Diabetes Management in the Elderly

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■ **IN BRIEF** Older adults with diabetes present unique challenges and require considerations that are not traditionally associated with diabetes management. In this review, we focus on issues that are unique to the older population and provide practical guidance for clinicians who care for them.

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Diabetes in Older Adults: A Growing Population With Special Challenges

The population of elderly patients with diabetes is rapidly growing, with significant impact on population health and economics (Table 1). Currently in the United States, older adults (age ≥65 years of age) make up >25% of the total population with diabetes (1). Even if the diabetes incidence rates were to level off, the prevalence of diabetes will double in the next 20 years as the population ages (2).

Older adults with diabetes are at higher risk for both acute and chronic microvascular and macrovascular complications from the disease, including major lower-extremity amputations, myocardial infarctions, visual impairments, and end-stage renal disease, compared to any other age-group (3). Patients who are >75

TABLE 1. Diabetes in Older Adults: Statistics

- More than 25% of adults >65 years of age have diabetes.
- Diabetes was the 7th leading cause of death in the United States in 2015.
- The average cost of medical expenditures for adults with diabetes is $13,239/year compared to $6,675 for a younger cohort.
- Older adults with diabetes have the highest rates of complications.

years of age are more likely to develop complications, have higher rates of death from hyperglycemic crises and have an increased rate of emergency department visits for hypoglycemia compared to those who are <75 years of age (1).

A recent analysis of the economic cost of diabetes showed that ~61% of all health care costs attributed to diabetes are incurred by people with diabetes who are >65 years of age (4). The average annual expenditure for older adults (≥65 years of age) was $13,239 compared to $6,675 for the younger cohort. Thus, older adults with diabetes comprise a growing population posing high health and economic burdens to the society.

All Older Adults Are Not the Same

Diabetes management in older adults presents challenges because there is extensive variability within this population in terms of clinical presentation, psychosocial environment, and resource availability. A person's living situation and degree of available social support can affect both glycemic goals and the ways in which diabetes is managed. Diabetes management can differ across the spectrum according to where elderly patients live (i.e., whether they are community dwelling or live in an assisted-living facility or a nursing home (5). Table 2 describes the characteristics of older adults in

TABLE 2. Characteristics of Older Adults in Different Living Situations and How These Characteristics May Affect Diabetes Management

Living Situation	Patient Characteristics	Impact on Diabetes Care
Community dwelling	• High functioning • Medically stable • May or may not need caregivers	• Complex regimens can be dangerous if patients are unable to follow them • Acute illness can cause decline in cognitive or physical status • Patients need frequent education and reeducation
Residing in an assisted living facility	• High functioning • Need partial assistance in ADL/IADL • Need more assistance from caregivers	• Patients may or may not have control over the content of their meals • Patients need assistance with oral medication–taking but not with blood glucose monitoring or insulin administration • Patient have high risk of regimen failure after acute illness (i.e., failing to take medications as prescribed)
Residing in a short-term rehabilitation center	• High functioning • Need temporary partial or full assistance • Goal is to return to permanent living situation	• Patients need tighter glycemic control for wound-healing • Patients may benefit from education to improve glycemic control
Residing in a nursing home	• Low functioning • Need assistance or are dependent on others for ADL and IADL • Have limited life expectancy • Have a high burden of comorbidities	• Patients have no control over the timing or content of their meals • Patients have higher risk of side effects with oral medications • Patients have higher risk of acute illness, anorexia, and dementia/delirium • Patients' self-care is performed by nursing home staff

ADL, activities of daily living (e.g., bathing, toileting, transferring from place to place, dressing, and eating); IADL, instrumental ADL (e.g., using the telephone, managing medications, handling finances, performing housework, cooking, and arranging transportation.

different living situations and how these characteristics may affect diabetes management.

Some elderly people with diabetes are high functioning and medically stable, can perform self-care, and may or may not need caregivers. However, for others who are unable to follow instructions and manage their own medication regimen, diabetes management can be tricky and dangerous. In addition, the aging population with diabetes also has a higher risk of other conditions (termed "geriatric syndromes") that include cognitive dysfunction, depression, physical disability, pain, polypharmacy, and urinary incontinence. The goals of diabetes management must differ for older adults based on the presence or absence of these comorbidities, as well as on the patients' living situation and available resources. Another challenge in this population is a higher frequency of acute illnesses and frequent changes in overall health, which can affect glucose control and lead to decline in cognitive functioning and physical status. In such cases, it is important to adjust treatment goals as needed. Most of the discussion in the remainder of this article pertains to community-living older adults.

Current Guidelines for Diabetes Management in Community-Dwelling Older Adults

Several organizations have published guidelines regarding diabetes management in older adults. Most of these guidelines stress the importance of considering patients' overall health, comorbidities, cognitive and physical status, hypoglycemia risk, and life expectancy to guide glycemic goal-setting. The details vary by guideline, and these differences are summarized below.

The European Diabetes Working Party for Older People in 2011 published clinical guidelines for treating older adults with diabetes who are ≥70 years of age (6). With regard to glycemic targets, these guidelines divide older adults into two categories. For those without other major comorbidities, an A1C goal of 7–7.5% and a fasting glucose target range of 6.5–7.5 mmol/L (117–135 mg/dL) are recommended, whereas for frail older adults and those with multisystem disease, an A1C goal of 7.6–8.5% and a fasting glucose target range of 7.6–9.0 mmol/L (137–162 mg/dL) are recommended to minimize the risk of hypoglycemia and metabolic decompensation.

The American Diabetes Association (ADA) in 2012 published a consensus report on managing diabetes in older adults (7). In this report, glycemic goals are stratified based on patient characteristics and health status. As shown in Table 3, major consideration is given to coexisting severe medical conditions, presence of cognitive dysfunction, and ability to perform day-to-day activities. Based on these parameters, patients are divided into healthy, complex/intermediate, or very complex/poor health categories, with recommended A1C goals of <7.5, <8, and <8.5%, respectively, and similarly stratified fasting and bedtime glucose target ranges.

In 2013, the International Diabetes Federation (IDF) published its global guideline, "Managing Older People with Type II Diabetes" (8), and recommended individualized glycemic goals according to older adults' functional status, comorbidities, risk of hypoglycemia, and presence of microvascular complications. This guideline also divided older adults into three major categories with different glycemic targets. For functionally independent older adults, the IDF recommends an A1C goal of 7–7.5%, whereas for functionally dependent, frail patients or patients with dementia, an A1C goal of 7–8% is recommended. For end-of-life care, IDF recommends avoiding a specific A1C goal and focusing instead on avoiding symptomatic hyperglycemia.

In 2018, the American College of Physicians published a guidance statement on selecting targets for the pharmacologic treatment of type 2 diabetes (9). Guidance Statement 4 in this document relates to older adults and states that "Clinicians should treat patients with type 2 diabetes to minimize symptoms related to hyperglycemia and avoid targeting an HbA_{1c} level in patients with a life expectancy less than 10 years due to advanced age (80 years or older), residence in a nursing home, or chronic conditions (such as dementia, cancer, end-stage kidney disease, or severe chronic obstructive pulmonary disease or congestive heart failure) because the harms outweigh the benefits in this population."

Special Considerations in the Management of Diabetes in Older Adults

Older adults with diabetes require some unique considerations that are not traditionally associated with diabetes care. The following considerations and practical pointers are useful when developing treatment goals and management strategies for older adults.

Presence of Age-Related Conditions

Both aging and diabetes increase the risk of certain comorbidities (geriatric syndromes) including cognitive dysfunction, depression, functional disabilities, falls and fractures, polypharmacy, chronic pain, and urinary incontinence (10). It is important to recognize these conditions because they can interfere with patients' ability to perform diabetes self-care. If clinicians are not aware of these coexisting conditions, they may prescribe treatment that is too complex for a patient with cognitive dysfunction or miss an opportunity to treat depression that can lead to nonadherence to medications and social isolation. Polypharmacy can increase the risk of drug interactions, and pain and incontinence directly affect quality of life. Vision and hearing impairments can also lead to social isolation, errors in treatment, traumatic falls, and dis-

TABLE 3. A Framework for Treatment Goals for Diabetes in Older Adults From the ADA

Patient Category and Associated Characteristics	Suggested A1C Goal (%)	Suggested Average Fasting Glucose Target Range (mg/dL)	Suggested Average Bedtime Glucose Target Range (mg/dL)	Rationale
Healthy • Few comorbidities • Functionally and cognitively intact	<7.5	90–130	90–150	• Significant life expectancy • Goal is to prevent future macrovascular and microvascular complications
Complex/intermediate • Multiple chronic comorbidities *or* • Two or more IADL impairments *or* • Mild to moderate cognitive impairment	<8	90–150	100–180	• Intermediate life expectancy • High treatment burden • At risk for hypoglycemia and falls
Very complex/poor health • Residency in a long-term care facility *or* • End-stage chronic illnesses *or* • Two or more IADL impairments *or* • Moderate to severe cognitive impairment	<8.5	100–180	110–200	• Limited life expectancy • Benefit uncertain • High risk of hypoglycemia and falls

ADL, activities of daily living (e.g., bathing, toileting, transferring from place to place, dressing, and eating); IADL, instrumental ADL (e.g., using the telephone, managing medications, handling finances, performing housework, cooking, and arranging transportation).

ability. Table 4 details how the presence of geriatric syndromes can interfere with patients' ability to perform self-care tasks and offers strategies for optimizing care in such situations.

Risk of Hypoglycemia and Poor Outcomes

Hypoglycemia is one of the major limiting factors when trying to achieve recommended levels of glycemic control at any age (11,12). However, older patients have a higher risk of hypoglycemia and poor outcomes due to altered adaptive physiologic responses to low glucose levels (13,14). Hypoglycemia unawareness is also common in older adults and increases the risk of silent hypoglycemia that remains unrecognized (15). For aging patients with diabetes, hypoglycemia also has the potential to precipitate or trigger cardiovascular events, worsen cognitive function,

and lead to poor outcomes (16). Other devastating complications of hypoglycemia that lead to decline in quality of life include an increase in falls and fractures, fear of falling, confusion, delirium, and symptoms such as fatigue and dizziness (17).

In older adults, it is crucial that individualized care and treatment strategies include early recognition and management of hypoglycemia. Avoiding medications with a high risk of hypoglycemia is a reasonable first step.

Role of A1C in the Care of Older Adults

A1C remains the gold standard test to assess long-term glycemic control in the management of diabetes. It is now also used to diagnose diabetes (18). However, as shown in Table 5, several factors commonly seen in older adults can falsely raise or lower A1C

(19). Aging itself is associated with an elevation in A1C (20).

In addition, the measurement of A1C is dependent on the length of time the red blood cells (RBCs) circulate in the blood. Many conditions that increase RBC circulation time can falsely elevate A1C levels by increasing the exposure time to glucose and protein glycation. Conversely, conditions that decrease RBC circulation time can falsely lower A1C levels. These conditions include iron deficiency anemia, hemodialysis, erythropoietin therapy, metabolic acidosis, anemia of chronic disease, hemolytic anemia, sickle cell anemia, thalassemia, polycythemia, and other hemoglobinopathies, as well as recent blood transfusions (19,20). Although, this is an important consideration in all patients with diabetes, it is particularly important with regard to elderly patients and

TABLE 4. Common Geriatric Syndromes Associated With Diabetes

Condition	Strategies for Optimizing Care
Cognitive dysfunction	• Avoid tight glucose control or complex diabetes medication regimens and treatment programs • Educate caregivers, if available • Avoid diabetes treatments with high risks of hypoglycemia • Recommend alarms and pill boxes for medication reminders
Depression	• Identify, assess, and treat the depression
Physical disabilities (e.g., hearing loss, visual impairment, and gait abnormalities)	• Recommend assistive devices (e.g., hearing aids, glasses, canes, and walkers) • Recommend a safe exercise program based on current physical capacity
Polypharmacy and medication noncompliance	• Ask patients to bring all medication bottles or list of medications and dosages with them to appointments, including over-the-counter medications • Review patients' medications at each visit • Discontinue any medications that do not have benefit

TABLE 5. Conditions That Can Falsely Increase or Decrease A1C

Condition	Possible Mechanism	False Change in A1C
Age	Increased insulin resistance	↑
Race (African American or Hispanic)	Unknown	↑
Iron deficiency anemia	Decreased RBC turnover, longer glycation exposure	↑
Hemolytic anemia, sickle cell anemia, or thalassemia	Increased RBC turnover	↓
Anemia of chronic diseases	Unknown	↑ or ↓
Recent transfusion	Increased RBC turnover	↓
Polycythemia	Longer RBC life span	↑
Hemoglobinopathies	Interference from hemoglobin variants	↓
Hemodialysis	Shorter RBC life span	↓
Erythropoietin therapy	Increased young RBCs/shorter RBC life span	↓
Metabolic acidosis/uremia	Carbamylation of hemoglobin	↑

nursing home residents, who have a high prevalence of these conditions and for whom A1C-derived average glucose values may not correlate with average glucose as measured by continuous glucose monitoring (21).

It is also important to remember that A1C reflects mean glucose over a 90-day period. It is a poor marker of glucose variability or risk of hypoglycemia (22). Thus, another clinically important pearl regarding A1C use in elderly patients is that simply liberalizing A1C goals in this population does not eliminate the risk of hypoglycemia (23).

It is important to avoid dependence on A1C as a sole parameter for glycemic goals in frail elderly with multiple comorbidities that may affect A1C measurement. The best current option is to use finger-stick blood glucose testing results to guide therapy when A1C is deemed unreliable.

Prevention of Diabetes in Older Adults

The ADA recommends that all overweight adults (BMI ≥25 kg/m^2 or ≥23 kg/m^2 in Asian Americans) with risk factors and all adults >45 years of age should be screened for prediabetes and diabetes in the clinical setting every 1–3 years (18). Although a great deal of evidence supports diabetes screening of younger adults, for older adults, consideration should be given to the heterogeneity within this population, which can affect treatment decisions (7). The benefits of screening depend on whether primary or secondary preventive interventions would be effective for the older patient, which in turn depends on issues such as life expectancy, anticipated timeframe of benefits, and aggressiveness of the intervention. For older adults who have a long life expectancy and are relatively healthy, it is reasonable to follow current general screening recommendations. For very old adults, those with multiple comorbidities, and those with a short

life expectancy, it is best to focus intervention on preventing worsening of their conditions and complications and to be cognizant of complications that could further impair patients' functional status or quality of life.

Best Approach to Pharmacotherapy in Older Adults

Older adults with diabetes differ from their younger-adult counterparts in terms of glycemic goals and management of other cardiovascular risk factors. They also often have comorbidities and geriatric syndromes that interfere with self-care. It is crucial for providers to be aware of these differences to allow for proper assessment and to develop pharmacotherapeutic strategies that are adapted to unique challenges.

Lifestyle modification is important as the starting point for all patients with diabetes, including older adults. Although very restrictive diets are not recommended for older adults, counseling to avoid large carbohydrate loads at any one meal can reduce glucose excursions without unnecessary dietary restriction. Exercise is also important for all ages. It is important to consider patients' physical abilities when developing an exercise plan. For example, older adults who are not very active and at risk of falls should be encouraged to walk for 5–10 minutes, two to three times per day, inside the house. The exercise program can be increased gradually as tolerated.

When lifestyle modifications alone are unable to maintain target treatment goals, pharmacological interventions should be considered (24). A variety of oral and injectable agents are currently available, most of which are well tolerated by older adults. It is reasonable to follow the algorithm described in the ADA's *Standards of Medical Care in Diabetes—2018* (24). Table 6 provides a list of commonly used antihyperglycemic agents, along with their advantages, disadvan-

TABLE 6. Pharmacologic Therapies Commonly Used in Older Adults

Medication Class	Benefits in Older Adults	Cautions in Older Adults	Caveats and Additional Considerations
Biguanides	• Safe to use if no contraindications • Low risk of hypoglycemia • Low cost	• May cause gastrointestinal disturbances • May cause weight loss in frail older adults • Associated with vitamin B12 deficiency	• Considered first-line treatment unless contraindicated • Extended-release formulation may decrease gastrointestinal disturbances
Sulfonylureas	• Low cost	• Hypoglycemia risk • Drug interactions with some common geriatric drugs (such as warfarin and allopurinol)	• Consider short-acting agents (i.e., glipizide) to reduce risk of hypoglycemia • Avoid glyburide because of higher risk of hypoglycemia
Meglitinides	• Can skip doses if meals are skipped • May be useful in older adults with variable eating habits	• Multiple doses before each meal increase pill burden • High cost	• Useful to take before one large meal to control postprandial hyperglycemia
Glucagon-like peptide 1 receptor agonists	• Should be considered in overweight patients • Low risk of hypoglycemia	• Nausea, vomiting, diarrhea, and increase satiety • High cost • Injectable formulation	• May cause unintended weight loss in frail older adults • Limited safety profile in older adults
Dipeptidyl peptidase 4 inhibitors	• Low risk of hypoglycemia	• Nausea, vomiting, stomach discomfort, and diarrhea • High cost • Low efficacy	• Well tolerated in frail elderly because of once-daily pill formulation

TABLE 6. Pharmacologic Therapies Commonly Used in Older Adults, *continued from p. 250*

Medication Class	Benefits in Older Adults	Cautions in Older Adults	Caveats and Additional Considerations
Thiazolidinediones	• Low risk of hypoglycemia • Can be used in impaired renal function	• Edema and congestive heart failure • Increased bone loss and fracture risk • Concerns about bladder cancer	• Many contraindications in elderly (e.g., congestive heart failure, edema, and high risk of falls and fractures) • In those with limited life expectancy, less concerns for bladder cancer • Well tolerated and effective in reversing insulin resistance
Sodium–glucose cotransporter 2 inhibitors	• Low risk of hypoglycemia • Benefits for patients with atherosclerotic cardiovascular disease or congestive heart failure • Benefits to decrease progression of renal disease	• Increased risk for genital yeast infections and urinary tract infections, dehydration, weight loss, hyperkalemia, and elevated LDL cholesterol • May increase risk of euglycemic diabetic ketoacidosis	• Limited safety profile in older adults
Insulin	• Once-daily basal insulin is effective with low complexity	• High risk of hypoglycemia	• Avoid complex regimen • Using basal insulin doses in the morning to control fasting blood glucose and noninsulin agents to control postprandial hyperglycemia is a good strategy in older adults • Avoid a long-term sliding-scale insulin regimen

tages, and caveats for use in the older population.

In older adults who are likely to be on multiple medications, cost and drug–drug interactions are important considerations (25). Risk of hypoglycemia is also particularly important to consider when choosing medications for elderly patients.

Insulin can be used safely in older adults as long as the complexity of the regimen is not overwhelming (26). Use of basal insulin in combination with noninsulin agents is well tolerated in the older population. Basal insulin is tolerated better when given in the morning because postprandial glucose contributes more than fasting glucose to overall hyperglycemia in older patients (27). Dosing basal insulin in the morning allows the use of higher doses titrated to fasting glucose levels and lowers the risk of early-morning hypoglycemia. Although larger studies are not available, a small, randomized, controlled trial showed no difference in glycemic control or hypoglycemic episodes among residents in a long-term care facility who were treated with basal insulin or oral agents (28).

Even with all current guidelines recommending liberalization of glycemic goals in older patients with multiple comorbidities, overtreatment of diabetes in the elderly remains common (29). Part of the reason for this overtreatment could be that many clinicians are not clear about how to de-intensify therapy when a patient is unable to follow a complex insulin regimen safely. In a prospective study, adults >70 years of age with type 2 diabetes on multiple daily insulin injections underwent simplification of their regimen by changing to once-daily basal insulin with noninsulin agents. Simplifying the insulin regimen was found to reduce the risk of hypoglycemia without compromising glycemic control, and patients also noted an improvement in diabetes-related distress (30). Figure 1 depicts an algorithm
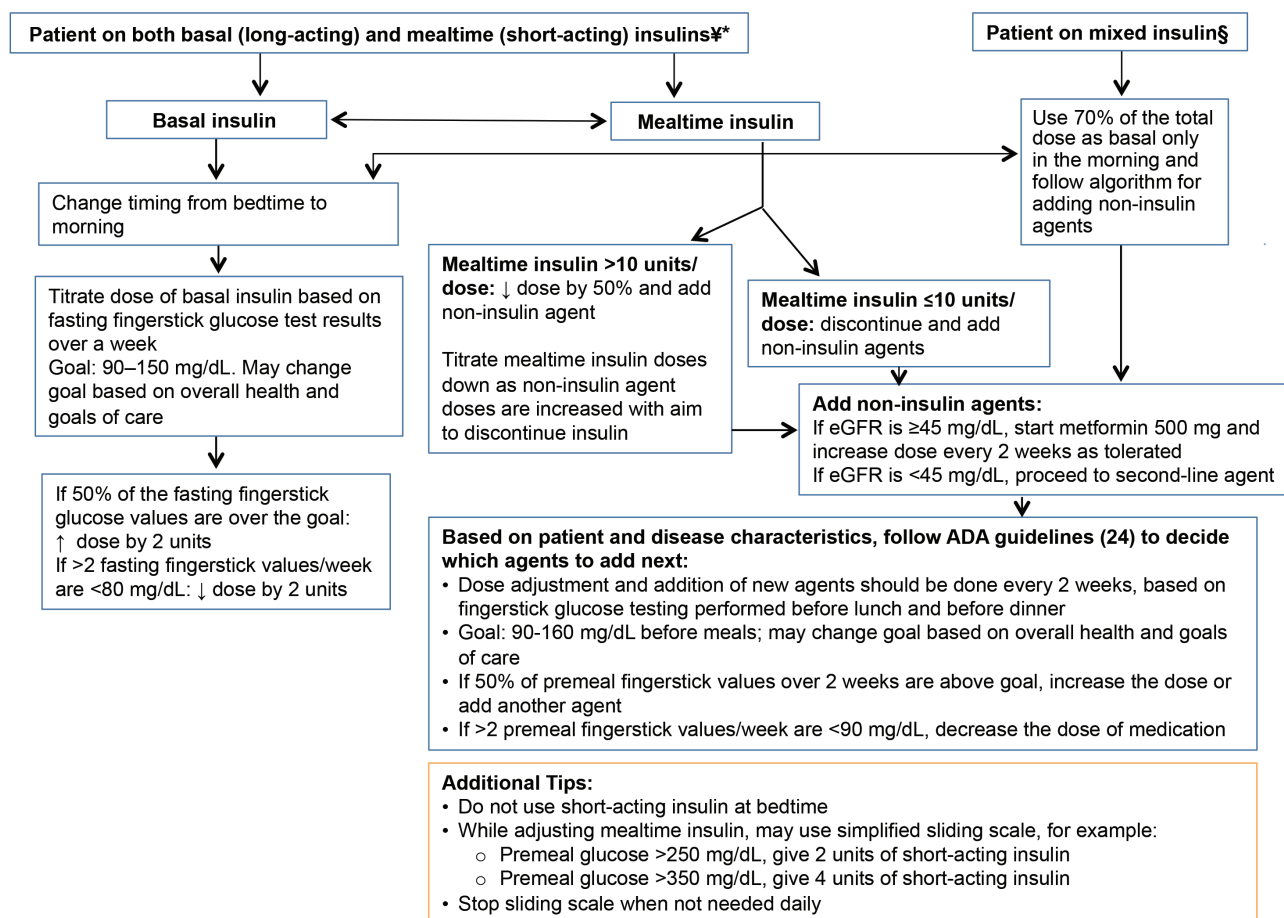
■ **FIGURE 1**. An insulin simplification regimen: from multiple injections to once-daily long-acting (basal) insulin plus noninsulin agents. *Basal insulins: glargine U-100 and U-300, detemir, and degludec. ¥Mealtime insulins (rapid-acting): lispro, aspart, and glulisine. §Mixed insulins: 70/30, 75/25, and 50/50. eGFR, estimated glomerular filtration rate. Adapted from ref. 30.

to simplify regimens adapted from this study (30).

As shown in Figure 1, when patients are on multiple daily insulin injections, both basal insulin and mealtime insulin should be addressed simultaneously. In patients who are not on any basal insulin, it should be added once daily in the morning. For patients who are already on basal insulin, the timing of injections should be moved to morning if they have been getting their basal insulin at bedtime. For patients on premixed insulin, 70% of the dose should be managed as basal insulin and 30% as mealtime insulin.

The dose of basal insulin should be increased by 2–3 units every 5–7 days until fasting glucose is in the individualized target range. For most older adults, 90–150 mg/dL is a reasonable fasting glucose target range. However, goals should be adjusted based on overall health and other comorbidities.

Mealtime insulin should be discontinued while adding noninsulin agents. Metformin is the first-line therapy for older adults and is well tolerated if renal function remains stable (31). The choice of additional noninsulin agents should be individualized based on the ADA algorithm, with consideration given to disease- and patient-related factors (24). Agents with a low risk of hypoglycemia are generally preferred; however, a high prevalence of renal insufficiency among the elderly frequently precludes the use of many of the newer agents. Doses of noninsulin agents should be tirtrated based on post-meal fingerstick blood glucose test results.

Summary

Diabetes management in older adults requires careful assessement of clincial, functional, and psychosocial factors. Before developing glycemic goals and a treatment strategy, each patient's overall health, coexisiting medical conditions, personal preferences, coping capacity, and factors affecting quality of life should be considered.

Duality of Interest

No potential conflicts of interest relevant to this article were reported.

Author Contributions

All three authors reviewed literature and wrote and edited the manuscript. M.N.M. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and accuracy of the data analysis.

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