# Chinese Expert Consensus on Community-Based Prevention and Management of Adult Hypertension with Type 2 Diabetes Mellitus and Dyslipidemia (2024 Edition) Post-Print

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## Abstract

Hypertension, type 2 diabetes mellitus, and dyslipidemia are collectively termed the “three highs,” frequently coexisting within the same individual and substantially elevating the risks of hospitalization, mortality, and associated disease burden. Consequently, integrated risk management and standardized treatment of these three conditions are imperative. Primary-level medical and health institutions constitute the principal setting for chronic disease prevention and control. Although existing clinical evidence offers important insights for the primary-level prevention, treatment, and management of populations with the “three highs,” there are currently no co-management specifications, consensuses, or guidelines applicable to primary-level settings, either domestically or internationally. The Beijing Hypertension Prevention and Treatment Association, together with four other academic societies/associations, organized primary-level medical personnel and invited experts and scholars from multiple disciplines—including cardiology, endocrinology, pharmacy, and public health—to jointly develop an expert consensus on primary-level prevention and treatment of the “three highs” comprising 21 recommendations. This was accomplished through extensive solicitation of clinical practice needs from primary-level medical personnel, integration and appraisal of evidence related to primary-level prevention and treatment of the “three highs,” and multiple rounds of discussion, revision, and voting. The recommendations in this consensus aim to enhance the awareness and capacity of primary-level medical personnel regarding prevention and treatment of the “three highs,” provide scientific strategic support for primary-level medical and health institutions to implement “three highs” prevention and treatment, and establish a solid foundation for co-management of the “three

highs" tailored to primary care settings.

## Full Text

## Preamble

**Chinese Expert Consensus on Grassroots Prevention and Treatment of Hypertension Combined with Type 2 Diabetes Mellitus and Dyslipidemia in Adults (2024 Edition)**

**Issuing Organizations:** Beijing Hypertension Association, China Association of Gerontology and Geriatrics, Beijing Community Health Service Association, Beijing Community Health Promotion Association

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**Abstract:** Hypertension, type 2 diabetes mellitus (T2DM), and dyslipidemia are collectively referred to as the "three highs," which often coexist in the same individual. This combination significantly increases the risk of hospitalization, mortality, and disease burden. Therefore, joint risk management and standardized treatment of these three conditions are essential. Primary healthcare institutions serve as the main battlefield for chronic disease prevention and treatment. While existing clinical evidence provides important insights into the prevention, treatment, and management of the "three highs" in primary care settings, no standardized guidelines, consensus statements, or norms specifically tailored for grassroots co-management of these conditions exist domestically or internationally. To address this gap, four academic associations led by the Beijing Hypertension Association organized primary healthcare workers and invited experts and scholars from cardiology, endocrinology, pharmacy, and public health. Through extensive consultation with primary care clinicians about their practical needs, systematic evaluation of evidence related to "three highs" prevention and treatment in primary care, and multiple rounds of discussion, revision, and voting, this expert consensus comprising 21 recommendations was developed.

The recommendations aim to enhance primary healthcare workers' awareness and capacity for "three highs" prevention and treatment, provide scientific strategic support for primary care institutions to implement "three highs" management, and establish a solid foundation for co-management of these comorbidities with primary care characteristics.

**Keywords:** Hypertension; Diabetes mellitus, type 2; Dyslipidemias; Multiple

chronic conditions; Three high co-management; Primary healthcare institutions; Expert consensus

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Hypertension, diabetes, and dyslipidemia—collectively known as the "three highs"—frequently coexist as comorbidities in the same individual. Currently, the prevalence rates among Chinese adults aged 18 and older are 27.8% for hypertension, 12.4% for diabetes, and 33.8% for dyslipidemia. According to 2018 data from the China Health and Retirement Longitudinal Study (CHARLS), the prevalence of "three highs" among Chinese adults aged 60 and above reaches 10.0%. Analysis of 2018 data from the China Chronic Disease and Risk Factor Surveillance revealed that the comorbidity rate of hypertension, diabetes, and dyslipidemia among Chinese residents aged 45 and older is 7.6%. However, control rates remain suboptimal. Survey results show that among managed hypertensive patients, blood pressure control rates are 67.72%, while diabetes control rates are only 33.1%. Among high-risk adults for primary cardiovascular prevention, low-density lipoprotein cholesterol (LDL-C) target achievement is 25.0%, and among those with established atherosclerotic cardiovascular disease (ASCVD) at very high risk, LDL-C target achievement is merely 6.8%. Moreover, patients with "three highs" face significantly increased cardiovascular disease risk compared to those with a single condition: blood pressure levels positively correlate with cardiovascular risk; T2DM patients have 2-4 times higher cardiovascular risk; and dyslipidemia, particularly elevated LDL-C, is a key factor in ASCVD development. The medical costs of cardiovascular and cerebrovascular diseases attributable to "three highs" are surging annually, reaching 270.901 billion yuan in 2020, including 13.26 billion for hypertension and 31.641 billion for diabetes. Clearly, "three highs" impose enormous burdens on individuals, families, and society, making their control an urgent priority.

With the implementation of tiered healthcare delivery, primary healthcare institutions have become the main venues for chronic disease prevention and treatment in China. These institutions provide patient-centered, continuous, comprehensive, accessible, and individualized care, which effectively enhances patient adherence and self-management capabilities while promoting integration of medical care and prevention within institutions and vertical integration of healthcare resources across different levels, thereby improving co-management outcomes for "three highs." The National Basic Public Health Service Standards (Third Edition) specifies management protocols and control targets for hypertension and T2DM in primary care, but dyslipidemia management has not

yet been included as a separate item in national basic public health services, lacking effective co-management. Although existing clinical evidence offers important insights for preventing, treating, and managing "three highs" in primary care, integrated evidence and application recommendations are lacking. Therefore, the Beijing Hypertension Association, China Association of Gerontology and Geriatrics, Beijing Community Health Service Association, and Beijing Community Health Promotion Association jointly organized the development of this "Chinese Expert Consensus on Grassroots Prevention and Treatment of Hypertension Combined with Type 2 Diabetes Mellitus and Dyslipidemia in Adults," with primary healthcare workers as the main contributors and participation from experts in cardiology, endocrinology, pharmacy, and public health. This consensus aims to provide scientific strategic support for "three highs" prevention and treatment in primary care and establish a solid foundation for comorbidity co-management.

## 1. Consensus Development Methods and Target Population

This consensus followed clinical guideline development processes. Before project initiation, the working group completed protocol development and registration on the International Practice Guideline Registration and Transparency Platform (Registration No.: PREPARE-2023CN509). The consensus development began with a nationwide questionnaire survey of primary healthcare workers across multiple provinces to comprehensively understand grassroots prevention and treatment needs for "three highs" and identify clinically relevant questions with good applicability. Systematic literature searches were then conducted in PubMed, Embase, Cochrane, CNKI, and Wanfang Data to integrate and evaluate evidence on "three highs" prevention and treatment in primary care, considering benefits, risks, evidence quality, and resource accessibility. Recommendations were formulated through multiple rounds of discussion, revision, and voting.

The GRADE (Grades of Recommendation Assessment, Development and Evaluation) system was used to grade evidence quality and recommendation strength (Table 1 ). Due to the complexity of "three highs" management and limited clinical evidence on grassroots prevention and treatment, this consensus only assigned grades to intervention recommendations.

This consensus is intended for reference and use by general practitioners, village doctors, and other professionals in primary healthcare institutions. The target population includes Chinese adults aged 18 and older with primary hypertension combined with T2DM and dyslipidemia, as well as those assessed as being at risk for "three highs."

The consensus proposes a framework for "three highs" prevention and treatment for the entire population in primary healthcare institutions (Figure 1 [Figure 1: see original paper]).

## 2. Consensus Recommendations

### 2.1 What Are the Common Risk Factors for "Three Highs" Development?

**Unhealthy Lifestyles:** (1) Unhealthy diets, including high sodium/sugar-sweetened beverages, low calcium, low potassium, low whole grains, low nuts/seeds, low legumes, low fruits, low vegetables, low dietary fiber, low polyunsaturated fatty acids, high trans fatty acids, low omega-3 fatty acid seafood, and high processed meat consumption. (2) Physical inactivity, including insufficient exercise (less than 150 minutes/week of moderate-intensity aerobic activity or 75 minutes/week of vigorous activity or equivalent combination), irregular exercise, and sedentary behavior. (3) Smoking, including active smoking (including e-cigarettes), passive smoking, and smoking history. (4) Excessive alcohol consumption, defined as daily alcohol intake >25 g for men or >15 g for women, or weekly intake $ $100 g, with increasing risk at higher consumption levels. (5) Inadequate or excessive sleep duration, defined as <6 hours or >8 hours daily, or presence of sleep apnea.

**Overweight/Obesity:** Overweight is defined as BMI $ $24.0 kg/m^{2}$, and obesity as BMI $ $28.0 kg/m^{2}$.

**Pathophysiological States:** Endothelial dysfunction, elevated coagulation factors, chronic inflammation, oxidative stress, and insulin resistance.

**Psychological Factors:** Mental stress and psychological issues such as anxiety and depression.

**Other Factors:** Genetic factors, economic status, education level, social status, and occupation.

### 2.2 How to Identify and Screen High-Risk Populations for "Three Highs"?

**High-Risk Populations Requiring Individualized Management:** (1) Individuals with high-normal blood pressure (120-139/80-89 mmHg, 1 mmHg=0.133 kPa) or hypertension history; (2) Those with diabetes, prediabetes (impaired glucose tolerance, impaired fasting glucose, or both), gestational diabetes history, or transient steroid-induced diabetes; (3) Those with dyslipidemia history; (4) Those with ASCVD or chronic kidney disease history; (5) Overweight/obesity and/or central obesity (waist circumference $ $90 cm in men, $ $85 cm in women); (6) Long-term unhealthy lifestyles such as high-sodium diet, smoking, excessive alcohol consumption; (7) Long-term use of antipsychotic and/or antidepressant medications, steroid use history; (8) Family history of hypertension or T2DM, familial hyperlipidemia, or premature cardiovascular disease (first-degree male relatives <55 years or female relatives <65 years with ASCVD).

**Screening Content and Frequency for High-Risk Populations:** All indi-

viduals meeting the above criteria should undergo: (1) Blood pressure screening every 3-6 months, with encouragement and guidance for home blood pressure monitoring (HBPM), and ambulatory blood pressure monitoring when available; (2) Blood glucose screening at least every six months, including fasting plasma glucose (FPG), with self-monitoring of blood glucose (SMBG) guidance, and oral glucose tolerance test (OGTT) if FPG $ $6.1 mmol/L or random glucose $ $7.8 mmol/L, plus HbA1c when available; (3) Lipid screening at least every six months, including total cholesterol (TC), LDL-C, HDL-C, and triglycerides (TG), with apolipoprotein B (ApoB) and lipoprotein(a) [Lp(a)] testing when available.

### 2.3 How to Prevent "Three Highs" Development?

**For the General Population:** (1) Lifestyle interventions including healthy diet, increased physical activity, weight control, smoking cessation, alcohol restriction, healthy sleep, and psychological well-being; (2) Comprehensive public education on chronic disease prevention, promoting healthy lifestyles, early diagnosis and treatment; (3) Creating healthy environments by providing fitness areas and equipment, and encouraging family-based lifestyle modifications.

**For High-Risk Populations:** In addition to general measures: (1) Assess ASCVD risk using the "Chinese Adult ASCVD Overall Risk Assessment Procedure" (Figure 2 [Figure 2: see original paper]) for stratified management and individualized lifestyle intervention; (2) Consider early pharmacotherapy if intensive lifestyle interventions are ineffective; (3) For overweight/obese individuals, recommend low-calorie diet and $ $150 minutes/week of moderate-intensity physical activity to achieve 5-10% weight loss within 3-6 months.

**For Non-Compliant Individuals:** Discuss personal cardiovascular risks and prevention benefits, emphasize intensive lifestyle intervention while actively implementing secondary prevention, focus on pharmacotherapy, and ensure regular follow-up and monitoring.

### 2.4 What Are the Diagnostic Criteria for "Three Highs" Patients?

Currently, no unified diagnostic criteria exist for "three highs" comorbidity; individual disease criteria remain in use (Table 2 ). Note that dyslipidemia diagnostic criteria primarily apply to low ASCVD risk populations. The order of disease diagnosis is not emphasized; "three highs" is diagnosed when patients meet all three diagnostic criteria.

### 2.5 How to Identify, Screen, and Initially Manage Complications in "Three Highs" Patients?

Primary healthcare workers must maintain awareness of complication screening, utilizing available medical resources and referral networks. For acute complications, rapid identification and emergency referral with pre-referral management

are essential. For chronic complications, regular screening and referral to higher-level hospitals for further evaluation when necessary are recommended, followed by standardized management according to relevant guidelines.

**2.5.1 Acute Complications Hypoglycemia (Blood Glucose <3.9 mmol/L):** High-risk individuals include those with missed/delayed meals, vomiting/diarrhea, alcohol intake (especially on empty stomach), increased exercise, autonomic dysfunction, hepatic/renal insufficiency, insulin or insulin secretagogue use, or overly strict glycemic targets. Clinical manifestations include sympathetic overactivity (palpitations, anxiety, sweating, dizziness, tremor, hunger) or central nervous system symptoms (altered consciousness, cognitive impairment, seizures, coma). Elderly patients may present with atypical symptoms or behavioral changes; some may have asymptomatic hypoglycemia. Management follows the protocol in Figure 3 [Figure 3: see original paper].

**Hyperglycemic Crises:** Including diabetic ketoacidosis and hyperosmolar hyperglycemic state. High-risk situations include fluid loss, inadequate hydration, infection, trauma, surgery, stroke, myocardial infarction, and insulin dose reduction/discontinuation. Clinical features vary but include polyuria, polydipsia, fatigue, nausea, vomiting, abdominal pain, altered consciousness, rapid deep breathing, and dehydration. Management requires intravenous access, fluid resuscitation (preferably 0.9% sodium chloride), insulin infusion (0.1 U/kg/h), laboratory evaluation, and emergency referral.

**Hypertensive Emergencies and Urgencies:** High-risk conditions include hypertensive encephalopathy, intracranial hemorrhage, stroke, heart failure, acute coronary syndrome, aortic dissection, pheochromocytoma crisis, drug use, perioperative hypertension, and pre-eclampsia/eclampsia. Hypertensive emergencies present with sudden, severe blood pressure elevation (generally >180/120 mmHg) with progressive target organ dysfunction, while urgencies show markedly elevated blood pressure without acute target organ damage. Management involves continuous monitoring, removing precipitating factors, intravenous antihypertensives (targeting <25% mean arterial pressure reduction within the first hour), and emergency referral.

**2.5.2 Chronic Complications Cardiovascular Disease:** Regular 12-lead ECG, ambulatory ECG, and echocardiography; consider coronary CT/angiography referral when indicated.

**Cerebrovascular Disease:** Regular carotid ultrasound and transcranial Doppler; consider brain CT/MRI/MRA referral when indicated.

**Lower Extremity Arterial Disease:** Regular pedal pulse and foot skin examination; ankle-brachial index and lower extremity vascular ultrasound when indicated.

**Chronic Kidney Disease:** Regular urinalysis, urinary albumin-to-creatinine

ratio (UACR), serum creatinine, and estimated glomerular filtration rate (eGFR).

**Ocular Disease:** Comprehensive eye examination including visual acuity, intraocular pressure, and fundoscopy; referral for further evaluation when indicated.

**Neuropathy:** Peripheral neuropathy screening including ankle reflex, pinprick, vibration, pressure, and temperature sensation; nerve conduction studies when indicated.

**Other Vascular Diseases:** Renal artery ultrasound when indicated.

**Additional Assessments:** Cognitive function, psychological issues, nutritional status.

### 2.6 When Should "Three Highs" Patients Be Referred?

Based on healthcare capacity, timely referral is recommended for: (1) Difficulty in diagnostic classification; (2) Persistent failure to achieve blood pressure, glucose, or lipid targets after standardized treatment; (3) Pregnant or lactating patients; (4) Severe acute complications; (5) Suspected new cardiac, cerebral, renal, or ocular complications with uncertain diagnosis; (6) Suspected drug-related adverse reactions that are difficult to manage; (7) Clinical conditions that cannot be managed at the primary care level.

### 2.7 What Are the Comprehensive Treatment Targets for "Three Highs" Patients?

Treatment aims to reduce cardiovascular, cerebrovascular, renal, and vascular complications and mortality while improving quality of life. Management should be ASCVD risk-stratified, vascular protection-centered, and individualized for safety, efficacy, simplicity, and cost-effectiveness. Clinical practice should consider target achievement, treatment response, and shared decision-making to prioritize issues and select management goals. The diagnosis and treatment pathway for the entire population is shown in Figure 4 [Figure 4: see original paper].

Component-specific control targets are listed in Table 3 . Additional recommendations include: (1) Monitoring time in range (TIR) for glucose (3.9-10.0 mmol/L) with target >70% ($ $16.8 hours/day) when feasible; (2) Time in blood pressure target range (TTR) as an independent cardiovascular risk predictor, with target >75%; (3) ApoB <0.8 g/L and Lp(a) <300 mg/L when testing is available; (4) Resting heart rate control at 60-70 beats/min, with attention to nocturnal minimum and exercise heart rates.

### 2.8 How to Implement Dietary Intervention for "Three Highs" Patients?

Primary healthcare workers should provide scientific, effective, and feasible dietary interventions using various clinical opportunities. Interventions include nutritional assessment, plan development, implementation, continuous monitoring, patient education on food labeling, and plan modification as needed.

**2.8.1 Principles of Healthy Diet** Follow diverse food intake, appropriate energy, 定量主食, light diet, food-based therapy, and regular meals. Calculate total energy intake at 105-126 kJ (25-30 kcal)/kg ideal body weight, adjusted for height, weight, gender, age, activity level, and stress status. Recommended macronutrient distribution: carbohydrates 45-60%, total fat 20-35%, protein 15-20% with high-quality protein >50% of total protein. Limit refined grains; increase whole grains and tubers (whole grains/legumes should comprise 1/4-1/2 of cereals); restrict added sugars. Limit saturated fat to <10% of total energy and trans fat to <2%; replace with polyunsaturated and monounsaturated fats. Limit dietary cholesterol to <300 mg/day. Choose protein sources such as dairy, fish, shrimp, soybeans, and their products. Include 25-40 g dietary fiber daily (7-13 g soluble fiber). Consume $ $500 g fresh vegetables daily (dark vegetables >50%); vegetables and fruits are not interchangeable. Maintain fluid intake >1500 mL daily (1500-1700 mL for adults $ $65 years with normal cardiac function). Restrict salt intake to <5 g/day; reduce sodium-containing condiments and pickled foods; choose potassium, calcium, and magnesium-rich foods.

**2.8.2 Dietary Patterns** Personalized patterns can be implemented based on age, gender, weight, lifestyle, occupation, and residence, following low-salt, low-fat diabetic diet principles. Recommended patterns include: (1) Eastern Healthy Diet Pattern (Zhejiang, Shanghai, Jiangsu, Fujian regions) characterized by light, low-salt, diverse foods, grain-based, abundant vegetables/fruits, rich in aquatic products and dairy/soy products, with high physical activity; (2) Chinese Heart-Healthy Diet (developed by Chinese clinicians, nutritionists, and cardiovascular experts) featuring reduced sodium and fat, increased protein, carbohydrates, potassium, magnesium, calcium, and fiber, with four regional cuisine options; (3) DASH diet (Dietary Approaches to Stop Hypertension) rich in fresh vegetables, fruits, low-fat dairy, poultry, fish, soy, and nuts, with reduced sugar, sugary beverages, and red meat.

**2.8.3 Meal Timing and Portioning** Plan meal frequency and distribution based on energy needs and individual conditions; eat regularly, chew thoroughly, and avoid overeating. Maintain relatively fixed meal times and portions. Decide on meal splitting based on individual glucose levels.

### 2.9 How to Implement Exercise Intervention for "Three Highs" Patients?

Individualized exercise prescriptions should be developed based on assessment results, with regular monitoring of exercise process and effects for timely adjustment.

**2.9.1 Exercise Safety Assessment** Evaluate cardiovascular event risk, exercise injury risk, and exercise-related illness risk while excluding contraindications. Assessment includes: (1) Cardiovascular risk through routine indicators (blood pressure, glucose, lipids, BMI, heart rate, ECG), physical activity level, cardiorespiratory fitness, muscle strength/endurance, flexibility, and balance; (2) Individual factors like injury history, fitness level, and cognition; (3) Imaging or functional assessments; (4) Environmental factors; (5) Exercise-related illness risks such as heat stroke, dehydration, hypoglycemia, and rhabdomyolysis.

**2.9.2 Exercise Prescription (FITT-VP Principles)** **Frequency:** At least 5 days/week. **Intensity:** Moderate intensity (64-76% maximum heart rate), assessed by rating of perceived exertion or talk test. **Time:** 30-45 minutes per session, $ $150 minutes/week. **Type:** Aerobic exercise (walking, running, cycling, swimming, dancing, non-competitive ball sports, Tai Chi, Baduanjin) and resistance training (gravity-resisted exercises, resistance bands, weights); include balance and flexibility exercises. **Volume:** $ $150-300 minutes/week moderate-intensity or 75-150 minutes/week vigorous-intensity aerobic activity, or equivalent combination; volumes exceeding these provide additional benefits. **Progression:** Adopt "low starting point, slow progression" strategy, adjusting frequency and duration before intensity.

**2.9.3 Implementation** Help patients recognize exercise benefits, develop personalized, effective, and sustainable exercise prescriptions based on individual conditions and interests, encourage long-term adherence, and monitor progress with plan adjustments as needed.

### 2.10 How to Implement Psychological Intervention for "Three Highs" Patients?

Psychological factors influence "three highs" development and progression. Primary healthcare workers should screen for psychological issues using PHQ-9 or GAD-7, and PHQ-15 or somatization symptom scales when somatic symptoms are prominent. Interventions emphasize prevention and combine prevention, treatment, and rehabilitation. For abnormal psychology or behavior, use cognitive behavioral therapy or pharmacotherapy, and refer to specialists when necessary.

### 2.11 How to Manage Weight in "Three Highs" Patients?

Weight management is crucial for improving treatment efficacy and delaying disease progression. Target BMI 18.5-24.0 kg/m$^2$, with appropriate relaxation with age. For underweight patients (BMI<18.5), medications causing weight gain may be used with monitoring. For overweight/obese patients (BMI>24.0), recommend 3-5% weight loss within 3-6 months, or more stringent targets (5%, 7%, 15%) based on individual conditions.

**Weight Loss Strategies:** (1) Lifestyle intervention with 6-month plan including low-calorie diet and 200-300 minutes/week moderate-to-vigorous physical activity, followed by long-term ($ $1 year) maintenance plan with monthly follow-up; (2) Pharmacotherapy: GLP-1 receptor agonists and other glucose-lowering agents with weight loss effects (metformin, SGLT2i, $\alpha$-glucosidase inhibitors) for BMI $ 27.0$kg/m^{2}$; (3) Metabolic surgery for those failing lifestyle and pharmacotherapy; (4) Cognitive behavioral therapy to enhance long-term adherence and maintenance.

### 2.12 Lifestyle Management Techniques for "Three Highs" Patients

**2.12.1 Self-Monitoring** Develop good recording habits to improve adherence and management efficiency. Patients should record data in Table 4 under professional guidance, with timing and frequency individualized through shared decision-making.

**2.12.2 Smoking Cessation Techniques** Encourage smokers with quit intention to receive medical counseling and guideline-recommended treatment. For those without quit intention, enhance motivation using multiple methods. The "5A" approach (Ask, Advise, Assess, Assist, Arrange) can directly and efficiently help smokers. For unwilling smokers, use "5R" measures (Relevance, Risk, Rewards, Roadblock, Repetition). Provide counseling through quitlines and online platforms, with referral to smoking cessation clinics when needed.

**2.12.3 Alcohol Restriction Techniques** Recommend complete abstinence. If unavoidable, limit occasional drinking to $ $25 g/day for men and $ $15 g/day for women. Tailor interventions based on drinking amount, frequency, and motivation stage using health education, counseling, and referral to specialists for alcohol dependence or withdrawal symptoms.

### 2.13 Pharmacological Treatment Principles for "Three Highs" Patients

Pharmacotherapy should be based on: (1) Achievement of treatment targets and presence of complications/comorbidities; (2) Drug interactions, contraindications, and disease effects on medications; (3) Drug costs, patient preferences, economic status, and insurance policies to select safe, effective, and appropriate medications.

**2.13.1 Antihypertensive Drugs** Commonly used oral antihypertensives include RAAS inhibitors (ACEI/ARB), calcium channel blockers (CCB), diuretics, and $\beta$-blockers; ARNI is also effective for primary hypertension. ACEI/ARB are preferred; add CCB, diuretics, $\beta$-blockers, or $\alpha$-blockers as needed. Use conventional doses, starting with smaller effective doses in elderly patients. Prefer long-acting agents; initiate combination therapy for blood pressure $ $160/100 mmHg or >20/10 mmHg above target, or for single-drug treatment failure. For tachycardia (resting heart rate >80 beats/min), prefer $\beta$-blockers if no contraindications.

**2.13.2 Glucose-Lowering Drugs** Besides insulin, commonly used agents include metformin, insulin secretagogues, $\alpha$-glucosidase inhibitors, thiazolidinediones, DPP-4 inhibitors, SGLT2i, and GLP-1RA. Initiate pharmacotherapy based on HbA1c: single agent for 7.0%≤HbA1c<7.5%; dual therapy for 7.5%≤HbA1c<9.0%. Metformin should be maintained throughout treatment unless contraindicated. If HbA1c remains uncontrolled after 3 months of dual therapy, add agents with different mechanisms. For ASCVD or high cardiovascular risk, prioritize SGLT2i or GLP-1RA; for chronic kidney disease or heart failure, prioritize SGLT2i. For overweight/obese patients, prefer agents with weight loss effects (metformin, SGLT2i, GLP-1RA, $\alpha$-glucosidase inhibitors).

**2.13.3 Lipid-Lowering Drugs** **Cholesterol-Lowering:** Statins (moderate intensity as first-line, adjusted based on response and tolerance), ezetimibe, PCSK9 inhibitors, probucol, and bile acid sequestrants. If LDL-C remains uncontrolled on statins, add ezetimibe and/or PCSK9 inhibitors. **TG-Lowering:** Fibrates, high-purity omega-3 fatty acids, and niacin. For TG $ $2.3 mmol/L despite lifestyle intervention and statins, add high-purity omega-3 fatty acids or fibrates. For severe hypertriglyceridemia (TG $ $5.7 mmol/L), immediately initiate TG-lowering drugs to reduce pancreatitis risk.

**2.13.4 Antiplatelet Drugs** For "three highs" patients with $ $1 cardiovascular risk enhancement factor (Table 5 ) but without high bleeding risk (ages 40-70), initiate primary prevention with antiplatelet agents such as aspirin, clopidogrel, or indobufen.

**2.13.5 Fixed-Dose Combination (FDC) Therapy** FDC simplifies treatment, improves adherence, increases long-term persistence, enhances target achievement, reduces adverse effects from dose escalation, and lowers ASCVD risk. Early use of FDC containing 2-3 antihypertensives, statins, SGLT2i, low-dose aspirin, or mixed insulin provides greater cardiovascular benefit.

**2.13.6 Drug Interactions** "Three highs" patients often use multiple medications, requiring attention to pharmacokinetic and pharmacodynamic interactions. For example, most statins are metabolized via CYP450; dose adjustment

or substitution may be needed when combined with other CYP450-metabolized drugs. $\beta$-blockers combined with sulfonylureas may increase glucose; $\beta$-blockers with insulin require hypoglycemia vigilance.

### 2.14 Insulin Therapy for "Three Highs" Patients

Insulin is important for patients with inadequate oral agent response or severe comorbidities. **Types:** Prandial insulin (postprandial glucose control), basal insulin (fasting glucose control), premixed insulin (both), and dual insulin analogues (better physiological simulation). **Indications:** Add basal insulin to oral agents if HbA1c $ $7.0% after $ $3 months; intensify to multiple daily injections if still uncontrolled; consider short-term intensive insulin for FPG $ $11.1 mmol/L or HbA1c $ $9.0% with hyperglycemic symptoms.

### 2.15 Monitoring and Managing Adverse Drug Reactions

**2.15.1 Antihypertensive Drugs RAAS Inhibitors (ACEI/ARB):** ACEI may cause dry cough; ARB is alternative. Monitor potassium and creatinine regularly for hyperkalemia. **CCB:** May cause ankle edema, headache, flushing; non-dihydropyridine CCB may cause atrioventricular block. **Diuretics:** Large doses may cause electrolyte disturbances and affect glucose, lipid, and uric acid metabolism; monitor potassium regularly.

**2.15.2 Lipid-Lowering Drugs** **Statins:** Monitor liver enzymes and creatine kinase; common adverse effects include elevated transaminases and muscle complications (management in Figure 7 [Figure 7: see original paper]). **Ezetimibe:** Generally well-tolerated with mild, transient headache or GI symptoms. **PCSK9 Inhibitors:** Injection site reactions. **Fibrates:** Hepatic, muscular, and renal toxicity similar to statins. **Niacin:** Flushing, itching, liver damage, hyperuricemia, hyperglycemia. **Omega-3 Fatty Acids:** Mild GI effects; may increase atrial fibrillation risk.

**2.15.3 Glucose-Lowering Drugs** **Hypoglycemia:** Metformin, SGLT2i, GLP-1RA, $\alpha$-glucosidase inhibitors, and DPP-4i alone rarely cause hypoglycemia, but risk increases when combined with sulfonylureas, glinides, or insulin. Start low, titrate slowly, and monitor glucose. **GI Effects:** Metformin, GLP-1RA, and $\alpha$-glucosidase inhibitors may cause GI symptoms; start low and titrate. **Genitourinary Infections:** SGLT2i may increase risk; ensure adequate hydration and hygiene. **Edema:** Thiazolidinediones cause fluid retention; contraindicated in heart failure. **Weight Gain:** Sulfonylureas, glinides, thiazolidinediones, and insulin may cause weight gain.

### 2.16 Traditional Chinese Medicine for "Three Highs" Patients

TCM management should leverage holistic concepts and syndrome differentiation, using four diagnostic methods and disease-syndrome combination. Based

on syndrome type, patient preference, and resources, select herbal decoctions, patent medicines, or non-pharmacological therapies. Main syndrome types include: (1) Liver-stomach heat stagnation (irritability, bitter taste, polydipsia, polyphagia) - Major Bupleurum Decoction; (2) Phlegm-dampness accumulation (chest oppression, heavy limbs, somnolence) - Warm Gallbladder Decoction; (3) Phlegm-stasis intermingling (chest pain, palpitations, rough skin) - Two-Cured Decoction plus Peach Kernel and Carthamus Four Substances Decoction. Acupuncture, massage, Tai Chi, and Baduanjin are recommended as safe, simple adjunctive therapies.

### 2.17 How to Implement Classified Management for "Three Highs" Patients?

**Classification:** Establish health records for all "three highs" patients in the service area, implement chronic disease management with classification based on national basic public health service requirements, and conduct long-term standardized follow-up to improve target achievement and reduce complication risk (Figure 8 [Figure 8: see original paper]).

**Monitoring:** Recommended examinations and frequencies for newly diagnosed and stable patients are in Table 6 ; increase frequency for those with treatment adjustments or poor control.

**Referral Tracking:** Follow up within 2 weeks on emergency referrals and complication status. Integrate stable patients referred back to community into chronic disease management.

### 2.18 Health Education for High-Risk Populations and Patients

Health education should be based on needs assessment using information dissemination, education, and behavioral interventions to establish health concepts, knowledge, skills, and behaviors. Steps include: (1) Collect basic and health information; (2) Assess conditions and prioritize interventions; (3) Select appropriate methods and theories; (4) Develop progressive educational content; (5) Implement and supervise; (6) Evaluate and improve.

Consider sociodemographic characteristics, culture, customs, religion, and language. Involve family members to enhance effectiveness. Use behavior change theories (KAP, Health Belief Model, Stages of Change) and methods (individual counseling, group activities, social support). "Internet + Health Education" includes online education, consultation, remote monitoring, and social support, requiring attention to e-health literacy and age-appropriate design.

### 2.19 How to Enable Self-Management in "Three Highs" Patients?

Assess patients' capacity for self-management based on condition, education, learning ability, and self-efficacy. Develop self-management plans through shared decision-making.

**2.19.1 Plan Development and Adjustment At Diagnosis:** Establish treatment goals, lifestyle interventions, medication adherence strategies, self-monitoring protocols, emergency management, health education, and resource access.

**Annual Review:** Reassess knowledge, skills, behaviors, weight changes, and adjust goals and education.

**Complex Influences:** Personalize behavior change strategies and special self-care skills for factors like traditional festivals.

**Treatment Changes:** Coordinate with care team for transition plans and new education/support.

**2.19.2 Self-Management Programs Chronic Disease Self-Management Program (CDSMP):** Stanford-developed program focusing on daily disease management, quality of life improvement, and healthcare resource reduction through education, support, behavior change training, and self-efficacy enhancement.

**Diabetes Self-Management Education and Training (DSME/T):** Includes process (knowledge/skill development) and behavior (implementation assistance) components.

**2.19.3 Shared Decision-Making (SDM)** SDM encourages collaborative clinical decision-making between doctors and patients, enhancing self-management. Elements include: identifying decisions, presenting options, discussing benefits/risks, understanding patient values, reaching consensus, and implementing jointly.

### 2.20 How to Improve Adherence in "Three Highs" Patients?

Poor adherence relates to physician attitude, patient beliefs, treatment complexity, healthcare system, and other factors. Non-judgmental discussion to identify barriers enables personalized solutions.

**Improvement Strategies:** - **Physician:** Provide disease/treatment information, give feedback, assess barriers, use motivational interviewing. - **Patient:** Self-monitoring, group support, family involvement, reminder devices. - **Treatment:** Prefer once-daily long-acting drugs and FDC; avoid complex regimens; consider costs.

### 2.21 How to Use Information Technology for "Three Highs" Management?

Information technology enhances self-management and physician efficiency, controlling disease and delaying complications.

**Applications:** (1) Regional health information platforms for integrated, lifelong digital chronic disease management; (2) Instant messaging for smart reminders, online Q&A, guidance, education, and remote consultation; (3) IoT, cloud computing, and wearables for real-time monitoring and precision intervention; (4) Social media for health education; (5) Age-appropriate design considering physical and cognitive characteristics.

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**Conclusion:** The increasing prevalence of "three highs" and associated cardiovascular risk necessitates effective primary care co-management. This consensus provides evidence-based pathways for diagnosis, treatment, lifestyle intervention, and patient empowerment, emphasizing patient-centered, individualized care through shared decision-making. Future research should address evidence gaps in diagnostic criteria, treatment targets, and management pathways for "three highs" comorbidity.

*Note: Figure translations are in progress. See original paper for figures.*