


# Clinical expert consensus on standard care of blood glucose for residents in senior care facility in China (2021 edition)

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## ABSTRACT

With the demographic changes, more and more elderly people have chosen to spend their retirement life in a senior care facility. The elderly people in senior care facility are commonly suffering from various geriatric syndromes, including declined daily living activities, cognitive dysfunction, frailty, comorbidities, and polypharmacy, which make them vulnerable to adverse effects, like hypoglycemia and fall. Therefore, layered management is necessary for this population with group disparities. However, the staff in senior care facility vary greatly in concepts and skills on management of senile diabetic population, which needs urgently to be standardized and improved. For this purpose, based on literature review and panel discussion, 28 recommendations are proposed in respect of the standardized management of blood glucose, covering the comprehensive assessment, layered management and grouping, exercise, nutrition, glucose monitoring, identification and treatment of severe hyperglycemia, identification of macrovascular and microvascular complications, management of hypoglycemic drugs, falls and choking and other common problems, blood glucose

Other members are listed in Appendix 1. [Corrections added on 30 June 2021, after first online publication on 11 June 2021: The phrase, 'nursing institution', has been amended to 'senior care facility' throughout the article. A few changes to phrasing have been made throughout the article to improve readability. Youshuo Liu has been moved to the first author under the Correspondence section. His correspondence address has been updated to include, 'National Clinical Research Center for Metabolic Diseases (The Second Xiangya Hospital)'.]

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screening, hypoglycemia prevention, and blood glucose management in major public health events or serious natural disasters. This guideline aims to standardize management skills of medical staff and caregivers in senior care facility for the blood glucose of elderly people and improve their quality of life.

#### KEYWORDS

blood glucose, elderly, senior care facility

## 1 | INTRODUCTION

Senior care facility refer to institutions that provide full-time centralized accommodation and nursing services for the elderly, with 10 or more beds. The results showed that the common geriatric syndromes in the elderly admitted to senior care facility include declined activity of daily living (80.7%), cognitive dysfunction (80.5%), and polypharmacy (44.7%).<sup>1</sup> These problems affect their quality of life and make them more vulnerable to adverse effects such as hypoglycemia and falls. According to the requirements of standardized management and the combination of medical and nursing care in China's senior care facility, the ability of the senior care facility in China to manage the health conditions of the elderly who were admitted to a senior care facility has been continuously improved through the cooperation with medical institutions or the establishment of medical departments in the institutions. For this reason, we organized experts in geriatrics, endocrinology, and general family medicine to formulate the Clinical expert consensus on standard care of blood glucose for residents in senior care facility in China (abbreviated as the Consensus), following the principles of practicality, simplicity, and advancement, absorbing the management guidelines for elderly diabetes published in recent years both in China and abroad, and paying attention to the management experience in this field in China. The Consensus is designed to guide doctors, nurses, and caregivers in senior care facility to perform standardized management of blood glucose for the elderly.

## 2 | GLUCOSE CONTROL IN SENIOR CARE FACILITY

The health conditions of the elderly admitted into a senior care facility vary greatly from active to disabled and mentally disabled. Medical and management personnel of a senior care facility differ greatly in their concepts, abilities, and technology for the management of elderly diabetes. When there is a complicated situation, like when a comprehensive consideration of the geriatric syndrome and survival prediction is required in the management objectives of blood glucose, health managers will inevitably feel at a loss.<sup>2-9</sup> Therefore, it is necessary to establish an individualized program for the standardized management of blood glucose in senior care facility.

**Recommendation 1:** Comprehensive geriatric assessment (by referring to the *Chinese Expert Consensus on the Application of Comprehensive Evaluation Technology for the Elderly* formulated by the Geriatrics Branch of the Chinese Medical Association) shall be done among the elderly at the age of 70 or above in senior care facility, and survival prediction [(Karnofsky Performance Status (KPS) and Palliative Prognostic Score (PPS)] shall be done among the elderly with malignant tumors.

**Recommendation 2:** Physicians in the senior care facility shall be familiar with the application of assessment tools for cognitive function, daily living ability, and frailty state of the elderly.

**Recommendation 3:** Dividing the elderly in the senior care facility into three groups according to their daily living ability, cognitive function, weakness state, and coexisting diseases: (1) the active elderly (aged but not frail); (2) semi-disabled elderly (aged and frail with certain functions); (3) disabled elderly (Table 1). The elderly in different groups shall be managed with stratified methods.

## 3 | ELDERLY PATIENTS WITH DIABETES

### 3.1 | Targets of glucose control

In setting the targets of glucose control, the diseases, functional status, and expected survival time of the elderly shall be fully considered, as shown in Table 1.

**Recommendation 4:** (1) For the active elderly or those with an expected survival time of 10 years or more, the targets of glucose control shall be the same as ordinary adults; (2) For the elderly with semi-disability or an expected survival time of not more than 5 years, the targets of glucose control shall be lowered to <8.0% of glycated hemoglobin (HbA1C); (3) For the elderly with disability or an expected survival time of not more than 6-12 months, the targets of glucose control should avoid the occurrence of acute complications associated with hyperglycemia; (4) For the elderly that have approached their end and no longer take food through mouth or nasal feeding pipeline, hypoglycemic therapy can be discontinued as it may be appropriate.

**Recommendation 5:** Physicians should set corresponding evaluation intervals for different groups, in order to identify the group changes of the elderly in time and adjust management strategies.

**TABLE 1** Targets of glucose control in the elderly residents with diabetes in senior care facility

Key element	Active elderly	Semi-disabled elderly	Disabled elderly
Activity of daily living (ADL) Instrumental ADL(IADL)	No ADL impairment and $\leq 1$ IADL impairment	1 ADL impairment and $\geq 2$ IADL impairments	$\geq 2$ ADL impairments
Mini-mental state examination (MMSE, score)	Normal ( $\geq 27$ )	Mild cognitive impairment / dementia (21-26)	Moderate to severe dementia ( $\leq 20$ )
Frailty screening scale (FRAIL, points)	Health (0)	Pre-frailty (1-2)	Frailty ( $\geq 3$ )
Complications (items)	0-2	$\geq 3$	Terminal-stage diseases
Glucose control targets			
HbA1C	6.5-7.0	7.0-8.0	7.0-8.5
Fasting blood glucose (mmol/L)	6.0-8.0	6.0-9.0	8.0-10.0
Blood glucose (mmol/L) before bedtime	6.0-10.0	8.0-10.0	8.0-14.0
Evaluation cycle	Every 12 mo after the initial evaluation or when disease conditions change	Every 6-12 mo after the initial evaluation or when disease conditions change	Only done in the initial evaluation

Complications include osteoarthropathy and hypertension; chronic diseases include symptomatic cerebrovascular accident, chronic pulmonary disease, and coronary heart disease; institutions with conditions can use the Cumulative Illness Rating Scale-Geriatric for systematic evaluation of comorbidity; terminal-stage diseases refer to diseases with a limited expected survival time ( $\leq 1$  year), such as metastatic cancer, lung disease requiring continuous oxygen support, terminal-stage renal disease requiring dialysis, and terminal-stage heart failure. [Correction added on 30 June 2021, after first online publication on 11 June 2021: The row, 'HbA1c', has been inserted in Table 1.]

## 3.2 | Lifestyle guidelines for patients with diabetes

### 3.2.1 | Exercise

Exercise is one of the three basic treatments for diabetes. Exercise can enhance the sensitivity of surrounding tissues to insulin, improve lipid metabolism, and achieve the target of a good control of blood glucose. Exercise can also improve neurological and cardiopulmonary functions, promote systemic metabolism, and enhance immunity. Appropriate exercise mode, amount, and time should be adopted by elderly patients with diabetes.

**Recommendation 6:** The elderly patients with diabetes should choose exercise intensity according to exercise intensity classification (Table 2). Medium intensity is defined as 5–6 points, and high intensity is defined as 7–8 points.

**Recommendation 7:** (1) The active elderly should mainly engage in moderate aerobic activities and can receive strength training and coordination training periodically; (2) The semi-disabled elderly should mainly engage in bedside strength training and balance/flexibility training; (3) The disabled elderly should mainly engage in passive limb activity to prevent complications and maintain mobility, as shown in Table 3.

**Recommendation 8:** Elderly patients with diabetes are not all suitable for exercise due to various complications, so medical staff

should provide timely guidance. The amount and time of exercise should be appropriate.

**Recommendation 9:** Elderly diabetic patients with stable conditions, especially those with obesity and impaired glucose tolerance, can take exercise when their blood glucose is controlled at 5.5–16.7 mmol/L.

Contraindications: (1) In the case of insulin deficiency, it is not suitable for exercise before insulin is supplemented; (2) extremely unstable blood glucose; (3) diabetic retinopathy with fundus hemorrhage; (4) diabetic nephropathy with severe renal dysfunction; (5) severe hypertension uncontrolled, and severe cardiovascular and cerebrovascular diseases uncontrolled or unstable; (6) severe situations, such as complicated acute infection, ketoacidosis, and pulmonary heart disease, etc.

### 3.2.2 | Nutrition suggestions

In order to maintain blood glucose in an ideal range, the elderly diabetic patients will control their diet alone by reducing the intake of staple foods and meat, which is the commonest practice. The long-term insufficient intake of energy and high-quality protein will increase the risk of other diseases. Since the clinical outcomes and glucose control targets of the elderly diabetic patients vary in

different groups, it is recommended to develop the corresponding nutritional plans for different groups, which should be adjusted in time according to the group changes of the elderly (Table 4).

**TABLE 2** Rating of perceived exertion of elderly patients with diabetes in senior care facility

Grade	Intensity	Proprioceptive sense
Level 0	Rest	No fatigue, breathing smoothly, rest condition
Level 1	Very easy	No fatigue, breathing smoothly, reading state
Level 2	Easy	No fatigue, breathing smoothly, when wearing clothes
Level 3	Moderate	No fatigue, breathing smoothly, walking from the bedroom to the living room
Level 4	Somewhat difficult	Slightly heavier breathing, the state of walking
Level 5	Difficult	Can clearly feel breathing, the state of fast walking
Level 6	Moderate difficult	Shortness of breath, the state of running after a bus, speak normally
Level 7	Very difficult	Tired, panting, barely able to talk to people
Level 8	Very difficult	Extremely tired, serious shortness of breath, cannot talk to people
Level 9	Super difficult	Dyspnea, inability to talk to people, near the limits of human motion
Level 10	Maximal	All-out, exhausted

**TABLE 3** Suggestions on activities of elderly patients with diabetes in senior care facility

Exercise Modes	Suggestions	Activity recommendations
Aerobic exercise	30-60 min, can be completed in segments ≥5 d per week 5-6 points for moderate intensity, and full score is 10 points (0 point means sitting quietly, 5-6 points means being able to talk, and 10 points means exhausted)	Housework, gardening activities, climbing stairs, medium-speed walking (4.8-5.5 km/h), swimming, etc
Strength training	8-10 times of training (abdomen, bilateral upper limbs, bilateral lower limbs, shoulder and hip) 1-3 groups, 8-12 repeated actions in each group ≥nonconsecutive 2 d per week 5-8 points for medium to high intensity, with full scores of 10 points (5-6 points for being able to talk and 7-8 points for tachypnea)	Weight-bearing aerobics or upper and lower limb resistance training
Flexibility/ balance training	≥2 d per week maintaining/improving the flexibility of the exercise; balance training for the elderly prone to falling	Traction of upper and lower limbs and lower back, yoga, shadowboxing, personalized balance training, etc
Limb passive activity	≥3 d per week, once or twice a day preventing muscle atrophy, joint motion limitation, thrombosis and other complications	Passive movement of upper and low limb joints of whole body by nurse personnel

**Recommendation 10:** Elderly patients with diabetes should adopt a reasonable lifestyle, including adjusting their dietary structure and habits, and take appropriate exercise to control blood glucose.

**Recommendation 11:** There is no significant difference in the general principle of nutritious diet, the recommended amount of diet, and the distribution of three meals among different groups. It should be particularly noted that the nutritional needs of the elderly diabetic patients with enteral nutrition are consistent with those of ordinary elderly people.

When fed with self-prepared food homogenate, the food should be diversified, including staple foods, meat, eggs, vegetables, oil, and salt in each meal. Besides, enteral nutrition should be timed and quantitative. As far as possible, enteral nutrition should be carried out at the same time every day and with the same amount in each meal, which is more conducive to blood glucose management. During enteral nutrition, we should try to prevent choking and reflux aspiration, reduce the pressure on the gastrointestinal tract before each meal, and pay attention to the volume and color of the fluid in the gastric tube. If tolerance is poor, consult a clinical physician or a dietician to choose a total nutrition formula.

### 3.3 | Glucose monitoring

Glucose monitoring is an important part of diabetes management in senior care facility. At present, the common glucose monitoring method adopted by senior care facility is fingertip glucose monitoring with a blood glucose meter, and the results are helpful for assessing the degrees of glucose metabolism disorder of patients with diabetes and developing a reasonable treatment plan. The glucose monitoring reflects the effect of hypoglycemic therapy and guides the adjustment of therapy (Table 5).

**TABLE 4** General principles of nutritional diet for elderly diabetic patients in senior care facility

General principles of nutritious diet	Nutrition measures		
	Active elderly	Semi-disabled elderly	Disabled elderly
BMI should be in the range of 20.0-26.9 kg/m <sup>2</sup>	Weigh once a week; pay attention to the weight change; reduce the weight 0.5-1.0 kg per week for obese elderly, and not more than 2 kg per month until the ideal weight is reached	Pay attention to weight change, and keep the weight stable	Pay attention to weight change, and keep the weight stable; increase the weight of thin elderly
A full range and regular adjustment	Take rice/noodles, potatoes, grains/beans; fruits and vegetables (at least half) and soybeans, nuts; eggs, milk/yogurt, fish and lean meat; a variety of vegetable oils, etc every day	Take rice/noodles, grains /beans; fruits, vegetables and soybeans; eggs, milk/yogurt, fish and lean meat; vegetable oil every day	Take rice/noodles; fruits and vegetables; eggs, milk/ yogurt, fish and lean meat; vegetable oil every day
Meat:grain:milk and beans: fruit and vegetables = 1:2:2:5 (by weight)	1 fist meat and eggs, 2 fist milk and beans, 2 fist potatoes, 5 fist fruits and vegetables (1 fist size food is about 150-200 g of raw foods)	1 fist of meat and eggs, 2 fists of milk and beans, 2 fists of potatoes, 5 fists of fruits and vegetables	1 fist of meat and eggs, 2 fists of milk and beans, 2 fists of potatoes, 5 fists of fruits and vegetables
Grease control 20-25 g/d	Take steamed, stewed, and boiled foods mainly, and avoid fried and deep-fried foods	Take steamed, stewed, and boiled foods mainly, pay attention to food properties	Boiled in water, and then prepared for food homogenate, and add oil and salt at the end
Rich food varieties	At least 12 kinds of foods should be consumed every day; increase the variety of foods in small amount	Try to take 12 or more kinds of food every day; increase the variety of food in small amount	Daily intake of staple foods, fruits and vegetables, meat, eggs and milk should be guaranteed
Three meals and extra meals regularly and quantitatively, eat and chew slowly	The eating speed of each meal should not be too fast, and it should be chewed slowly; chew each mouthful at least 20 times	Chew slowly, try to prevent choking and coughing	Pay attention to maintain the tube feeding position of 30° to 45° and control the speed according to the actual situation
Drink a small amount of water to ensure adequate water intake	The amount of drinking water is 1500-1700 mL/d; warm boiled water or light tea is recommended	Add thickening agent to adjust the properties of water if necessary, try to prevent choking and coughing	A proper amount of warm water is recommended between meals, and pay attention to the speed
Eat some foods between two meals or before bedtime	For stable blood glucose control, 1 fist of fruits per day (200-250 g)	For stable blood glucose control, 1 fist of fruits per day (200-250 g)	For stable glucose control, 1 fist of fruits per day (200-250 g), prepared for homogenate
Sufficient vegetables for three meals	Vegetables at least 500 g/d, for three meals, and mainly with dark vegetables (more than 1/2)	Vegetables at least 500 g/d, for three meals	Ensure two or more vegetables, try to choose melons and eggplants
Nuts within 15 g/d	Eat foods between meals, and reduce the intake of staple foods and oil	Eat foods between meals, and reduce the intake of staple foods and oil	Not required

As the semi-disabled elderly may have mild dysphagia, choke prevention is required in nutrition management. For disabled elderly with enteral nutrition, the food should be prepared in the form of homogenate.

**Recommendation 12:** HbA1c and continuous glucose monitoring (CGM) can be performed in senior care facility if permitted by conditions.

CGM, as a blood glucose monitoring technology, can monitor blood glucose at any time without the use of blood collection needles and test strips, thus improving the compliance of the elderly in the senior care facility. CGM can be carried out in senior care facility if permitted by conditions (Figure 1).

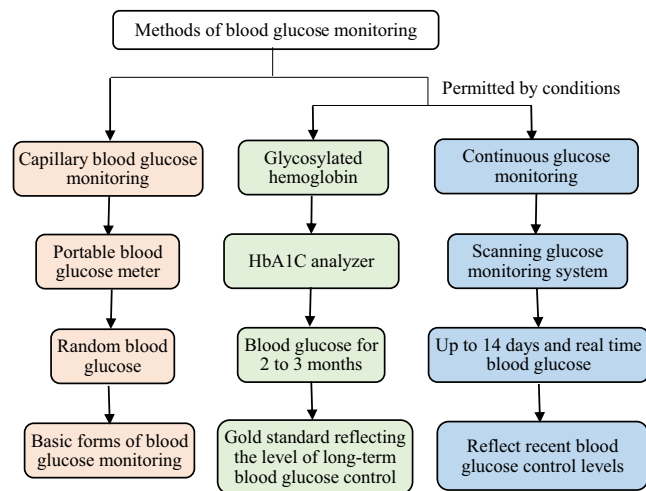
The frequency and time of blood glucose testing should be based on blood glucose control, hypoglycemia, insulin application, and concomitant diseases.

**Recommendation 13:** The frequency of blood glucose monitoring should be increased when the blood glucose level of diabetic patients fluctuates greatly, the risk of hypoglycemia is high, during the medication adjustment period, or when the conditions of concomitant diseases have changed (Figure 1).

**TABLE 5** Recommended total amount of daily meals and distribution of three meals

Types of food	Recommended intake	Meal distribution			
		Breakfast	Lunch	Dinner	Extra meal
		6:30-7:30	12:00-13:00	17:30-18:30	9:30-10:00 15:00-15:30
		25%-30%	30%-40%	20%-25%	5%-10%
Salt	5 g	✓	✓	✓	✓
Oil	20-25 g	✓	✓	✓	✓
Milk and dairy products	250-300 g	Added into any meals, or taken in separate meals			
Soybeans and nuts	30-50 g	It is recommended to take in separate meals			
Livestock meat	50 g	✓	✓	✓	✓
Fish, shrimp and poultry	50-100 g	✓	✓	✓	✓
Eggs	25-50 g	Added into any meals, or taken in separate meals			
Vegetables	400-500 g	✓	✓	✓	✓
Fruits	200-400 g	✓	✓	✓	✓
Whole grains and beans	50-150 g	✓	✓	✓	✓
Potatoes	200-350 g				
Potatoes	50-100 g	✓	✓	✓	✓
Other cereals	100-150 g	✓	✓	✓	✓
Water	1500-1700 mL	✓	✓	✓	✓
Condiment	Soy sauce and bean paste contain salt and should be avoided. (20 mL soy sauce contains about 3-5 g salt; 20 g soybean paste contains about 3 g salt)				

For breakfast: 6:30 am-7:30 am, accounting for 25%-30% of the total intake; for lunch: 12:00 pm-1:00 pm, accounting for 30%-40% of the total intake; for dinner: 5:30 pm-6:30 pm, accounting for 20%-25% of the total intake; for extra meals: 9:30 am-10:00 am, 3:00 pm-3:30 pm, accounting for 5%-10% of the total intake.



**FIGURE 1** Blood glucose monitoring methods and tools for diabetic patients in senior care facility

The time range of blood glucose monitoring at each time point is shown in Table 6, and the basic principles of blood glucose monitoring are shown in Table 7.

### 3.4 | Extremely high blood glucose

Hyperosmolar hyperglycemia state (HHS) and diabetic ketoacidosis (DKA) are the commonest hyperglycemia conditions among elderly diabetic patients in senior care facility, which are two most serious acute complications of diabetes. HHS is mainly characterized by severe hyperglycemia, elevated plasma osmotic pressure, dehydration, and consciousness disorder, and ketosis and metabolic acidosis are usually absent. Elderly diabetic patients are prone to HHS. The mortality of HHS is higher than that of DKA, about 10 times that of DKA. Infection is the main cause of HHS.<sup>2,7</sup> Diagnostic criteria for HHS include a plasma glucose level of  $\geq 33.3$  mmol/L, an effective plasma osmotic pressure of  $\geq 320$  mOsm/L, and the absence of metabolic acidosis and ketosis.

DKA is a severe metabolic disorder of sugar, fat, and protein caused by insufficient insulin and improper elevation of glucose-raising hormone. DKA is mainly characterized by hyperglycemia, hyperketone, and metabolic acidosis. The difference between DKA and HHS is primarily based on the presence of ketoacidosis and the degree of hyperglycemia. Although DKA is uncommon

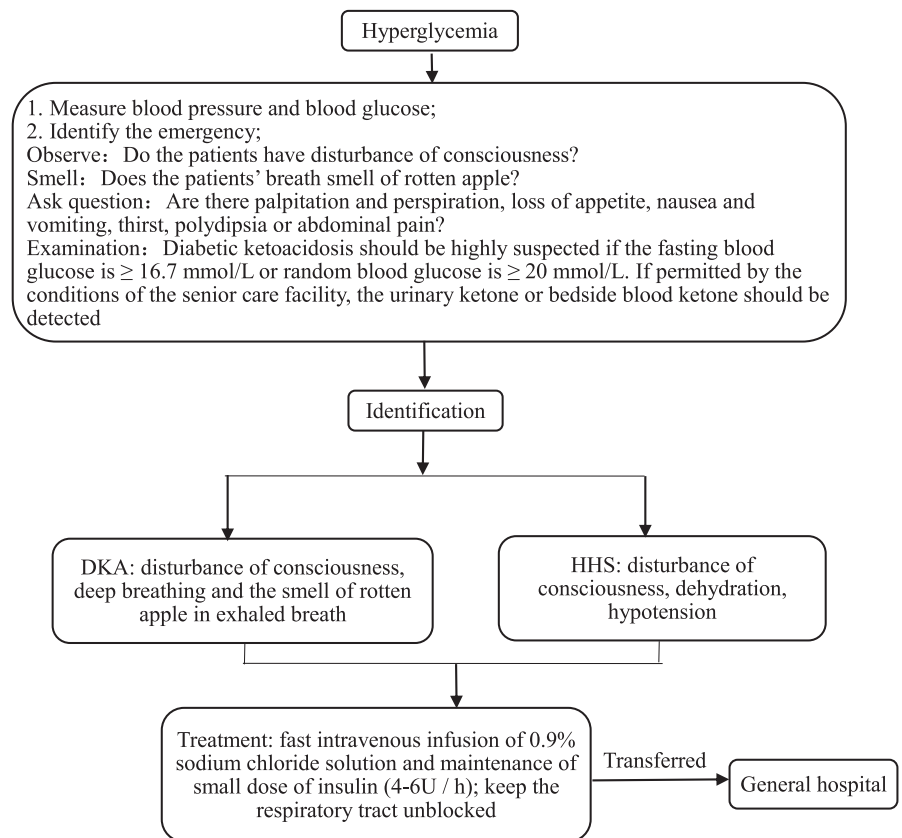
**TABLE 6** Blood glucose monitoring at each time point

Time	Application
Pre-meal blood glucose	Fasting blood glucose is high or there is a risk of hypoglycemia (the elderly, people with blood glucose well controlled)
Blood glucose 2 h after a meal	The fasting blood glucose is well controlled, but HbA1c still fails to reach the standard level and patients who need to know the effects of diet and exercise on blood glucose
Blood glucose before sleeping	Patients treated with injection of insulin, especially those who are injected with insulin before dinner
Blood glucose at night	Those whose blood glucose reach the standard level after treatment, but the fasting blood glucose is still high, or those who are suspected to have hypoglycemia at night
Others	Blood glucose should be monitored in time when symptoms of hypoglycemia appear and should be monitored before and after strenuous exercise

**TABLE 7** Basic principles of blood glucose monitoring

Patients	Principles of blood glucose monitoring
Lifestyle intervention	To understand the effects of diet control and exercise on blood glucose and adjust diet and exercise according to the blood glucose monitoring results
Using oral hypoglycemic drugs	Monitor fasting or post-meal blood glucose 2-4 times per week, or continuously monitor the blood glucose for 3 d in the week before seeing a doctor, and 7 times per day (before and after breakfast, lunch, dinner, and at bedtime)
Insulin users	Fasting blood glucose should be monitored for those using basal insulin; fasting and pre-dinner blood glucose should be monitored for those using pre-mixed insulin; pre-meal and post-meal blood glucose should be monitored for those using insulin before meals

**FIGURE 2** Management of hyperglycemia in senior care facility. [Correction added on 30 June 2021, after first online publication on 11 June 2021: Missing arrows have been added for Figure 2.]



in elderly diabetic patients, when it does occur, the elderly are more likely than younger diabetic patients to have various complications, leading to impaired organ system functions and adverse outcomes. Moreover, the coexistence of DKA and HHS is not rare.

### 3.4.1 | Identification and diagnosis of hyperglycemia

Most importantly, physicians and nursing staff in the senior care facility to control hyperglycemia should identify DKA and HHS in time. Specific identification and treatment process is shown in Figure 2.

**Recommendation 14:** (1) Observe: Do the patients have disturbance of consciousness? Do they have deep breathing, flushing, or fever? (2) Smell: Does the patients' breath smell of rotten apple? (3) Question: Are there palpitation and perspiration, loss of appetite, nausea and vomiting, thirst, polydipsia, or abdominal pain? (4) Examination: Diabetic ketoacidosis should be highly suspected if the fasting blood glucose is  $\geq 16.7$  mmol/L or random blood glucose is  $\geq 20$  mmol/L. If permitted by the conditions of the senior care facility, the urinary ketone or bedside blood ketone should be detected.

### 3.4.2 | Treatment of hyperglycemia

Both DKA and HHS treatments should observe the following principles.

**Recommendation 15:** Fluid infusion should be carried out as soon as possible to restore blood volume, reduce blood glucose level, and solve electrolyte and acid-base imbalance. Besides, we should identify and remove the causes, prevent and treat for the complications, and reduce the mortality rate. Elderly diabetic patients with

suspected DKA and HHS should be transferred immediately after urgent treatment.

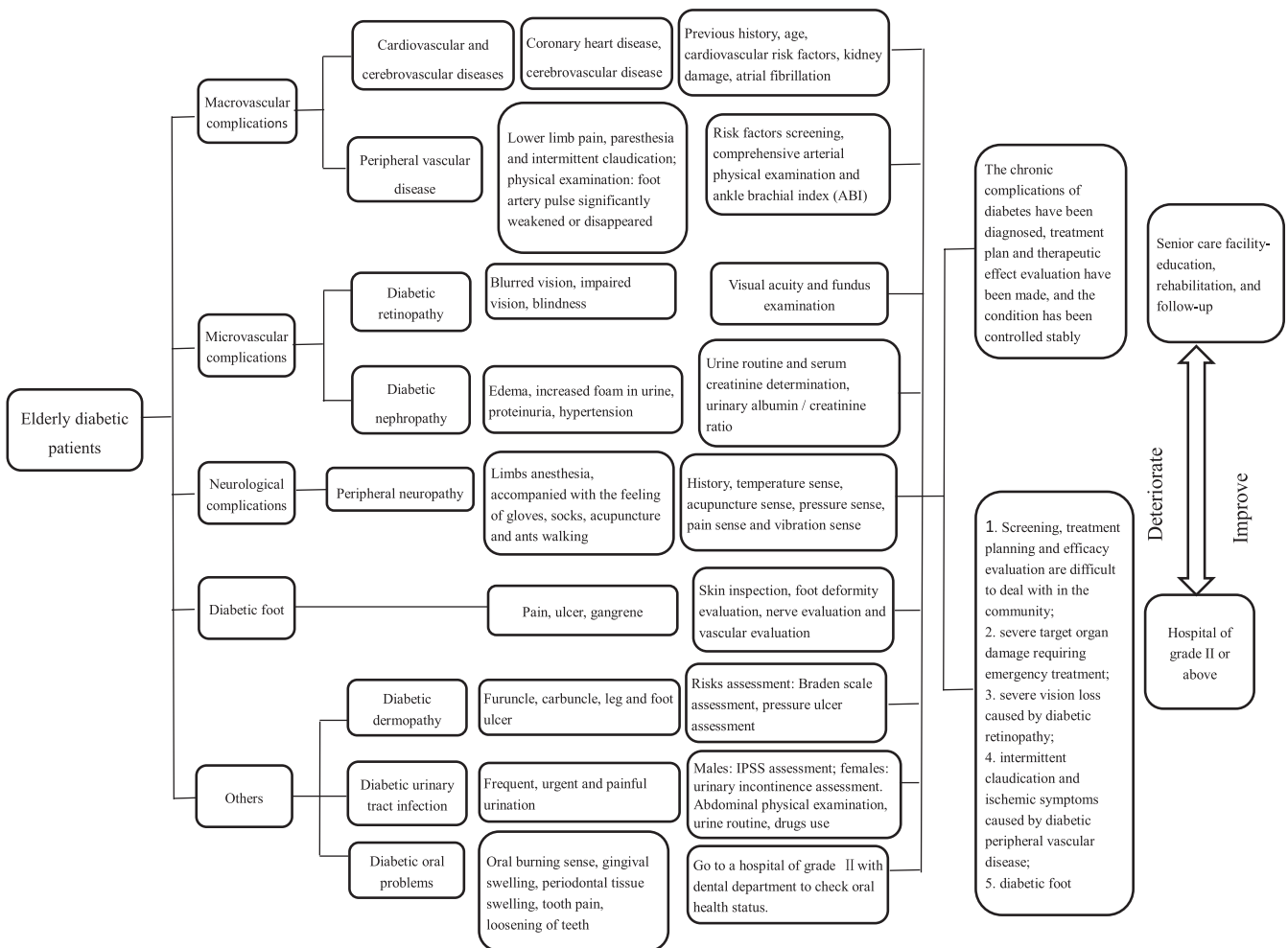
The treatment process is shown in Figure 2.

### 3.5 | Identification of macrovascular and microvascular complications

Macrovascular diseases (including coronary atherosclerotic heart disease, cerebrovascular disease, and lower extremity vascular disease) and microvascular diseases (retinopathy, nephropathy, foot lesions, and peripheral neuropathy) are the most common complications of type 2 diabetes in the elderly patients. These vascular complications seriously affect the quality of life of patients and have become the main causes of death and disability.

**Recommendation 16:** The macrovascular and microvascular complications of diabetes should be identified in time according to the symptoms and signs of elderly diabetic patients. When the patients' conditions get worse, they should be transferred to a hospital of grade II or above for treatment.

The specific process is shown in Figure 3.



**FIGURE 3** Identification and treatment of diabetic macrovascular and microvascular complications by medical staff in senior care facility



### 3.6 | Management of commonly used hypoglycemic drugs in diabetic patients

Patients with diabetes usually need to receive hypoglycemic drugs, and attention should be paid to the risk of hypoglycemia in the elderly patients with diabetes during medication.<sup>10-12</sup>

**Recommendation 17:** Emphasis should be placed on hypoglycemia warning education, especially for the elderly patients who need to take sulfonylurea, glinides, and insulin. Blood glucose should be monitored during medication. Besides, in order to ensure hypoglycemic effect and reduce the risks of medication, patients should adopt an appropriate method of medication. Injectable drugs should be injected subcutaneously into the

abdomen, thighs, or upper arms, and the injection points should be changed in rotation.

The specific usages and common adverse reactions of various hypoglycemic drugs are shown in Table 8.

### 3.7 | Management of common geriatric events in elderly patients with diabetes<sup>13-16</sup>

#### 3.7.1 | Falls

Elderly diabetic patients are prone to falls due to a variety of reasons, which may result in fractures, craniocerebral injury, and other

**TABLE 8** Usages and common adverse reactions of hypoglycemic drugs

Types of drugs		Common drugs	Usage	Common adverse reactions	
Oral preparation	Sulfonylureas	Glibenclamide	15 min before meals	Hypoglycemia, gastrointestinal effects, weight gain	
		Glimepiride	Before the first meal of the day		
		Gliclazide	For sustained-release tablets and capsules with breakfast; for common tablet and dispersible tablet, not affect by food intake		
	Glinides	Glipizide	30 min before meals		
		Repaglinide	15 min before meals		
		Nateglinide			
	Thiazolidinediones	Pioglitazone	Not affected by food intake		Edema, female fracture, weight gain
		Rosiglitazone			
	Bisphosphonates	Metformin	For common tablet and sustained-release tablets with meals; for enteric-coated tablets and enteric-coated capsules, 30 min before meals		Gastrointestinal effects
DPP-4 inhibitors	Saxagliptin	Saxagliptin	Not affected by food intake, and take the tablet with sufficient water, do not break or chew	Dizziness, headache	
		Sitagliptin	Not affected by food intake		
		Linagliptin			
		Vildagliptin			
Alpha-glucosidase inhibitor	Acarbose	Acarbose	Chewed with the first bite of food at a meal	Abdominal pain, diarrhea, abdominal distention	
		Voglibose			
		Miglitol			
SGLT-2 inhibitors	Empagliflozin	Empagliflozin	On an empty stomach or 30 min after a meal	Genital and urinary tract infections, weight loss	
		Dapagliflozin	Not affected by food intake, recommended before breakfast		
		Canagliflozin			

(Continues)

TABLE 8 (Continued)

Types of drugs			Common drugs	Usage	Common adverse reactions
Injection	Insulin	Fast-acting	Insulin aspart	Subcutaneous injection 15 min before meals	hypoglycemia
			Insulin lispro		
			Insulin glulisine		
		Regular	Recombinant human insulin	Subcutaneous injection 30 min before meals	
			Human biosynthetic insulin		
			Insulin detemir		
	Long-acting	Insulin glargine	Subcutaneous injection at fixed time every day		
		Insulin degludec			
	Premix	Insulin aspart 30, 50	Subcutaneous injection 15 min before meals		
		Protamine biosynthesis of human insulin (premix 30R, 50R)	Subcutaneous injection 30 min before meals		
GLP-1 receptor agonists	Liraglutide	Subcutaneous injection at fixed time every day	Nausea, loss of appetite, weight loss		
	Exenatide	Subcutaneous injection 1 h before breakfast and dinner			

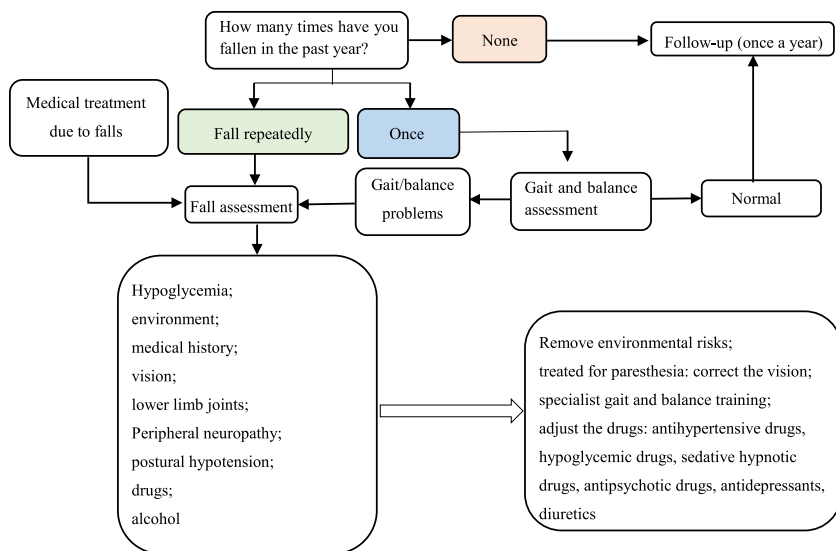


FIGURE 4 Assessment process for elderly falls in senior care facility

serious problems. The management focus of their falls lies in screening and prevention, as shown in Figure 4.

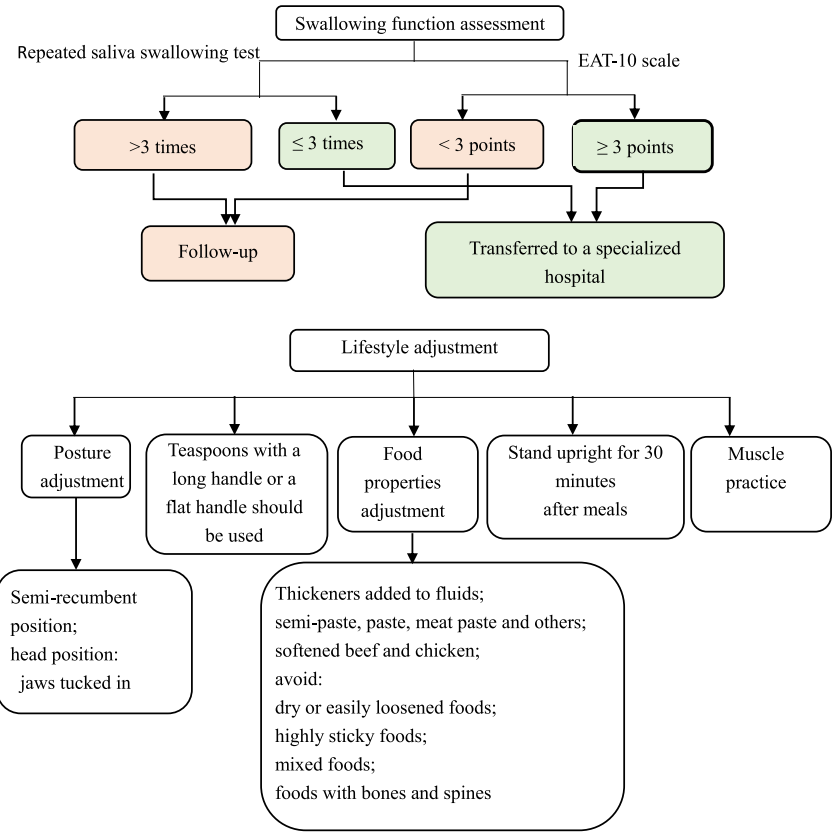
**Recommendation 18:** Diabetic patients in a senior care facility should be screened for the risk of falling at least once a year. For any fall accident of the elderly patients, hypoglycemia should firstly be excluded.

### 3.7.2 | Choking

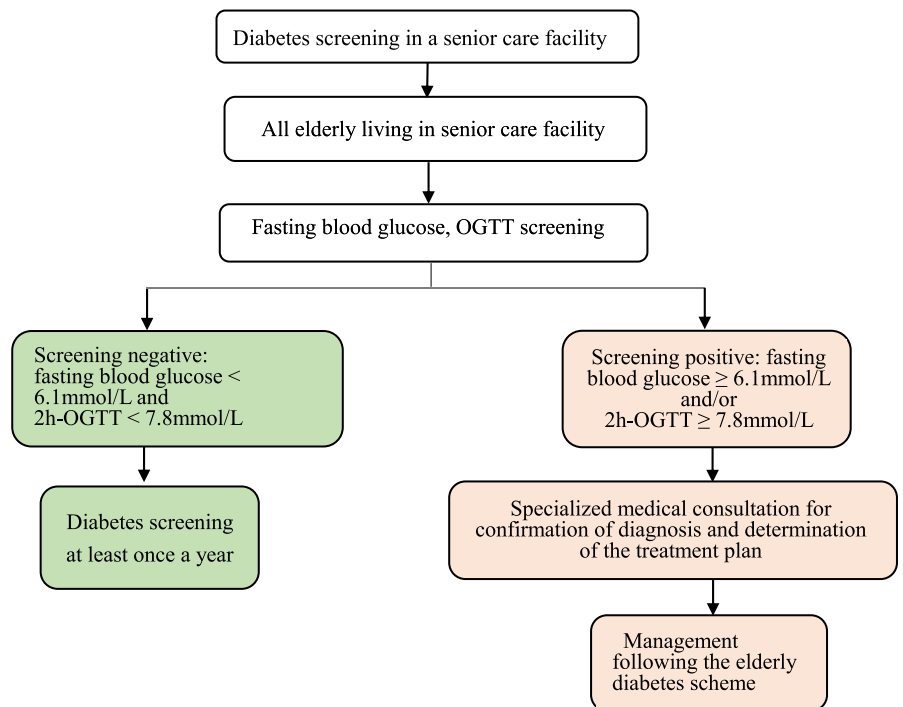
Choking is closely related to adverse clinical events such as hypoglycemia and malnutrition in the elderly with diabetes.

**Recommendation 19:** Repeated saliva swallowing test or the EAT-10 scale can be used to evaluate the swallowing function of

**FIGURE 5** Swallowing function assessment and lifestyle prevention of choking for the elderly in senior care facility



**FIGURE 6** Screening process for non-diabetic elderly in senior care facility  
 Note: 2h-OGTT refers to blood glucose at 2 hours after glucose load.



the elderly in the senior care facility. Among the elderly with a risk of choking, most of the choking incidents can be avoided by interventions such as improving feeding patterns and food properties (Figure 5). Nasal feeding tubes are required to supply some elderly patients with nutrition, but they cannot effectively avoid choking and aspiration.

#### 4 | NON-DIABETIC ELDERLY

The screening process of non-diabetic elderly in senior care facility is shown in Figure 6.

**Recommendation 20:** Diabetes usually has a long asymptomatic period, and interventions in prediabetes can prevent or delay the

onset of diabetes. The elderly are at high risk of diabetes, so it is recommended that the senior care facility conduct diabetes screening at least once a year.

**Recommendation 21:** Fasting blood glucose detection is simple and easy to perform and is suitable for routine screening in senior care facility. However, the specificity and sensitivity of fasting blood glucose detection in the elderly population are decreased, and there is a possibility of missed diagnosis. The *Diabetes Risk Score in China* (Table 9) can be used for auxiliary screening. For those with a total score of  $\geq 25$ , OGTT (fasting blood glucose and blood glucose 2 hours after glucose load) should be performed to determine whether they have diabetes. The application of HbA1c is not recommended in routine diabetes screening in senior care facility.

**Recommendation 22:** The normal range: Fasting blood glucose  $< 6.1$  mmol/L and/or 2 hours post-glucose load blood glucose (2h-OGTT)  $< 7.8$  mmol/L. It is suggested to receive a screening at least once a year.

**Recommendation 23:** Fasting blood glucose  $\geq 6.1$  mmol/L and/or 2 hours post-glucose load blood glucose  $\geq 7.8$  mmol/L are prediabetic or diabetic stage with impaired fasting blood glucose and impaired glucose tolerance (Table 10). It is recommended to be diagnosed by a diabetes or endocrine specialist and develop a treatment scheme.

## 5 | HYPOGLYCEMIA

**Definition:** Hypoglycemia is defined as a state of intravenous blood glucose below 2.8 mmol/L in non-diabetic patients and below 3.9 mmol/L in diabetic patients. Due to the lower threshold of hypoglycemia in the elderly, hypoglycemia should be dealt with in advance and as soon as possible when the blood glucose of the elderly in the senior care facility is lower than 5.0 mmol/L, and the hypoglycemia drugs should be adjusted.

**Symptoms:** hunger, palpitations, sweating, tremor, pallor, dizziness, and weakness, etc. The elderly rarely have hypoglycemia prodrome, directly manifested as vertigo, disorientation, sudden behavioral changes, or even serious clinical events such as cardiac arrhythmia, myocardial infarction, falls, syncope, convulsion, and coma.

**Recommendation 24:** Blood glucose monitoring in senior care facility is not as frequent as that in hospitals, the former mainly avoids the occurrence of hypoglycemia through health education and early identification of hypoglycemia.

**Recommendation 25:** The blood glucose threshold of the prodrome of hypoglycemia in the elderly is very close to the threshold of hypoglycemia. When hypoglycemia symptoms occur, blood glucose may already be lower than 3.9 mmol/L. For the elderly in senior care facility, it is recommended to loosen the diagnostic criteria of hypoglycemia. Hypoglycemia should be treated immediately when blood glucose is lower than 3.9 mmol/L. Similarly, when blood glucose is below 5.0 mmol/L, hypoglycemia should be treated as soon as possible in advance.

**Recommendation 26:** Whether the elderly have diabetes or not, when hypoglycemia occurs, they should be treated according to Figure 7. If the elderly have recurrent hypoglycemia in a short period, they should be referred to a general hospital to find out the cause of hypoglycemia.

**TABLE 9** Diabetes Risk Score in China

Indicators	Scores
Age (years)	
20-24	0
25-34	4
35-39	8
40-44	11
45-49	12
50-54	13
55-59	15
60-64	16
65-74	18
BMI (kg/m <sup>2</sup> )	
<22.0	0
22.0-23.9	1
24.0-29.9	3
$\geq 30.0$	5
Family history of diabetes (parents, siblings, sons and daughters)	
No	0
Yes	6
Waist circumference (cm)	
<75.0 (male), <70.0 (female)	0
75.0-79.9 (male), 70.0-74.9 (female)	3
80.0-84.9 (male), 75.0-79.9 (female)	5
85.0-89.9 (male), 80.0-84.9 (female)	7
90.0-94.9 (male), 85.0-89.9 (female)	8
$\geq 95.0$ (male) OR $\geq 90.0$ (female)	10
Systolic blood pressure (mm Hg)	
<110	0
110-119	1
120-129	3
130-139	6
140-149	7
150-159	8
$\geq 160$	10
Gender	
Female	0
Male	2

1 mmHg = 0.133 kPa.

## 6 | BLOOD GLUCOSE MANAGEMENT DURING MAJOR PUBLIC HEALTH EMERGENCIES OR SERIOUS NATURAL DISASTERS

Major public health emergencies, especially the COVID-19 pandemic, have incurred physical and psychological suffering to patients and their families, exerted a huge impact on society and economy,

and posed major challenges to medical supply. For humanitarian reasons, patients should not be abandoned, regardless of their survival prognosis.

**Recommendation 27:** Whole-person medical care should be provided for elderly patients near the end of life, and the aims are to promote the quality of life of patients, their families, and caregivers.

Senior care facility should develop contingency plans for emergencies in advance in accordance with the *Administrative Measures for Senior Care Facility (Order No. 66 of the Ministry of Civil Affairs of the People's Republic of China)*.

**Recommendation 28:** When major public health events or severe natural disasters occur suddenly, the elderly patients' awareness and ability to precautions are weak, and changes in living environment and living habits may lead to unstable glycemic control of diabetes, aggravation of basic diseases, and the occurrence of new complications. So the senior care facility should provide the elderly with necessary protection measures and timely emotional counseling, psychological support, crisis intervention, and other services.

**Recommendation 29:** The blood glucose management process in major public health events or serious natural disasters in senior care facility is shown in Figure 8.

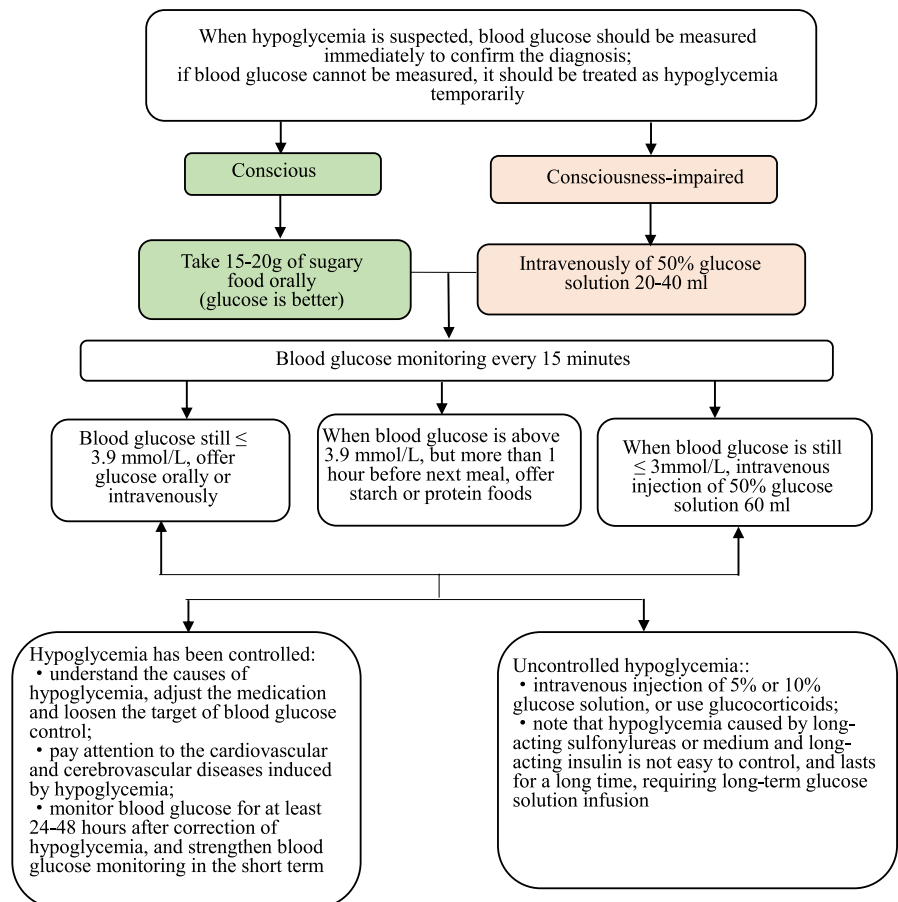
**TABLE 10** Classification of diabetes screening results<sup>17</sup>

Glycometabolic state	Intravenous plasma glucose (mmol/L)	
	Fasting plasma glucose	2-h postload plasma glucose (2-h PG)
Normal glucose range	<6.1	<7.8
Impaired fasting glucose	6.1-7.0	<7.8
Impaired glucose tolerance	<7.0	7.8-11.1
Diabetes	≥7.0	≥11.1

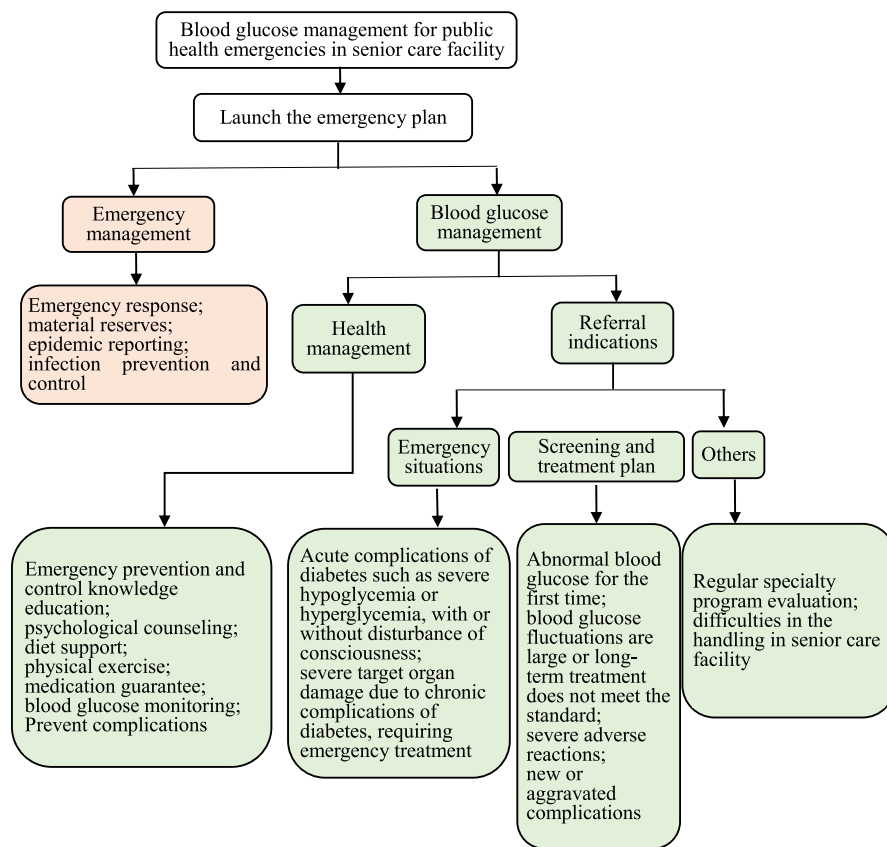
Impaired fasting glucose and impaired glucose tolerance are collectively referred to impaired glucose regulation or prediabetes.

## 7 | USING TELEMEDICINE AND SMART MEDICINE TO MANAGING BLOOD GLUCOSE

Due to the impact of COVID-19, and the need for defense and isolation, telemedicine was developing at a high speed in 2020, and the strategy of Internet plus medicine was implemented quickly. Telemedicine and smart medical technology can cover the shortage of professional staff in senior care facility. Moreover, the use of telemedicine and smart medical technology can integrate resources and optimize blood glucose management.



**FIGURE 7** Management process of hypoglycemia



**FIGURE 8** Emergency management process of diabetes when a major public health event occurs in senior care facility

**Recommendation 30:** Encourage senior care facility and general hospitals to establish remote education and consultation platforms to promote the level of diagnosis and treatment. It is recommended that if permitted by conditions, senior care facility can make full use of various devices based on medical Internet for blood glucose monitoring. Smartphone APP and related intelligent terminals can be used to connect with the remote chronic disease management centers and realize a remote, refined and systematic management of blood glucose.

#### CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose.

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## APPENDIX 1

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