Elderly Patients With Type 2 Diabetes Mellitus—
the Need for High-Quality, Inpatient Diabetes Care

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Abstract: Elderly patients (aged > 70 years) with diabetes are at high risk of hospitalization. We provide a detailed commentary about recent international clinical guidelines and a consensus statement devoted to elderly patients with type 2 diabetes mellitus in the context of hospitalization. In emergency departments, the 4 medication agents associated with the greatest number of patient adverse drug events are warfarin, oral glucose-lowering medications, insulin, and antiplatelet agents, all of which are commonly prescribed in older patients with diabetes. Comprehensive gerontological assessment, including review and, if indicated, discontinuation of all potentially unsafe or inappropriate patient medications should be done upstream to reduce the likelihood of adverse drugs events. Severe infections and ischemic heart disease are also frequent causes of acute admission into hospital in patients aged > 75 years. These patients are also likely to be malnourished and nutritional status should be monitored. Nutritional support, combined with specific products to avoid uncontrolled hyperglycemia must be implemented in patients at risk of malnutrition. Early exercise prescription may help patients maintain physical function and prevent the risk of falling. Clinical guidelines should be applied to achieve safe and effective patient target glucose levels. Insulin should be used earlier for its anabolic properties and patients closely monitored to reduce the risk of hypoglycemia and excessive hyperglycemia. The discharge plan needs to address full medical and social needs along with suitable follow-up to ensure a high level of patient safety.

Keywords: elderly patient; adverse drug events; individualized targets for treatment; comprehensive gerontological assessment

Introduction

People with diabetes are at high risk for hospitalization, occupy a substantial proportion of hospital beds, and account for a major cost to any health care system. Data from the United Kingdom1 suggest a 70% higher non-elective admission rate for patients with diabetes, with the highest risk of admission associated with elderly patients. Among a representative sample of 9000 patients with diabetes, 22.1% were found to have been hospitalized during the previous year for a stay > 24 hours.2 This was associated with a worse health-related quality of life. Older patients are at particular risk of requiring hospitalization.3 In 2006, in a group of women with diabetes, aged > 80 years, the 5 main causes for hospitalization were congestive heart failure, pneumonia, urinary tract infection, diabetes-related complications, and septicemia. The picture was similar in the cohort, aged 70 to 79 years, but in a younger cohort of women, the presence of cardiovascular disease (CVD) was a greater contributor to patient likelihood of hospitalization. In older men, ischemic CVD was a more frequent cause but pneumonia was the second cause of hospitalization. Diabetes appeared frequently as a co-morbidity in these patients and, particularly in the most elderly, infectious disease was critical.
Elderly hospitalized patients with diabetes have specific needs that clinicians have to address and a clinician working in an acute care hospital will require support to deliver a standard of care necessary to address these unmet needs. Clinical guidelines for the management of patients with type 2 diabetes mellitus (T2DM) launched by the European Diabetes Working Party for Older People,¹ and the Position Statement from the International Association of Gerontology and Geriatrics and International Expert Group,² address many of the important issues raised by elderly patients with T2DM. The aim of our article is to review the clinical implications of these statements in the care of older inpatients with T2DM. We do not focus on the management of diabetic ketoacidosis, which, in general occurs in patients with type 1 diabetes; or on the care of patients with hypoglycemia or acute foot problems—all of which would require a second article in this series.

**Elderly Patients With T2DM in the Emergency Department**

A US emergency department (ED) study⁶ of older subjects with adverse drug events (ADEs) reported overnight hospitalization admissions in about one-third of cases and these particularly affected the oldest patients. Drugs frequently used by patients with T2DM were in the top 4 medications with associated ADEs: insulin, oral hypoglycemic agents, warfarin, and antiplatelet agents. Hypoglycemia accounted for 44% of hospital admissions, with two-thirds of patients having neurologic symptoms. It was also reported that 37% of ED visits by patients with T2DM were due to hypoglycemia; and 80% of those hospitalized after hypoglycemic events were > 70 years old and had concurrent illnesses.⁷ Diabetes, polypharmacy, and dementia were more frequent in Chinese older patients with ADEs admitted to an ED.⁸ Diabetes medications accounted for 8.1% of ADEs.

To assess the impact of comorbidity on the management of older patients with T2DM, the European guidelines of diabetes care⁴ and the Position Statement⁵ recommend performing a comprehensive gerontological assessment (CGA) of the patient,⁹ including functional and cognitive evaluation, nutritional assessment, renal function screening, and cardiovascular risk measurement. It is also recommended that the overall functional status of the older patient be estimated, defining those who are robust with single-organ involvement, and those who are frail or dependent as having a short life expectancy. Targets for treatment, including the use of glucose lowering agents or CVD prevention drugs are defined in this assessment process with less stringent goals recommended in frail or dependent patients. Treatment revision is an important part of CGA. To prevent unnecessary hospitalization related to ADEs, this upstream action is important and may be very efficient; in our view, it is mandatory to prevent further readmissions. In the context of EDs, CGA is rarely possible without the contribution of a consultation team with specialist expertise in managing older patients.¹⁰ Unfortunately, such mobile geriatric teams do not exist in the majority of health care systems.

**Elderly Patients in Acute Care Settings**

In hospitalized older patients with T2DM, diabetes has been shown to be associated with an increased 4-year mortality.¹¹ Global comorbidity and functional limitations were more highly associated with this increased risk via T2DM than cardiovascular comorbidity. In acute care settings, adapted CGA should be performed during hospitalization to modify goals of treatment according to the functional status of each patient.

**Blood Glucose Level Targets**

To improve patient outcomes from infections, and to reduce the number of cardiovascular ischemic events or surgical complications, the question of whether blood glucose level control is important is debated. The presence of T2DM increases patient risk of contracting infectious diseases and an elevated glycosylated hemoglobin (HbA₁c) level negatively impacts patient prognosis after sepsis,¹²,¹³ or after surgical interventions.¹⁴ Frequently associated conditions, such as ischemic heart disease, hypertension, and older age, were also found to be risk factors for sepsis.¹⁵ The older patient with T2DM is particularly exposed to the risk of infection. To reduce further vulnerability brought on by T2DM in these patients, intensive blood glucose monitoring has been proposed. A reduction in morbidity in adult populations associated with intensive insulin therapy has been shown in several studies,¹⁶,¹⁷ including patients with and without T2DM during intensive care unit (ICU) stays at the expense of an increased risk of hypoglycemia.¹⁶,¹⁷ In one study,¹⁷ which looked at patients in ICUs, a history of diabetes was found in 203 (16%) inpatients and mortality risk was not decreased by intensive insulin therapy in this group (34/208 deaths with conventional treatment compared with 42/180 deaths in patients treated in the ICU).¹⁷

Other studies in the context of cardiac resuscitation,¹⁸ or intensive medical and surgical units,¹⁹ were not associated with a benefit from intensive insulin therapy in adult patients.
but an increased risk of hypoglycemia was seen. In these studies, however, patients in both groups did not have uncontrolled hyperglycemia. A blood glucose level range of 4.4 to 6.1 mmol/L was compared with a blood glucose level range of < 10 or 11 mmol/L. The consensus statement on blood glucose level targets for older patients specifies that to reduce patient risk of hypoglycemia, no patient should have a fasting blood glucose level on treatment < 6.0 mmol/L, and levels below 5.0 mmol/L should be strictly avoided. In addition, to minimize patient symptoms and complications, a random glucose testing result should not be > 11.0 mmol/L. We feel that these targets should not be modified by a critical care situation.

To achieve target blood glucose level goals during critical illness and where failure or contraindications to therapy with oral glucose-lowering drugs has occurred, managing the patient with insulin is generally preferred. The usual insulin dose requirement varies from 0.45 U/d/kg body weight in the case of failure of oral therapy, to a lower insulin requirement (0.2 U/d/kg body weight) in patients with T2DM and terminal illness. The main difference between various types of patients with T2DM can be explained by distinctions in dietary intake. Higher insulin doses, even appropriately weight-based for the patient, may increase the risk of hypoglycemia. Hospital practitioners often face a transitory and unstable insulin needs phase for their patients and are inclined to use sliding insulin scales to try to manage the patient’s fluctuating glycemic state; however, outcomes in acutely ill patients are often deleterious, including higher blood glucose levels, an increased rate of mortality, cardiovascular complications, sepsis, and more ICU admissions. In another study, predefined insulin protocols, based on patient-weight insulin doses and adapted neutral protamine Hagedorn (NPH) insulin doses were compared with a sliding-scale insulin-balance protocol in patients on an orthopedic ward. The intervention improved blood glucose level control and reduced patient length of stay by 2 days. In a geriatric ward study, the use of a protocol based on insulin analogs also produced a safer reduction in patient blood glucose levels.

**Glucose-Lowering Medications**

During acute and critical illness, it is recommended that both metformin and sulfonylurea therapy are stopped in patients with T2DM; however, it is difficult to state if the therapeutic use of dipeptidyl peptidase 4 (DPP-4) inhibitors is safer due to their low hypoglycemic risk, despite being shown to be well tolerated in older, frail patients. However, no trials have tested the safety of DPP-4 inhibitors during acute disease or in patients with a very low dietary intake. In the acutely ill, elderly patient with T2DM, insulin therapy provides the advantage of being anabolic and should logically be preferred until the acute phase of the illness is ended or in case of patient malnutrition.

**Nutritional Issues**

Elderly patients with T2DM are at high risk of both undernutrition and malnutrition. In the community, the proportion of overweight or obese subjects with diabetes decreases sharply in those aged > 80 years. Among patients in a rehabilitation unit, T2DM was shown to be an independent risk factor for malnutrition. Finestone et al sought the reasons for this particular increased risk. Dysphagia was seen more frequently in patients with T2DM and dysphagia increases risk of malnutrition. The diabetic diet these patients had received may have been restricted in the acute care unit, resulting in more frequent levels of malnutrition upon admission to the rehabilitation unit. Based on patient serum albumin concentration > 30 g/L, occurrence of malnutrition was particularly frequent (53%) in patients with T2DM in a geriatric ward. The high prevalence of malnutrition was not different between obese elderly patients and other older patients. In another geriatric ward study, the mean serum albumin concentration of patients with T2DM was also particularly low (mean 32 g/L; standard deviation [SD] ± 5.0). In these elderly patients with T2DM, the amount of dietary intake was very low—from 13 kcal/kg body weight/day total energy and 0.66 g/kg/day protein at admission, to 17 kcal/kg/day total energy and 0.85 g/kg/day protein at discharge for those with critical illnesses (infection, heart failure). These patients need nutritional support. Liquid diets are known to increase patient postprandial glycemic index (GI) and are likely to complicate management of hyperglycemia in patients taking oral or enteral nutritional support. Enteral formulas to reduce the risk of metabolic disorders in tube-fed patients have been developed. A meta-analysis has shown an overall benefit with use of diabetes-specific formulas on patient blood glucose level control in short-term or long-term use. Most of the formulas were enriched with fiber, fructose, higher lipid content (monounsaturated fatty acid), and lower carbohydrate content. Increased protein content was found in 1 formula tested in critically ill patients with T2DM or with stress-induced hyperglycemia in a randomized clinical trial. Use of the protein-enhanced formula resulted in better patient blood glucose level control. In a study performed in young subjects with type 1 diabetes, a fiber-enriched formula had a lower GI than a standard formula but 1 specific formula,
NutrisoN Diabetes, had the lowest GI. A characteristic of NutrisoN Diabetes is the inclusion of starch and fructose rather than dextrine maltose. As noted in the meta-analysis, the efficiency and benefits in terms of nutrition and other clinical outcomes were not assessed; thus, it is important to assess the nutritional status of hospitalized elderly patients with T2DM in order to provide the best quality of nutritional support needed to aid patient recovery from acute illness.

Prevention of Pressure Ulcers
Elderly patients with T2DM are at high risk of developing pressure ulcers (PU) during hospitalization due to alterations in skin perfusion. Patients can develop PU early in the hospitalization process, with a significant incidence seen in EDs and an increased risk in patients who are elderly. In a large series of patients with hip fracture, in medical wards, or in surgery units, the presence of T2DM was seen as an independent risk factor for PU development. The odds ratios for increased risk of PU occurring associated with T2DM has been estimated to range from 1.35 to 2.52. Other risk factors for PU development in patients are numerous, with mobility/activity limitation as major risk factor. A stage 1 PU (non-blanchable erythema) is a risk factor for the patient to develop a stage 2 PU. Stage 1, and even stage 2 PU are reversible in a short time and must be recognised early on to prevent further worsening. The deterrence of PU in patients relies on risk recognition and prevention strategies using special mattresses, mobilization, hygiene, and nutritional support implemented in the very first hours after patient admission. There is currently no randomized controlled trials devoted to elderly patients with T2DM and it seems sensible to apply the same blood glucose level targets to this population as is recommended in general.

Prevention of Functional Loss in Hospital and Loss of Autonomy at Discharge
Elderly patients with T2DM are at high risk of functional impairment. Hospitalization for an acute disease or surgery may accelerate functional decline. It is estimated that one-third of older community-living people do not recover their usual activities of daily living (ADL) independence by the time of discharge. In a French multicenter survey, hospital-acquired loss of autonomy in older patients was independently predicted by pre-admission walking difficulties, lack of autonomy, risk of falling, and malnutrition risk. The effects of diabetes have not been tested, but the older patient with T2DM has a higher risk of walking limitations and a history of falling and should be considered at risk for hospital-acquired loss of autonomy. Improvement of nutritional status is associated with improvement of muscle quality in hospitalized patients. Physical activity is the second arm for prevention of functional loss during hospitalization. Good clinical practice in a specialized ward for older patients consists of early transfer to sitting up in an armchair, as soon as patient basic clinical parameters are stable. Then, in the next few days, prescription of ≥ 3 physiotherapy sessions per week of hospital stay and continuation at home must be arranged for the patient. For patients in ICUs, the number of physiotherapy sessions has been considered a marker of quality of care. Early physiotherapy during hospitalization for acute disease has been shown to improve ADL recovery in older patients who were bedridden at admission. The intervention tested in the randomized controlled trial by Blanc-Bisson et al., consisted of physiotherapy sessions compared with usual care, started at day 1 or 2, in half-hour sessions twice daily, until patient walking abilities were recovered. Lower limb strength was reinforced in the bed using dynamic work, against the foot of the bed or the hand of the physiotherapist, with the knee flexed at 30°, and moving the pelvis to the left and to the right with 10 repetitions for each movement. When the patient was able to stand, exercises of plantar flexors and extensors were performed in the upright position. No trial has specifically investigated the effects of early physical activity during acute illness in elderly patients with T2DM. These patients, known to be at high risk of functional loss, are likely to benefit from early prevention with physical activity. The European guidelines recommend the implementation of a fall-prevention program to identify risk factors for falls and to minimize risk of falling for this population. Lower limb muscle function is an important factor in mobility. Uncontrolled hyperglycemia is likely to be unfavorable for good clinical practice in a specialized ward for older patients.

Table 1. Summary of Key Actions

<table>
<thead>
<tr>
<th>Each elderly inpatient with T2DM requires:</th>
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<tr>
<td>• A full medical and social needs assessment including, CGA</td>
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<tr>
<td>• Review and cessation of all potentially unsafe or inappropriate medications to reduce ADEs</td>
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<tr>
<td>• Application of clinical guidelines to guide safe but effective target blood glucose levels and use of glucose-lowering therapy</td>
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<tr>
<td>• A full nutritional assessment</td>
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<tr>
<td>• A check of renal function regularly</td>
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<tr>
<td>• Nutrition support and early active mobilization</td>
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<tr>
<td>• Close monitoring to reduce the risk of infections and prompt and effective antibiotic therapy when needed</td>
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<tr>
<td>• Early use of insulin when the clinician cannot control blood glucose levels by other means</td>
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<tr>
<td>• Close monitoring to reduce the risk of hypoglycemia and excessive hyperglycemia</td>
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<tr>
<td>• A well-coordinated discharge plan with suitable follow-up</td>
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Abbreviations: ADEs, adverse drug effects; CGA, comprehensive gerontological assessment; T2DM, type 2 diabetes mellitus.
muscle function and in contrast, tight glycemic control must be avoided in subjects at risk of falling.4,5

Discharge Planning
The discharge period is often a further opportunity to improve the global care of the older inpatient with T2DM and where guideline recommendations, such as a gerontological assessment and provision of carer education, can take place.4,5 Nutrition support and exercise planning also has to be carefully planned and explained to patient care givers. Patients with T2DM have a reported longer length of hospital stay than others in geriatric wards20 or surgical patients.35 After recovery, in patients with T2DM who are clinically stable can, in the absence of contraindications, recommence oral medications. Difficulties in the adjustment of glucose-lowering medication may delay patient discharge. The immediate post-discharge period is usually considered a high-risk period for hypoglycemia or hyperglycemia events because of both the combination of failure to communicate to primary care physicians the changes in patient treatment and the changes in metabolic status of the patient (mainly the development of malnutrition due to acute disease). Thus, the transition to community and outpatient care should be well organized on the basis of comprehensive gerontological assessment. These advisory statements are summarized in Table 1.

Conclusion
Elderly patients with T2DM make up a substantial proportion of all older inpatients and they may have a poorer prognosis and pose several treatment challenges for medical practitioners and staff.37 Specific educational programs developed for hospital practitioners addressing the needs of older inpatients with T2DM should improve the quality of care delivered to this vulnerable population.

Conflict of Interest Statement
Isabelle Bourdel-Marchasson, MD, PhD, is an independent contractor with Danone Research; and has received fees for conference attendance/presentations from Norvartis and Lilly. Alan Sinclair, MSc, MD, FRCP, reveals no conflicts of interest.

References


