume load; thiazides also dilate small arteries.	Diuretics: Hydrochlorothiazide, Indapamide (thiazides), Furosemide (loop diuretics), Amiloride (potassium-sparing);
	Sympathetic hyperactivity	Hyperactivity of sympathetic nerve activity, increased heart rate and myocardial contractility	Inhibit sympathetic nerve activity, slow heart rate and reduce myocardial contractility	β -Receptor blockers: Metoprolol, Bisoprolol, Atenolol
	Excessive RAAS activation + increased natriuretic peptide degradation	Excessive RAAS activation and increased natriuretic peptide degradation affect blood pressure regulation	Inhibit neprilysin from degrading natriuretic peptides (diuretic, vasodilatory); block angiotensin receptors for synergistic blood pressure reduction.	Angiotensin receptor neprilysin inhibitors (ARNI): Sacubitril/Valsartan, Sacubitril/Aliskiren
	Increased renin activity	Increased renin activity, promoting angiotensin II production and vascular contraction	Directly inhibit renin activity, reduce angiotensin II production	Direct renin inhibitors: Aliskiren
	Excessive aldosterone	Excessive aldosterone secretion, activating mineralocorticoid receptors, leading to sodium and water retention and vascular fibrosis	Block excessive activation of mineralocorticoid receptors, reduce blood pressure and protect heart and kidney function.	Mineralocorticoid receptor antagonists (MRA): Spironolactone, Eplerenone (steroidal), Finerenone (non-steroidal)
	Activation of endothelin system	Endothelin-1 binds to receptors, leading to vascular contraction and water retention	Inhibit endothelin-1 binding to ET _A /ET _B receptors, dilate blood vessels and reduce water retention.	Dual endothelin receptor antagonists: Ambrisentan

brain, liver, and kidneys and exacerbating complications.⁸² Therefore, the prevention and treatment of hypertension should focus on local lesions and overall regulation. In response to this phenomenon, in the field of drug development, the concept of multi-target drugs for complex diseases like hypertension is rapidly rising. The design of rational multi-target drugs has become an attractive drug development model. It is considered a potential treatment strategy for diseases with complex etiologies and serious drug resistance. These drugs aim to enhance efficacy or safety by regulating multiple targets simultaneously, offering advantages over single-target drugs or combinations of single-target drugs.^{83,84} Consequently, Western medicine primarily reduces adverse drug reactions. It improves the treatment efficiency of complex diseases through combination therapy and the development of multi-target drugs, thereby making drug efficacy more targeted.

Additionally, although Chinese and Western medicine classifications and usage bases differ, their mechanisms for treating the same hypertension disease have similarities. Modern pharmacological research indicates that *Gastrodiae Rhizoma* can effectively reduce peripheral vascular resistance, thereby playing a role in lowering blood pressure, and it can also significantly increase cerebral blood flow, ensuring the blood supply to the head; UR has sedative and blood pressure-lowering effects.⁸⁵ The aqueous extract of *Lycii Cortex*⁸⁶ and the *Coreopsis tinctoria* extraction⁸⁷ mainly lower blood pressure by reducing the content of angiotensin II, thus regulating the RAAS, which is the same as the mechanism of action of ACEIs in Western antihypertensive drugs. The Chinese medicine Yuxia capsule, whose main components are *Saposhnikovia Radix*, *Stigma Maydis*, *Prunellae Spica*, and *Raphani Semen*, significantly reduces the content of calcium ions in the myocardial tissue of rats with primary hypertension,⁸⁸ which is the same effect as CCB in Western antihypertensive drugs. Moreover, this capsule can increase the activity of sodium-potassium ATPase in the renal tissue of rats with primary hypertension, which also has the effect of a diuretic for hypertension. Diuretic hypertension is also a polygenic disease, and the low efficacy of some treatment methods is related to genetic variations among individuals (as shown in Table 4).^{63,89–93}

TCM employs a treatment system where the method is established through prescriptions, and prescriptions are passed on through methods. When selecting and composing medicines, TCM tailors treatments based on different symptoms and medicinal properties, providing personalized diagnosis and treatment. Additionally, different auxiliary symptoms are accommodated by adding or subtracting different medicines to the base formula, adapting to various other individuals and changes in pathogenesis, and achieving a "one person, one prescription" approach to precise medication. Although this differs from the basis for adjusting Western medicine, combining both often yields better results than using either Western or Chinese medicine alone in treating hypertension. A study⁹⁴ divided patients with hypertension of the "stagnant heat interplay" type into a Chinese medicine group, a Western medicine group, and an integrated Chinese and Western medicine group, finding that the total effective rate of the integrated group was significantly higher than that of the Chinese medicine group and the Western medicine group alone. When implementing Western medicine treatment for coronary heart disease patients while also providing TCM syndrome-based treatment, it was found that the total effective rate of the combined treatment was higher than that of the control group using Western medicine alone.⁹⁵ Therefore, integrating the dialectical thinking of TCM with the evidence-based thinking of Western medicine and implementing a combined Chinese and Western medicine approach for hypertension patients can improve patient indicators and symptoms, achieving personalized and precise medication use.

6. Summary and outlook

The medical characteristic of our country is to give equal importance to both TCM and Western medicine, and in clinical medication, the combination of Chinese and Western medicine is often used. TCM still

possesses a complete and unique theoretical system and rich diagnostic and therapeutic experience. It is a precious legacy left by our ancestors, and the principles of "principle, method, prescription, and medicine" are the essence of its understanding and treatment of diseases, which is extremely important.⁹⁶ Hypertension, as a standard and high-incidence disease in clinical practice, has not yet been given the best treatment plan by either TCM or Western medicine. However, many clinical studies by medical practitioners have shown that combining TCM and Western medicine in treating hypertension is a practical and effective clinical solution. This article compares the perspectives of "principle, method, prescription, and medicine" and finds differences and unifications between TCM and Western medicine in the study of hypertension.

The precision of both TCM and Western medicine is reflected in the internal connection between "principle, method, prescription, and medicine" during the diagnosis and treatment process. "Principle" is the etiology and pathogenesis of the disease, which is the basis for diagnosis and treatment. "Method" is the method of diagnosing the disease, which is the process of medical practitioners capturing and summarizing pathological signs. "Prescription" is the accurate judgment of the disease based on "method" and the combination of drugs to achieve the purpose of curing the disease. "Medicine" is the precise use of medicine under the correct "prescription".

By elaborating on the mutual reference between TCM and Western medicine regarding the "principle, method, prescription, and medicine" for hypertension, this paper indicates that precision medicine and integrated medicine are, in fact, the longitude and latitude tracks of modern medical development, presenting a dialectically unified relationship of "one entity with two wings". The integrative thinking of TCM focuses on grasping the imbalanced state of the human body from a macro-holistic perspective, and the system of "syndrome differentiation and treatment" is essentially a precision medical practice based on the dynamic evolution of syndromes.⁹⁷ In contrast, Western medicine emphasizes defining diseases from the micro levels of genome and proteome, pursuing the specificity of targets, and the strategy of "molecular subtyping" reflects the integrative thinking from the perspective of reductionism.⁹⁸ These two approaches exhibit a significant synergistic effect in the diagnosis and treatment of hypertension.

When considering the treatment of hypertension, a broader perspective is essential. Beyond focusing on blood pressure control, both medical systems should pay close attention to systemic comorbidities. For example, in Western medicine, when treating hypertensive patients, it is crucial to consider the potential risks of cardiovascular diseases, such as coronary heart disease and heart failure, as well as the impact on the kidneys, eyes, and other organs. Drugs are selected not only for their antihypertensive effects but also for their ability to protect target organs and reduce the risk of comorbidities. In TCM, the treatment of hypertension is not merely about lowering blood pressure but also about regulating the overall balance of the body's Qi, blood, and internal organs. TCM therapies aim to address the root causes of hypertension-related comorbidities, such as nourishing the liver and kidneys to prevent potential eye problems or improving blood circulation to reduce the risk of cardiovascular events.

For complex diseases such as hypertension, a single-dimensional approach of "precision" or "integration" is insufficient to address the full complexity of the condition. The true future direction lies in "Integrative Precision" or "Precision Integration" — which takes the holistic perspective and syndrome differentiation-based treatment as the top-level design, and employs modern molecular subtyping, biomarkers, and pharmacogenomics as precision tools.⁹⁹ What our paper demonstrates is that the integrative thinking of TCM provides a macroscopic framework and individualized ideas for the precision practice of Western medicine, while the precision technologies of Western medicine offer microscopic verification and a standardized language for the integrative schemes of TCM. These two approaches complement each other and jointly constitute the core connotation of modern integrative pharmacy: achieving precision on the basis of systematic integration and

accomplishing systematic regulation under the guidance of precision.

Exploring the laws of the essence of diseases, discovering the influencing factors of related diseases, moving the diagnostic and treatment ideas of diseases forward, intervening in time before the disease occurs to achieve the effect of "treating before illness" in TCM, and after the disease occurs, achieving precise medication further to improve the effectiveness of clinical diagnosis and treatment and increase the success rate of disease diagnosis and treatment is a path worth exploring together.

To advance this process and address the clinical challenges posed by complex diseases, future research should promote the transformation of disease prevention and treatment models from "universal protocols" to "individualized comprehensive protocols". This transformation not only aligns with the ultimate goal of precision medicine—emphasizing targeted evidence-based interventions—but also embodies the most valuable practice of integrative pharmacy.¹⁰⁰ It integrates the macro-holistic thinking of TCM and the micro-precision thinking of Western medicine to optimize disease management. In this way, this research direction effectively connects the universal and synergistic development path of disease management with the specific needs of prevention and treatment, providing systematic and individualized solutions for improving the overall efficacy of complex disease care.

CRedit authorship contribution statement

Jinliang Liu: Writing – original draft, Visualization, Methodology, Investigation, Conceptualization. **Jiena Xiao:** Writing – original draft, Visualization, Investigation, Conceptualization. **Zhongwei Lin:** Supervision, Funding acquisition. **Mingzhu Xiao:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Conceptualization.

Declaration of interest statement

These authors have no conflict of interest to declare.

Acknowledgments

This research was supported by the Natural Science Foundation of Guangdong Province (2023A1515010271) and the 2023 International Training Program for Outstanding Young Scientific Research Talents of Guangdong Province.

References

- Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. *Lancet*. 2021;398(10304):957–980.
- Zhuang J. Study on the correlation between H-type hypertension with phlegm-dampness syndrome and endothelial function. *Target Organ Damage*. Guangzhou University of Chinese Medicine; 2020.
- Shurin SB, Nabel EG. Pharmacogenomics—ready for prime time? *N Engl J Med*. 2008;358(10):1061–1063.
- Chen N, Zhang X, Gong Y, et al. Analysis and prospect of hospital pharmacy department to carry out the individualized pharmaceutical care. *Chin J Hospital Pharm*. 2015;35(15):1343–1346.
- Gao L, Cao M, Li J, et al. Traditional Chinese medicine network pharmacology in cardiovascular precision medicine. *Curr Pharm Des*. 2020;27(26):2925–2933.
- Terry SF. Obama's precision medicine initiative. *Genet Test Mol Biomark*. 2015;19(3):113–114.
- Miao M, Xie Y. Precision traditional Chinese herbal medicines from the perspective of precision medicine. *Shanghai J Tradit Chin Med*. 2023;57(5):31–36.
- Savoia C, Volpe M, Grassi G, et al. Personalized medicine—a modern approach for the diagnosis and management of hypertension. *Clin Sci*. 2017;131(22):2671–2685.
- Bamba H, Singh G, John J, et al. Precision medicine approaches in cardiology and personalized therapies for improved patient outcomes: a systematic review. *Curr Probl Cardiol*. 2024;49(5):102470.
- Louridas GE, Lourida KG. Conceptual foundations of systems biology explaining complex cardiac diseases. *Healthcare (Basel)*. 2017;5(1):10.
- Zhang L, Yang Y, Li H. Discussion on the difficulties and solutions in the clinical teaching of integrated Chinese and western medicine-pediatrics. *Chin Med Mod Distance Education China*. 2020;18(23):34–36.
- Zhang J, Wu M, Wang Y, et al. Medicine in future and advantages of integrated Chinese and western medicine. *Chin J Integr Med*. 2019;25(2):87–90.
- Ma H, Zhang W, Zhao J. The clinical experience of Professor Zhao Jifu, a famous Chinese medicine doctor, in diagnosing and treating hypertension. *China Practical Med*. 2023;18(23):126–129.
- Chen Y. Liangxue Shiwei Tablet combined with nifedipine in the treatment of essential hypertension. *Guangming J Chin Med*. 2024;39(3):433–436.
- Wang Q. *Chin Archives Tradit Chin Med*. 2008;(11):2321–2323. Dissertation on TCM conception and name of hypertension.
- Wu M, Shi Y. *Internal Medicine of Traditional Chinese Medicine*. China Press of Traditional Chinese Medicine; 2021.
- Wang J. Chinese guidelines for the prevention and treatment of hypertension (2024 revision). *J Geriatr Cardiol*. 2025;22(1):1–149.
- Qin M, Yang W, Lü Y, et al. Research progress on multi-targeted interventions of renin-angiotensin-aldosterone system inhibitors for treatment of hypertension. *Drugs Clinic*. 2022;37(2):439–444.
- Guo Y, Sun Y, Huang F, et al. Advances in autonomic function and hypertension. *Guizhou Med J*. 2023;47(2):178–179.
- Yang Y, Li Q, Wei X, et al. "Four syndrome classification" for syndrome differentiation and treatment of hypertension. *J Tradit Chin Med*. 2019;60(7):562–567.
- Sui S, Yi S. Clinical practice of 2023 hypertension guidelines update. *J Electrocardiol Circ*. 2023;42(3):203–206, 212.
- Li L, Li Y, Chang Y, et al. Research progress of Chinese medicine in treating hypertensive disease. *Human J Tradit Chin Med*. 2023;39(5):198–201.
- Liu SQ, Li J. Research progress of qiweibaizhu powder in treating digestive system diseases. *World J Tradit Chin Med*. 2021;7(4):391–396.
- Shao X, Deng Y. Progress of research on applying qi, blood and fluid theory in cardiovascular diseases. *Chin J Integr Med Cardio/Cerebrovasc Disease*. 2020;18(17):2801–2803.
- Zhang S, Chen Z, Tang Y. Recognition and development of TCM in the treatment of hypertension. *World Sci Technol-Mod Tradit Chin Med Mater Med*. 2020;22(12):4139–4146.
- Liu C. Effect of combining traditional Chinese and western medicine on primary hypertension. *Guide China Med*. 2023;21(23):45–48.
- Liu H, He X. Overview of objective research on hypertension based on "four diagnostic methods of traditional Chinese medicine. *China's Naturopathy*. 2022;30(7):120–122.
- Xiang X, Peng Y, Yang W, et al. Interpretability of Chinese medicine four examinations information of major adverse cardiovascular events in resistant hypertension: based on random forest rule extraction method. *J Tradit Chin Med*. 2022;63(7):628–634.
- Liu W. Understanding traditional Chinese medicine and Chinese herbs. *J Appl Phys*. 2011;74(6):4052–4059.
- Xiang K, Yang J, Wu X, et al. Advances in traditional Chinese medicine for cardiovascular disease therapy in 2020. *Tradit Med Res*. 2021;6(3):27.
- Zhang L. Classification and treatment principles of hypertension in the elderly. *Chin Foreign Med Res*. 2011;9(23):145–146.
- Hu W. Clinical study of combining traditional Chinese and western medicine treatment of primary hypertension. *Acta Chin Med*. 2011;26(5):607–608.
- Han X. Chinese medical diagnosis and treatment project of hypertension (First Draft). *China J Tradit Chin Med Pharm*. 2008;23(7):611–613.
- Li H, Wu W. The effect of traditional Chinese medicine treatment on antioxidant levels in elderly patients with phlegm-dampness yongsheng type essential hypertension. *Shanxi Med J*. 2012;41(9):965–966.
- Revision Committee of Chinese Guidelines for Hypertension Prevention and Treatment, China Hypertension League (CHL), Hypertension Branch of China International Exchange and Promotive Association for Medical and Health Care (CPAM). Chinese guidelines for hypertension prevention and treatment (2024 revision). *Chin J Hypertension*. 2024;32(7):603–700.
- McEvoy JW, McCarthy CP, Bruno RM, et al. ESC guidelines for the management of elevated blood pressure and hypertension: developed by the task force on the management of elevated blood pressure and hypertension of the European Society of cardiology (ESC) and endorsed by the European Society of Endocrinology (ESE) and the European Stroke Organisation (ESO). *Eur Heart J*. 2024;45(38):3912–4018, 2024.
- Chinese Society of Cardiology, Chinese Medical Association; Hypertension Committee of Cross-Straits Medicine Exchange Association; Cardiovascular Disease Prevention and Rehabilitation Committee, Chinese Association of Rehabilitation Medicine. Clinical practice guideline for the management of hypertension in China. *Chin Med J (Engl)*. 2024;137(24):2907–2952.
- Xu C, Li M, Meng W, et al. Etiological diagnosis and personalized therapy for hypertension: a hypothesis of the REASOH classification. *J Pers Med*. 2023;13(2):261–261.
- Zhang C, Wang L. Intestinal flora—a new target for cardiovascular disease regulation in Chinese medicine. *Chin J Integr Med Cardio-Cerebrovasc Disease*. 2018;16(22):3379–3382.
- Liu J, Li L. TCM syndrome differentiation and treatment of cardiovascular diseases based on intestinal flora. *Chin J Inf Tradit Chin Med*. 2021;28(9):11–14.
- Liu Q. Based on the four segments and treatment by syndrome differentiation to lower the mortality of sepsis. *Chin J Integr Med*. 2009;15(1):16–18.
- Liu J, Jiang T. Pondering on the diagnosis and treatment criteria for syndromes of epilepsy in traditional Chinese medicine. *Chin J Integr Med*. 2006;4(6):572–574.

43. Yang Z, Wang Q, Liu Y, et al. Gut microbiota and hypertension: association, mechanisms and treatment. *Clin Exp Hypertens*. 2023;45(1), 2195135–2195135.
44. Gibbons SM, Gurry T, Lampe JW, et al. Perspective: leveraging the gut microbiota to predict personalized responses to dietary, prebiotic, and probiotic interventions. *Adv Nutr*. 2022;13(5):1450–1461.
45. Liu C. New thinking of accurate diagnosis and treatment of traditional Chinese medicine. *J Shandong Univ Tradit Chin Med*. 2018;49–52.
46. Zhao X, Yang J, Li J, et al. Application of proteomics in study of traditional Chinese medicine syndrome of cardiovascular diseases. *Shandong J Tradit Chin Med*. 2022;41(6):691–695.
47. Yang S, Wang Z, Zhao H, et al. Modern research of tibetan medicine. *World J Tradit Chin Med*. 2019;5(2):131–138.
48. van Wietmarschen HA, van der Greef J, Schroeën Y, et al. Evaluation of symptom, clinical chemistry and metabolomics profiles during rehmannia six formula (R6) treatment: an integrated and personalized data analysis approach. *J Ethnopharmacol*. 2013;150(3):851–859.
49. Yan G, Yang X. Analysis of medication rules of the prescriptions for senile hypertension based on data mining. *West J Tradit Chin Med*. 2018;31(2):62–65.
50. Dai S, He Q, Yang G. Chinese medicine identification and treatment of hypertension ten methods and ten prescriptions. *Glob Tradit Chin Med*. 2021;14(2):316–319.
51. Fu Q, Luan H. Analysis of the effect of traditional Chinese medicine identification and typing in the treatment of hypertensive disease. *China Rural Health*. 2020;12(8):79.
52. Deng Y, Fan Y. Survey and analysis of hypertension co-administration by physicians in selected public hospitals in China. *Chin J Hypertens*. 2024;32(1):78–82.
53. Wang M, Zhou X. Research progress of traditional Chinese medicine treatment of resistant hypertension. *Asia-Pacific Tradit Med*. 2024;20(2):245–250.
54. Liu G. A review of the way combination medications are recommended in multinational hypertension guidelines. *Chin J Hypertens*. 2016;24(11):1008–1013.
55. Liu J. Highlights of the 2024 Chinese hypertension guidelines. *Hypertens Res*. 2025;48(3):1048–1053.
56. Zhu Y. Clinical effects of combining traditional Chinese and Western medicine in the treatment of patients with refractory hypertension. *J Bingtuan Med*. 2023;21(2):31–32.
57. Zhu D. Treatment of intrahepatic cholestasis with integrated traditional Chinese and Western medicine. *J Chin Integr Med*. 2004;2(6):412–414.
58. Raskin P, Guthrie R, Flack JM, et al. The long-term antihypertensive activity and tolerability of irbesartan with hydrochlorothiazide. *J Hum Hypertens*. 1999;13(10):683–687.
59. Lacourcière Y, Wright Jr JT, Samuel R, et al. Effects of force-titrated valsartan/hydrochlorothiazide versus amlodipine/hydrochlorothiazide on ambulatory blood pressure in patients with stage 2 hypertension: the EVALUATE study. *Blood Press Monit*. 2009;14(3):112–120.
60. White WB, Calhoun DA, Samuel R, et al. Improving blood pressure control: increase the dose of diuretic or switch to a fixed-dose angiotensin receptor blocker/diuretic? The valsartan hydrochlorothiazide diuretic for initial control and titration to achieve optimal therapeutic effect (Val-DICTATE) trial. *J Clin Hypertens*. 2008;10(6):450–458.
61. Poulter NR, Wedel H, Dahlöf B, et al. Role of blood pressure and other variables in the differential cardiovascular event rates noted in the anglo-scandinavian cardiac outcomes trial-blood pressure lowering arm (ASCOT-BPLA). *Lancet*. 2005;366(9489):907–913.
62. Johnson JA. Advancing management of hypertension through pharmacogenomics. *Ann Med*. 2012;44(S1):S17–S22.
63. Ma Y, Chen W, Deng J. Profile of gene polymorphisms related to anti-hypertensive medication in 361 patients from a taiyuan hospital. *Chin Rem Clin*. 2023;23(3):178–184.
64. Guo J, Shi L, Yuan J. Individualized use of clopidogrel based on CYP2C19 genotype. *Chin Pharm J*. 2015;50(12):1062–1065.
65. Mega JL, Hochholzer W, Frelinger AL, et al. Dosing clopidogrel based on CYP2C19 genotype and the effect on platelet reactivity in patients with stable cardiovascular disease. *JAMA*. 2011;306(20):2221–2228.
66. Collet JP, Hulot JS, Pena A, et al. Cytochrome P450 2C19 polymorphism in young patients treated with clopidogrel after myocardial infarction: a cohort study. *Lancet*. 2009;373(9660):309–317.
67. Wang D. Research in warfarin anticoagulant treatment and genetic polymorphisms of CYP2C9. *J Med Inf*. 2023;36(2):176–179.
68. Fischer M, Schmutzhard E. Posterior reversible encephalopathy syndrome. *J Neurol*. 2017;264(8):1608–1616.
69. Zou X, Yu M, Fang Y, et al. Comparison of the effects of pharmacogenomics-oriented drug therapy with conventional drug therapy in patients with hypertension. *Chin J Hypertens*. 2023;31(9):883–887.
70. ada H, Usui S, Sakata K, et al. Challenges of precision medicine for atherosclerotic cardiovascular disease based on human genome information. *J Atheroscler Thromb*. 2021;28(4):305–313.
71. Chaikijurajai T, Laffin LJ, Tang WHW. Artificial intelligence and hypertension: recent advances and future outlook. *Am J Hypertens*. 2020;33(11):967–974.
72. Barberis E, Khoso S, Sica A, et al. Precision medicine approaches with metabolomics and artificial intelligence. *Int J Mol Sci*. 2022;23(19):11269.
73. Chen X. Characteristics and predominance of TCM in treating and preventing hypertension. *Tianjin J Tradit Chin Med*. 2012;29(2):155–157.
74. Huang J, He Z. Observations on the efficacy of combining traditional Chinese medicines in the treatment of 40 cases of intractable hypertension in elderly people. *China Practical Med*. 2011;6(20):143–144.
75. Wang S, Shen J, Xu Y, et al. Clinical observation on 40 cases of intractable hypertension treated with combination of Chinese and western medicine. *J Sichuan Tradit Chin*. 2005(8):47–48.
76. Zhang F, Chen W, Chen Y. Treatment of 75 patients with refractory hypertension using pinggan huoxue decoction. *Chin J Tradit Med Sci Technol*. 2014;21(6):691–692.
77. Wang J. Observation on curative effect of regulating liver and promoting blood circulation method combined with dual therapy on obstinate hypertension. *Practical Clin J Integr Tradit Chin West Med*. 2020;20(11):122–123.
78. Wei G, Su G, Wu D, et al. Summary of clinical experience in treating intractable hypertension with the method of tonifying the kidney and promoting blood circulation. *Cardiovasc Disease Electronic J Integr Tradit Chin West Med*. 2018;6(17):31–32.
79. Zhang S, Wang C, Qi Y, et al. Clinical observation on treatment of 32 patients with measles by qingzhen decoction. *Chin J Integr Med*. 2009;15:389–392.
80. Wang F. Clinical observation on effect of nourishing liver and kidney on growth in adolescence. *J Chin Integr Med*. 2007;5(4):463–464.
81. Li L, Yang L, Yang L, et al. Network pharmacology: a bright guiding light on the way to explore the personalized precise medication of traditional Chinese medicine. *Chin Med*. 2023;18(1), 146–146.
82. Li Y, Wei H. Analysis of the effect of community health management for hypertension patients. *Chin Community Dr*. 2015;31(20):143–144.
83. Löscher W. Single-target versus multi-target drugs versus combinations of drugs with multiple targets: preclinical and clinical evidence for the treatment or prevention of epilepsy. *Front Pharmacol*. 2021;12:730257.
84. Loganathan L, Gopinath K, Sankaranarayanan VM, et al. Computational and pharmacogenomic insights on hypertension treatment: rational drug design and optimization strategies. *Curr Drug Targets*. 2020;21(1):18–33.
85. Meng X, Xiong X. Traditional Chinese medicine insights of newly-diagnosed and young hypertension and clinical practice of tianma gouteng decoction for hypertension treatment. *China J Chin Mater Med*. 2020;45(12):2752–2759.
86. Yuan Y, Gan Y, Huang H, et al. Study on anti-hypertensive effect and mechanism of lycii cortex in spontaneously hypertensive rats. *Chin Archives Tradit Chin Med*. 2018;36(11):2802–2804.
87. Ling B, Zhang L, Ha M, et al. Effect of *Coreopsis tinctoria* on blood pressure and renin-angiotensin system in hypertensive mice. *Pharmacol Clin Chin Mater Med*. 2013;29(2):80–83.
88. Zheng M, Zhu L, Yang J. Study on the antihypertensive mechanism of traditional Chinese medicine yuxia capsule. *Clin J Chin Med*. 2016;8(36):46–51+54.
89. Liu D. Research on Rules of Diagnosis and Treatment of Major Adverse Cardiovascular Events Resistant Hypertension Based on Real World Study. China Academy of Chinese Medical Sciences; 2020.
90. Dong L, Jiang G, Fan R. Study on the mechanism of traditional Chinese medicine in treating hypertension. *J Tianjin University Tradit Chin Med*. 2018;37(3):261–264.
91. Wang B. Modern Pharmacology and Clinic of Chinese Traditional Medicine Eng. Tianjin Science and Technology Translation and Publishing Company; 2004:657.
92. Pan W, Jiang H, Li Y. Effects of guteng (*Uncaria rhynchophylla*) extracting solution on urine metabolomics in spontaneously hypertensive rats. *J Tradit Chin Med*. 2019;60(1):62–66, 71.
93. Yuan N, Zhu M, Yang HF, et al. Protective effect and mechanism of ligustrazine on lipopolysaccharide-induced inflammatory injury in human coronary artery endothelial cells. *Chin J Arteriosclerosis*. 2020;28(2):113–117.
94. Tong X. Observation on the Therapeutic Effect of Qinghua Yurecipe on Essential Hypertension of stasis-heatinterjunction Type. North China University of Science and Technology; 2019.
95. Yang Y. Analyzing the clinical effect of combined Chinese and Western medicine in the treatment of coronary heart disease. *World Latest Med Inf*. 2018;18(83):151–152.
96. Zhou T. A discussion on the integrity of theory, method, prescription, and medicine. *J Practical Tradit Chin Med*. 1985(2):16–17.
97. Zhang M, Moalin M, Haenen GRMM. Connecting west and east. *Int J Mol Sci*. 2019;20(9):2333.
98. Hui R. Strengthening the construction of big data and entering the new era of cardiovascular precision medicine—Challenges and bottlenecks in the development and face of cardiovascular precision medicine. *Chin J Med Guide*. 2022;24(5):429–432.
99. Abdelhalim H, Berber A, Lodi M, et al. Artificial intelligence, healthcare, clinical genomics, and pharmacogenomics approaches in precision medicine. *Front Genet*. 2022;13:929736.
100. Singh DB. The impact of pharmacogenomics in personalized medicine. *Adv Biochem Eng Biotechnol*. 2019;171:369–394.