Chinese Guidelines for Behavioral and Lifestyle Intervention in Diabetes Mellitus (2024 Edition) Post-print Authors: Chinese Diabetes Society, Chinese Medical Association; National Health Commission Diabetes Prevention and Treatment Expert Committee –## Abstract Objective: To develop···

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Abstract

Behavior and lifestyle interventions (BLIs) can lower blood glucose and blood pressure, regulate blood lipids, control obesity, and reduce cardiovascular events, serving as first-line therapeutic measures for chronic diseases such as diabetes. BLIs encompass assisting patients in maintaining a healthy diet, adhering to physical exercise, maintaining normal body weight, ensuring adequate sleep, avoiding smoking and excessive alcohol consumption, performing psychological adjustment, establishing robust social support, conducting scientific blood glucose self-monitoring, and adhering to hypoglycemic medication therapy. Except in cases of severe hyperglycemia and acute diabetic complications requiring immediate pharmacological treatment, newly diagnosed patients with type 2 diabetes should first undergo BLIs. BLIs should adhere to principles of effectiveness, trust-building, problem-solving orientation, comprehensiveness, and personalization. Common intervention strategies include applying established behavior change theories, utilizing behavior change techniques, effectively employing communication strategies, enhancing patients' behavioral skills, and implementing person-centered patient self-management education and support. The fundamental steps comprise assessing behaviors and lifestyles along with their influencing factors, establishing behavioral goals, developing intervention implementation plans, executing interventions, and evaluating effectiveness. BLI effectiveness evaluation indicators encompass process indicators, clinical outcomes, psychosocial outcomes, behavioral outcomes, patient-reported outcomes,

and health outcomes. Effectiveness evaluation can be conducted using a combination of qualitative and quantitative methods; commonly used evaluation tools include the Summary of Diabetes Self-Care Activities (SDSCA), Patient Activation Measurement (PAM), and Diabetes Management Self-Efficacy Scale (DMSES).

Full Text

Chinese Diabetes Behavior and Lifestyle Intervention Guidelines (2024 Edition)

Diabetes Prevention and Control Committee of Chinese Preventive Medicine Association

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Abstract

Behavior and lifestyle interventions (BLIs) can reduce blood glucose and blood pressure, regulate blood lipids, control obesity, and decrease cardiovascular events, serving as first-line treatment measures for chronic diseases such as diabetes. BLIs encompass helping patients maintain a healthy diet, adhere to physical exercise, maintain normal weight, ensure adequate sleep, avoid smoking and alcohol abuse, make appropriate psychological adjustments, establish good social support, conduct scientific self-monitoring of blood glucose, and persist with hypoglycemic drug therapy. Except for cases of severe hyperglycemia and acute diabetic complications requiring immediate pharmacological treatment, newly diagnosed patients with type 2 diabetes should first undergo BLIs.

BLIs should adhere to principles of effectiveness, trust-building, problem-solving orientation, comprehensiveness, and personalization. Common intervention strategies include applying established behavior change theories, utilizing behavior change techniques, effectively employing communication strategies, improving patient behavioral skills, and implementing patient-centered self-management education and support. The basic steps include assessing behavior and lifestyle and their influencing factors, determining behavioral goals, developing intervention implementation plans, conducting interventions, and evaluating effectiveness. BLI effectiveness evaluation indicators include process indicators, clinical outcomes, psychosocial and behavioral outcomes, patient-reported outcomes, and health outcomes. Evaluation can be conducted using a combination of qualitative and quantitative methods, with commonly used evaluation tools including the Summary of Diabetes Self-Care Activities (SDSCA), Patient Activation Measurement (PAM), and Diabetes Management

Self-Efficacy Scale (DMSES).

Keywords: Diabetes mellitus; Hyperglycemia; Hyperlipidemia; Hypertension; Behavior and lifestyle interventions

1 Diabetes Behavior and Lifestyle

Controlling hyperglycemia, hyperlipidemia, and hypertension (the "three highs") constitutes the primary task of diabetes prevention and treatment [1-2]. Diabetes "three highs" are closely related to behavior and lifestyle. Behavior and lifestyle interventions (BLIs) can lower blood glucose and blood pressure, regulate blood lipids, control obesity, reduce cardiovascular events [3-5], decrease emergency visits and hospitalizations, reduce medical expenditures, prevent diabetes and its complications, and improve patients' quality of life [6-7]. BLIs include helping patients maintain a healthy diet, adhere to physical exercise, maintain normal weight, ensure adequate sleep, avoid smoking and alcohol abuse, make appropriate psychological adjustments, establish good social support, and conduct scientific self-monitoring of blood glucose while adhering to hypoglycemic drug therapy. BLIs are the preferred and first-line treatment measures for chronic diseases such as diabetes [8].

Achieving "three highs"control targets should be based on BLIs with comprehensive prevention and treatment [9-11]. Except for severe hyperglycemia and acute diabetic complications requiring immediate pharmacological treatment, newly diagnosed diabetic patients should first undergo BLIs [12-13]. The purpose of BLIs is to help patients learn diabetes prevention and treatment knowledge, master diabetes self-management skills (including communicating with healthcare providers, informed decision-making, problem-solving, setting behavioral goals and action plans, and helping implement them), improve emotional management and life stress coping abilities, build confidence in overcoming the disease, persist with correct treatment and healthy lifestyles, reduce or delay complications, and improve quality of life [14]. These guidelines, based on summarizing China' s diabetes prevention and treatment experience and referencing domestic and international diabetes management guidelines and consensus, were developed through discussion among Chinese diabetes prevention and treatment experts. The content covers BLI principles, strategies, content, and processes for reference by frontline clinical healthcare providers. These guidelines strictly adhere to evidence-based principles, marking only high-quality (Grade A) and strong recommendation (Level I) evidence [15].

1.1 Self-Management Behaviors

1.1.1 Self-Monitoring of Blood Glucose Self-monitoring of blood glucose includes capillary blood glucose from fingertip testing and interstitial fluid glucose measurement [16], with the latter also combinable with continuous glucose monitoring (CGM) to provide more comprehensive and dynamic blood glucose

data. Blood glucose monitoring helps diabetic patients use hypoglycemic drugs rationally, actively maintain healthy lifestyles, reduce hypoglycemia risk, and avoid unnecessary medical expenses [17-19].

1.1.2 Adherence to Drug Therapy Drug therapy is an important component of diabetes treatment, with incorrect medication use or treatment interruption being common problematic behaviors. Effective methods to improve medication adherence include: (1) support from society/family/healthcare providers; (2) enhancing patients' treatment willingness through education, counseling, and behavioral guidance; (3) improving patients' access to medications and healthcare services; and (4) using technical tools such as smart pillboxes and mobile reminder apps [20]. Reasons for treatment interruption include doubting drug efficacy, fearing hypoglycemia, difficulty obtaining medications, worrying about adverse reactions, requiring injections, and treatment costs [21-25].

1.1.3 Other Behaviors Other relevant behaviors include patient attendance at outpatient appointments and examinations, as well as patients' identification and acknowledgment of their own health problems.

1.2 Lifestyle Factors

1.2.1 Diet Healthy eating is fundamental to diabetes management, including reading food labels, food purchasing, meal preparation, portion control, calorie calculation, and carbohydrate counting. All patients with diabetes (type 1, type 2, gestational, and other specific types) or prediabetes should receive medical nutrition therapy [26] (Grade A evidence). Dietary behavior disorders can significantly affect blood glucose, lipid, and blood pressure control, increasing complication risk [27]. The goal of healthy eating is to promote and support healthy eating patterns that meet nutritional needs while maintaining eating pleasure [28]. Diet quality and energy control are central to blood glucose management [29]. Medical nutrition therapy provided by professional dietitians can significantly reduce HbA1c and help prevent, delay, and treat diabetic complications [14]. Recommended diets for blood glucose control also have greater effects on weight loss and improving lipid and blood pressure profiles [30-31], reducing diabetes progression risk (Grade A evidence). Natural foods and plant-based diets primarily consisting of whole grains, vegetables, legumes, fruits, nuts, and seeds, while avoiding or minimizing animal products and refined foods, are recommended. Healthy, food-category-based dietary interventions such as Mediterranean diets (MD), Dietary Approaches to Stop Hypertension (DASH), and whole-food plant-based patterns are superior to simple energy restriction or single nutrient restriction (e.g., low-carbohydrate, low-fat, high-protein) and can sustainably improve blood glucose, lipids, and blood pressure in diabetic patients [32-33].

1.2.2 Physical Activity Physical activity refers to active or passive limb or body movement, including walking, fitness exercises, sports, housework, gar-

dening, reducing sedentary time, and limiting screen time. After assessing for exercise-related contraindications such as proliferative retinopathy or ischemic heart disease, diabetic patients should engage in at least 150 minutes per week of moderate-to-vigorous intensity or 75 minutes per week of vigorous-intensity aerobic exercise, plus 2-3 sessions of resistance, flexibility, or balance training [2,34]. Regular exercise improves blood glucose and lipid control, reduces cardiovascular risk factors, aids weight loss, enhances muscle strength, lung function, and immune function, and improves overall health status [35-40]. Post-meal activity of $ $45 minutes maximizes blood glucose control effects [41-42]. Prolonged sedentary time is associated with poor blood glucose control and increased metabolic risk [43]. Recommended physical activities for diabetic patients are shown in Table 1 .

1.2.3 Sleep Adults should ensure 7-8 hours of sleep daily, as weekend catch-up is ineffective [45-48]. Sleep disorders in diabetic patients refer to impaired sleep quality and/or abnormal sleep duration [49]. Sleep deprivation (<6 hours/night) and circadian rhythm disruption can reduce insulin sensitivity, cause elevated blood glucose, and worsen diabetes [50-53]. Over half of diabetic patients experience sleep disorders due to obstructive sleep apnea syndrome, affecting blood glucose control [54]. Sleep disorders should be actively diagnosed and treated, and patients should be helped to develop good sleep habits to prevent diabetes progression [25] (Grade A evidence).

1.2.4 Smoking Smoking cessation can improve insulin resistance and blood glucose control [55], with significant lipid improvements observed within 1-3 months of quitting [55-57]. All diabetic patients should be asked about smoking, and smokers should be provided with cessation counseling or pharmacotherapy [26] (Grade A evidence). However, smoking cessation often causes blood glucose fluctuations, likely due to post-cessation weight gain [58], so weight management should be strengthened concurrently.

1.2.5 Alcohol Consumption Alcohol disrupts hepatic cholesterol synthesis and is considered a contributing factor to hyperlipidemia [59]. Alcohol consumption increases risks of hypoglycemia, persistent hypoglycemia (especially in insulin-treated patients), weight gain, and hyperglycemia (in heavy drinkers) [59-60].

1.2.6 Weight Management Weight management is more effective than usual care in diabetes remission. Weight reduction of 5%-15% is generally recommended for obese diabetic patients [61] (Grade A evidence).

The user wants me to translate a specific section titled "#### 1.2.7 Psychological Adjustment" from Chinese to English. However, looking at the provided text, it appears to already be in English. Let me examine it carefully:

`#### 1.2.7 Psychological Adjustment`

`All diabetic patients should receive psychosocial care to improve quality of life and health`

I notice there is one Chinese character sequence: "反过来" which means "in turn" or "conversely". The user specifically mentioned that Chinese characters were detected and must be removed. So I need to translate that part.

The instruction says: "DO NOT leave any Chinese characters - not even one"

So I need to: 1. Keep the section heading as is 2. Translate the Chinese phrase "反过来" to English 3. Ensure the rest of the text flows well 4. Maintain all citations, references, and formatting exactly as they are 5. Keep the academic tone

The phrase "can 反过来 affect" should become "can in turn affect" or "can conversely affect" or "can adversely affect" depending on context. Here, "in turn" seems most appropriate as it indicates a reciprocal relationship.

Let me construct the final translation:

The heading stays: #### 1.2.7 Psychological Adjustment

Then the paragraph with "反过来" translated:

"All diabetic patients should receive psychosocial care to improve quality of life and health outcomes. Psychological care should be integrated with routine treatment, emphasizing collaboration, person-centeredness, and cultural appropriateness [26] (Grade A evidence). Chronic hyperglycemia can cause cognitive decline, severely affecting diabetes treatment outcomes [62]. Cognitive impairment screening should be conducted if patients experience frequent hypoglycemia, difficulty with diabetes self-management, or unexplained falls. Psychological and emotional issues can in turn affect treatment task completion and health outcomes [63-64]. Patients should be assessed for depressive symptoms and referred to psychological/behavioral specialists for evidence-based interventions when necessary [26] (Grade A evidence). Hypoglycemia unawareness may co-occur with fear of hypoglycemia, and patients should be trained to recognize hypoglycemia symptoms and reduce hypoglycemia fear [26] (Grade A evidence)."

Wait, let me double-check the original text again. The user provided what appears to be an English text with one Chinese phrase embedded. The instruction says "Translate ONLY this section from Chinese to English" but the section is mostly English already. This seems like the user might have already translated it but missed one phrase, or this is a test to see if I catch the Chinese characters.

The specific issue detected was: "Chinese characters found: 来, 反, 过" which are the characters in "反过来".

So my task is to replace "反过来" with its English equivalent. The most natural translation in this medical context would be "in turn" or "conversely". "In turn" fits better here.

Let me make sure I follow all the rules: - Preserve all math: No math in this section - Preserve all citations: Yes, [26], [62], [63-64] are preserved - Preserve figure/table markers: None in this section - Maintain academic tone: Yes - Skip garbage text: None present - Use markdown: The heading is already in markdown format - No Chinese characters: I need to remove "反过来"

The final output should be just the translated section with the same structure. I should not add any commentary.

Actually, re-reading the prompt more carefully: The user## 2 Principles of Behavior and Lifestyle Interventions

BLIs should follow principles of effectiveness, trust-building, problem-solving orientation, comprehensiveness, and personalization.

2.1 Effectiveness Principle

Generally, effective behavior change advice has five characteristics: clarity, personal meaningfulness, frequent feedback, active guidance and support, and patient explanation [65]. BLIs should be conducted under scientific theoretical guidance and based on evidence.

2.2 Trust-Building Principle

Patient-provider trust is a prerequisite for effective diabetes management. Healthcare providers should master and apply skills in listening, empathy, understanding, open-ended questioning, and information sharing [66] to establish trusting relationships and implement patient-centered shared decision-making [67-68].

2.3 Problem-Solving Orientation Principle

Problem-solving refers to a cognitive-behavioral process that uses effective, flexible methods to address specific problems encountered in daily life [69]. Healthcare providers should teach problem-solving methods during each outpatient encounter, instructing patients in simple methods to identify problems, set goals, brainstorm solutions, and evaluate outcomes [70-71].

2.4 Comprehensiveness Principle

Comprehensive measures should be adopted to promote behavior change in diabetic patients, such as establishing intervention teams with community and family participation and addressing patients' health literacy and calculation difficulties (e.g., food exchange portion calculations). Merely improving disease prevention knowledge is insufficient to achieve behavior change goals; combining knowledge transmission with counseling or behavior change strategies can promote longer-term, more sustained adherence to new behaviors [72-73].

2.5 Personalization Principle

Behavior change advice should be personalized, providing more targeted recommendations for diabetic patients of different genders, ages, races, community infrastructures, and cultural backgrounds. Intervention measures often fail when individual barriers and social contexts affecting behavior change are ignored [74-75]. Psychosocial factors affecting patient behavior change include eating disorders, depression, diabetes distress, and diabetes-related worries and fears [76].

3 Behavior and Lifestyle Intervention Strategies

3.1 Applying Established Behavior Change Theories

Intervention measures guided by behavior change theories or theoretical components are more effective in changing various health behaviors and diabetes management [77-78] (Grade A evidence). Commonly applied behavior change theories in diabetes prevention and treatment include Social Cognition Theory (SCT), Theory of Self-Efficacy (TSE), Theory of Planned Behavior (TPB), Theory of Self-Determination (TSD), and the Trans-Theoretical Model (TTM). SCT suggests that new behaviors can be developed through imitation and observation [79]. TSE posits that increasing successful experiences, verbal persuasion, and others' successful experiences can enhance self-efficacy [80-81]. In TPB [82], perceived behavioral control and in TSD [83], individuals' "intrinsic growth tendency" (i.e., autonomy and competence for healthy and effective action) are related to diabetes management and outcomes. TTM divides behavior change into five stages: precontemplation, contemplation, preparation, action, and maintenance [84]. TTM-based interventions can address complex behavior and lifestyle issues related to diabetes and prediabetes, promote patient self-management behaviors, and improve health outcomes [85], as shown in Figure 1 [Figure 1: see original paper].

3.2 Effective Use of Communication Strategies

Effective patient-provider communication is a prerequisite for successful diabetes management [86]. Interventions that promote communication and collaboration between clinicians and patients and support patient self-management can improve diabetes distress and blood glucose control [87]. Dedicated patient education personnel or teams should be established to provide patient-centered self-management education in a timely manner based on full respect for diabetic patients [88]. During patients' behavior change process, effective use of patient-provider communication and collaboration strategies, combined with team strategies to promote patient autonomy, can effectively empower patients to form health behaviors—merely disseminating diabetes prevention knowledge is far from sufficient [86,89-91] (Grade A evidence).

3.2.1 Using Appropriate Language Communication between diabetic patients and healthcare team members is central to comprehensive care. Clinicians must recognize the importance of language, which in diabetes care should be: (1) neutral, non-stigmatizing, and fact-based; (2) strength-based (focusing on what works), respectful, and inclusive; (3) encouraging collaboration; and (4) person-centered [91]. During patient communication, it is best to focus on one issue per conversation, reduce information load, use plain language, and convey information through multiple modalities such as spoken language, written materials, and educational materials [91-92]. Potentially discriminatory or misunderstood terms or language should be avoided [93-94]. Patients' cognitive willingness and efficiency are affected by various emotions, so healthcare providers should consider patients' psychological and emotional states in addition to their education level [87,95].

3.2.2 Shared Decision Making (SDM) SDM is a patient-centered, evidence-based decision-making approach that incorporates clinical experience and patient values and preferences [96], reducing patient-provider conflict and improving care satisfaction [97]. Healthcare providers should provide tailored health advice based on a full understanding of patient characteristics (including gender, race, age, and resources). They must understand patients' health beliefs, frequently ask open-ended questions in a non-judgmental manner, and enable patients to share their true health status, behavioral experiences, perspectives, expectations, and beliefs to facilitate SDM [98].

3.2.3 Collaborative Goal Setting (CGS) CGS is an evidence-based communication strategy aimed at improving diabetic patients' self-care, patient-provider trust, and clinical outcomes [99-100]. CGS encourages sharing ideas and mutual communication between patients and providers to jointly set management goals and support goal achievement [101]. CGS is effective for depressive symptoms [102] and blood glucose control [103-104] in diabetic patients and is an effective, guideline-concordant diabetes care strategy [105] (Grade A evidence).

3.2.4 Motivational Interviewing (MI) MI involves equal dialogue and in-depth communication with patients to help them identify and clarify their behavioral motivations, providing health behavior advice based on patients' personal beliefs and preferences. MI has potential application value and benefits in diabetes [106]. Studies show MI can improve blood pressure and adherence in diabetic and hypertensive patients and help reduce HbA1c levels [107-109].

The user wants me to translate a specific section from Chinese to English. The section is "#### 3.2.5 Teach-Back Method".

Let me analyze the text:

"The teach-back method involves patients 复述 ing or demonstrating learned knowledge and skills to healthcare providers after receiving training, allowing

providers to assess patients' understanding and mastery of behavioral recommendations [110]. The teach-back method is superior to usual care in improving medication adherence [111], dietary behaviors [112-113], and promoting foot care [114], and can increase patients' self-efficacy and promote self-care behavior formation [115]."

Key issues: 1. "复述 ing" - this is a mix of Chinese character "复述" (meaning "repeat" or "recite") and English "-ing". I need to translate this properly. 2. The rest of the text is already in English, but with some Chinese characters mixed in.

Let me translate the Chinese parts: - "复述" means "to repeat", "to recite", "to restate". In the context of teach-back method, it would be "repeating" or "restating".

So the phrase "patients 复述 ing or demonstrating" should become "patients repeating or demonstrating" or "patients restating or demonstrating".

The rest of the text looks like it's already in English and just needs the Chinese characters removed/replaced.

Let me reconstruct the full sentence: "The teach-back method involves patients repeating or demonstrating learned knowledge and skills to healthcare providers after receiving training, allowing providers to assess patients' understanding and mastery of behavioral recommendations [110]."

The second sentence is already fully in English: "The teach-back method is superior to usual care in improving medication adherence [111], dietary behaviors [112-113], and promoting foot care [114], and can increase patients' self-efficacy and promote self-care behavior formation [115]."

Wait, let me double-check the original text again. The user said "Chinese characters found: 复, 述" and "These appear to be: technical terms and specifications". But looking at the text, it's "复述 ing" which is clearly "复述" (a Chinese word meaning repeat/restate) with English "ing" appended. This is likely a copy-paste error in the original document where the Chinese word wasn't fully translated.

So my translation should replace "复述 ing" with the appropriate English term. "Repeating" or "restating" both work, but "restating" is more formal and fits the academic context better, as it implies explaining in one's own words rather than just rote repetition.

Let me also check if there are any other Chinese characters. The text provided seems to have only "复述 ing" as the problematic part.

The structure should remain the same: - Keep the heading "#### 3.2.5 Teach-Back Method" - Keep the citations [110], [111], [112-113], [114], [115] unchanged - Keep the overall structure as a paragraph

The translation should be fluent and academic.#### 3.2.6 Message Framing

Message framing refers to customizing information presentation methods (emphasizing benefits of adopting a behavior vs. emphasizing losses from not adopting it) to influence individual behavioral decision-making without changing content or meaning [116]. Benefit-emphasizing messages are more persuasive for promoting long-term sustained health behaviors [117], such as "If you can manage your lifestyle according to our recommendations, you can maintain high-quality life like normal people—your self-management ability is strong, and this is actually easy to achieve," rather than loss-emphasizing messages like, "If you cannot manage your lifestyle according to our recommendations, you may develop serious complications such as heart disease, stroke, kidney disease, and limb gangrene, even threatening your life."

3.2.7 Increasing Communication Intensity The timing and frequency of behavioral advice are important. Follow-up within days after providing behavioral advice during outpatient visits and asking patients for feedback on implementation facilitate behavior formation. Gradually increasing the intensity and frequency of patient-provider contact helps patients maintain healthy diets and physical activity [118]. Setting behavior change tasks as phased, step-by-step processes can help patients improve self-efficacy [26].

3.2.8 Enhancing Relevance In-depth communication with patients to identify behavior cue scenes benefits habit formation, such as combining blood glucose monitoring with daily tooth brushing to make it easier for patients to establish monitoring as a habit [119]. Linking diabetes management behaviors with patients' daily routines facilitates easier implementation [120].

3.2.9 Cognitive Behavioral Therapy (CBT) CBT helps individuals restructure inappropriate thoughts, beliefs, and negative behaviors, rebuild appropriate thinking patterns and behaviors, and better regulate emotions [121-122]. CBT has been used to improve chronic disease management including diabetes [123-124] and is effective for blood glucose control and emotional management in diabetic patients [125-126].

3.2.10 Building Social Support Social support refers to the provision of social resources, including psychological support (e.g., comfort and care), interpersonal support (e.g., joint social activities), material support (e.g., financial assistance), or informational support (e.g., advice) [127-128]. Helping patients identify social supporters facilitates behavior implementation. Potential supporters include partners, family, friends, and clinicians. Support for patient behavior change can be provided through phone calls, WeChat, etc. Healthcare provider empathy and support are foundational to good patient self-management. Attempting to make patients feel ashamed, guilty, or intimidated is ineffective. With healthcare provider training and support, peer leaders enable diabetic patients to manage diabetes needs through emotional support, access to appropriate educational materials, clinical care, needed services, and other resources,

ultimately improving outcomes [129]. Well-designed peer leader programs can be advantageous for reaching more diabetic patients and helping them successfully engage in diabetes behavior management [130].

3.2.11 Modern Information Technology Application Providing behavioral interventions through internet and mobile medical technology is a growing field in diabetes management [131]. These technologies can provide convenient self-management tools for diabetic patients online. WeChat mini-programs and blood glucose monitoring systems based on the internet can achieve real-time data sharing and personalized feedback, helping patients monitor blood glucose changes and adjust lifestyles anytime. Text messaging and mobile applications can provide continuous health education and behavioral guidance, supporting long-term maintenance of good self-management habits. Through these intelligent software platforms, patients can not only receive personalized health advice but also communicate with doctors or other patients via social platforms to form effective social support networks. Mobile applications typically feature diet records, exercise monitoring, and medication reminders, enabling comprehensive tracking of patients' daily behaviors. Studies show that using such intelligent software can significantly improve blood glucose control in diabetic patients [117] (Grade A evidence and Level I recommendation).

3.2.12 Increasing Fun and Entertainment Studies show that increasing the fun and entertainment of lifestyle behaviors can improve motivation for behavior change [132]. For example, wearable devices (electronic watches, etc.) providing real-time heart rate during exercise can make patients find physical activity more enjoyable [133].

3.3 Improving Patient Behavioral Skills

Merely disseminating knowledge cannot fundamentally change behavior; diabetes self-management requires comprehensive patient participation. Coping skills training is a cognitive-behavioral intervention focusing on transforming inappropriate or non-constructive coping styles and behavior patterns into more constructive behaviors. Coping skills training can improve metabolic indicators, blood glucose, and quality of life [134] (Grade A evidence and Level I recommendation for type 2 diabetes). These coping skills include adaptive adjustment, problem-solving, communication, and family cooperation.

3.4 Using Behavior Change Techniques (BCTs)

BCTs are replicable components of behavioral interventions that can alter the causal direction of target population behaviors by enhancing facilitators or inhibiting barriers to behavior change [135]. For example, group interventions are more effective than individual interventions, and increased intervention frequency and intensity yield better results [73]. Task grading, instruction on behavior implementation, behavioral rehearsal, action planning, and behavioral

demonstration are associated with HbA1c reduction [136] (Grade A evidence). The most common BCTs in randomized controlled trials are social support (emotional, material) and problem-solving and goal setting (behavior), which are independently associated with significant HbA1c reduction [137]. Common BCTs are shown in Table 2 .

3.5 Implementing Patient-Centered Diabetes Self-Management Education and Support (DSMES)

DSMES refers to activities that help diabetic patients implement and maintain behaviors needed for disease management, providing support including behavior change, education, psychosocial, and/or clinical services. DSMES is a key intervention equally important as drug therapy [70,139]. DSMES provided by trained diabetes care and education specialists can significantly improve patients' knowledge, blood glucose levels, clinical and psychological outcomes, reduce hospitalizations and all-cause mortality, and is highly cost-effective [28,140-146]. Evidence shows that patients completing over 10 hours of DSMES over 6-12 months and those who continue participation have significantly lower HbA1c and mortality compared to those spending less time in DSMES [31]. All diabetic patients should participate in DSMES and receive needed support to promote mastery of knowledge, decision-making ability, and skills required for diabetes self-care [26] (Grade A evidence).

DSMES team members should provide educational materials that are person-centered, use simple language, avoid jargon, and are culturally relevant and appropriate for patients' language and literacy levels [26] (Grade A evidence). Endocrinology departments should establish DSMES teams. After patient assessment, DSMES team members should develop person-centered DSMES plans. DSMES should respect patients' culture, personal preferences, needs, and values, and can be conducted in groups or individually [26] (Grade A evidence). DSMES course content, key points, and effectiveness evaluation indicators are shown in Tables 3 through 5 . Effectiveness evaluation and follow-up records are shown in Tables 6 and 7 .

4 Steps of Behavior and Lifestyle Intervention

Before conducting behavioral interventions, comprehensive assessment of patients' behaviors, lifestyles, and influencing factors should be performed, including health status, cognitive level, skills and life background, psychosocial status, treatment behaviors, and lifestyle behaviors. In-depth communication with patients should be conducted to jointly determine behavioral goals. Behavioral goals should be specific, measurable, behavior-change-oriented, achievable yet challenging. When developing intervention implementation plans, work should be done regarding intervention providers, settings, and methods. During intervention, attention should be paid to helping patients overcome barriers affecting behavior implementation, including but not limited to patient beliefs, emotions, social networks, resources, and environmental conditions.

Diabetes patient BLIs generally include six steps [75]: (1) comprehensive assessment to identify primary behavior and lifestyle problems and behavior change goals; (2) identification of main influencing factors (including barriers and facilitators); (3) selection of evidence-based or theory-based intervention strategies and methods to form intervention plans according to actual needs; (4) soliciting opinions from relevant stakeholders and conducting pilot testing; (5) implementing intervention and clarifying effectiveness evaluation indicators; and (6) conducting intervention effectiveness evaluation, including patient participation, behavior change, and health outcome indicator changes, as shown in Figure 2 [Figure 2: see original paper]. The Capability-Opportunity-Motivation-Behavior (COM-B) model [149] and Ask-Assess-Advise-Agree-Assist (5As) model [150] can also be referenced to clarify intervention approaches. All BLIs should comply with medical ethics principles including informed consent, confidentiality, and patient autonomy [151].

4.1 Comprehensive Patient Assessment

Behavior and lifestyle assessment involves collecting information about patients' current diabetes-related behaviors and lifestyles through in-depth communication, observation, and record review, analyzing to identify the most prominent and priority behavior problems and their main influencing factors [152]. The direct influencing factor of behavior is behavioral intention, which is affected by multiple personal and environmental factors. Main facilitators and barriers should be clarified with patients [70].

Information collected includes:

4.1.1 Social Determinants of Health and Health Status First, collect and analyze information on social determinants of health (SDOH), including general demographic characteristics (gender, age, occupation, education, marital status) and socioeconomic status (income, housing, nutrition, transportation, healthcare access). Second, collect and analyze health status information including overall physical condition, diabetes type, clinical needs, medical history, physical limitations, risk factors, and comorbidities [153-154].

4.1.2 Cognitive and Skill Levels Collect and analyze information on patients' cognitive abilities and behavioral skills regarding health information, including: literacy, health beliefs and attitudes, diabetes knowledge, diabetes self-management skills (e.g., blood glucose and blood pressure self-monitoring techniques, meal planning and calorie calculation, exercise type and intensity selection, weight management), health literacy, learning readiness, learning barriers, and cognitive/developmental disabilities (e.g., intellectual disability, moderate-to-severe autism, dementia) [154,160]. Patient self-administered questionnaires and health literacy scales can be used for assessment. The purpose of collecting and analyzing this information is to provide reference for developing personalized, evidence-based comprehensive treatment plans [145,155-159].

4.1.3 Behavior and Lifestyle Status The main purpose of assessing behavior and lifestyle status is to identify primary behavior and lifestyle problems related to the "three highs,"determine main influencing factors, and under behavior change theory guidance, use BCTs to negotiate behavioral goals, intervention strategies, and methods with patients for better implementation. Assessment content and indicators can refer to Tables 8 and 9 .

4.2 Determining Behavioral Goals

Determining behavioral goals is the process of transforming behavioral intention into actual behavior through communication and negotiation with patients [148]. When negotiating behavioral goals with patients, the SMART principle should be followed [167].

4.2.1 Specificity Behavioral goals should be specific, clearly stating what to do, how to do it, when, where, and how much. For example, "brisk walk for 30 minutes in the community 30 minutes after dinner daily for 6 months" [168].

4.2.2 Measurability Behavioral goals must be quantifiable, including frequency and duration. For example, "jog 3 times weekly for 30 minutes each" rather than vaguely "engage in aerobic exercise regularly" [169-171].

4.2.3 Achievable yet Challenging When negotiating behavioral goals with patients, achievability should be considered. Overly difficult goals affect patients' confidence and lead to abandonment; overly simple goals make patients feel unaccomplished and not take them seriously [153].

4.2.4 Linking Management Behaviors with Daily Life Diabetes management behaviors should be linked or integrated with patients' daily routines to facilitate easier implementation [117]. Goals should focus on behavior change rather than physiological/biochemical indicators, such as "consume at least 350g of fresh vegetables daily" rather than "reduce weight by 5kg within 3 months" [118,159,172].

4.2.5 Time-Bound Time limits for achieving behavioral goals should be set for diabetic patients, such as "within 3 months from today" or "before August 1st" [172].

4.3 Developing Intervention Implementation Plans

Based on determined behavioral goals, specific behavioral intervention plans should be developed through in-depth communication with patients, including who will intervene, where, and how. Healthcare providers should adjust behavior plans as necessary based on patients' specific conditions during each encounter.

4.3.1 Intervention Providers The optimal intervention providers are healthcare providers or community doctors responsible for patient management. Providers' knowledge, experience, and supportive communication skills are fundamental qualities for successful diabetes remission [33]. Intervention providers should possess basic knowledge and skills in communication, education, psychology, and behavioral science.

4.3.2 Intervention Settings In addition to face-to-face interventions during regular patient visits, interventions can also be conducted at home during follow-up visits, or in community-based patient groups meeting regularly [173-174].

4.3.3 Intervention Methods Specific, theory-based intervention methods should be clarified based on evidence and individualized assessment. In addition to face-to-face interventions, methods can include telephone, social media, text messaging, WeChat, etc. [131,175].

4.4 Implementing Intervention

Barriers affecting behavior implementation include: (1) beliefs, such as lack of confidence; (2) emotions, such as low mood due to lack of operational skills; (3) social support, such as lack of family, friend, or colleague support; (4) resources, such as lack of time or money; and (5) material conditions, such as lack of facilities or equipment [176].

Guided by BLI principles, using behavior intervention strategies, gradually reducing support for intervention activities, identifying meaningful goals, and working with patients to analyze anticipated behavior barriers can cultivate patients' self-regulation skills (preventing intervention dependence), provide diverse social companionship opportunities, and more effectively improve patient adherence to behavior recommendations [177]. Effective measures to help patients persist with healthy behaviors and lifestyles include: (1) increasing intervention frequency and duration; (2) timely adjusting behavior plans based on goal achievement; (3) frequently encouraging and praising small patient progress and reinforcing empowerment; (4) helping patients with self-monitoring and supervision; and (5) helping patients overcome various difficulties, reassuring them that occasional missed behaviors are not serious and should continue as planned [118].

5 Evaluation of Behavior and Lifestyle Intervention Effectiveness

Evaluation indicators include process indicators, clinical outcomes, psychosocial and behavioral outcomes, patient-reported outcomes, and health outcomes. Evaluation can use combined qualitative and quantitative methods. Commonly used evaluation tools include the Summary of Diabetes Self-Care Activities (SD-

SCA), Patient Activation Measurement (PAM), and Diabetes Management Self-Efficacy Scale (DMSES).

Evaluation refers to systematically collecting information on behavior implementation to understand goal achievement and identify factors affecting goal attainment to provide basis for intervention improvement.

5.1 Evaluation Indicators

Evaluation indicators assess whether intervention goals are achieved or the degree of achievement. Indicators should be developed based on intervention goals, including process indicators, clinical outcomes, psychosocial and behavioral outcomes, etc. [68]. Example indicators are shown in Table 10 .

5.2 Evaluation Methods

Process evaluation primarily uses on-site observation, face-to-face interviews, group discussions, and patient oral reports. Patients can keep life diaries, with healthcare providers regularly collecting and summarizing information. Clinical and health outcome indicators are comprehensively analyzed with clinical test data.

5.3 Evaluation Tools

Commonly used evaluation tools include the Summary of Diabetes Self-Care Activities (SDSCA) [178], Patient Activation Measurement (PAM) [179-180], and Diabetes Management Self-Efficacy Scale (DMSES) [181].

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Appendix: Abbreviations

1-RM: one-rep maximum
BCTs: behavior change techniques
CGM: continuous glucose monitoring
DASH: Dietary Approaches to Stop Hypertension
DMSES: Diabetes Management Self-Efficacy Scale
DSMES: Diabetes Self-Management Education and Support
GFR: glomerular filtration rate
HbA1c: hemoglobin A1c
HDL-C/LDL-C: high-density lipoprotein cholesterol/low-density lipoprotein cholesterol
HRR: heart rate reserve
MD: Mediterranean diet
PAM: Patient Activation Measurement
PNF: proprioceptive neuromuscular facilitation
RPE: rate of perceived exertion
SCT: social cognitive theory
SDOH: social determinants of health
SDSCA: Summary of Diabetes Self-Care Activities
SMBG: self-monitoring of blood glucose
TC: total cholesterol
TIR: time-in-range (percentage of time glucose remains within target range [3.9-10.0 mmol/L] over 24 hours)
TPB: theory of planned behavior
TSE: theory of self-efficacy
TSD: theory of self-determination
TTM: trans-theoretical model
VO2R: oxygen consumption reserve

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