Clinical Guidelines for Type 1 Diabetes Mellitus with an Emphasis on Older Adults

A Report prepared by Sinclair AJ¹ and Dunning T² and an International Group of Experts 2019

Working Group Chairs

Professor Alan Sinclair MSc MD FRCP
Visiting Professor in Diabetes Care, Kings College, London, UK

and

Professor Trisha Dunning, PhD AM
Chair in Nursing
Deakin University, Australia
FOREWORD

This Guideline for managing type 1 diabetes mellitus in adults is a timely development and has created the opportunity to incorporate an emphasis on older people with this condition. It represents a decision taken by an international group of scientists and clinicians to address management concerns reflecting the increasing numbers of adults with type 1 diabetes and the continuing shortfalls in quality diabetes care that is apparent even in well-resourced clinical care pathways.

This diabetes Guideline has a key objective to educate and upskill health professionals in managing adult people with type 1 diabetes and their families by providing clear practical advice on assessment and management; it will also have value for clinical researchers and scientists, local and national commissioners of health care strategies, and create a platform for enhancing the effectiveness of clinical interventions in reducing the public and personal health burden associated with this condition.

The Guideline has recognised that many older adults (aged 70 years and over) have type 1 diabetes and some may also present de novo with type 1 diabetes in later life. With advancing age comes the increased risk of pre-disability conditions such as frailty and dementia, and the need to consider care provided predominantly by close family and informal carers. These latter scenarios increase the complexity of type 1 diabetes management and where appropriate specific age-related recommendations have been provided. In contrast, we have not included management guidelines relating to type 1 diabetes in pregnancy as we felt this subject was outside our remit for this guideline.

Our international working group consisted of clinical experts who were each given the task of identifying new and pertinent information on type 1 diabetes in adults and have attempted where possible to provide an evidence-based approach in making recommendations. They have been assisted by being given a set of descriptive categories of a broad range of people with diabetes. The major theme in managing type 1 diabetes remains a package of ‘individualised care’ and we have also tried to ensure that wherever possible we have adhered to key principles of diabetes care previously laid down by other diabetes organisations such
that our recommendations assist in enhancing health outcomes, raise the awareness of type 1 diabetes in adult and ageing populations, and uphold the importance of health equality and equity which dampens the emergence of discrimination.

**Professor Alan Sinclair, Kings College, London, UK**

**Professor Trisha Dunning, Deakin University, Australia**
Working Group

Professor Alan Sinclair, London, UK (Working Group Co-Chair)
Professor Trisha Dunning, Geelong, Australia (Working Group Co-Chair)

Professor Wayne H-H Sheu, Taichung, Taiwan
Dr Shih-Yi Lin, Taichung, Taiwan
Dr Ahmed Hafiz, Rotherham, UK
Professor Graydon Meneilly, Vancouver, Canada
Professor Medha Munshi, Harvard, USA
Professor Giuseppe Paolisso, Naples, Italy
Dr Raffaele Marfella, Naples, Italy
Professor Leocadio Rodriguez Manas, Madrid, Spain
Professor Isaac Sinay, Buenos Aires, Argentina
Dr Sylvia Rosas, Boston, USA
Dr Srikanth Bellary, Birmingham, UK
Dr Noela M Prasad, Melbourne, Australia
Dr Richard Le Mesurier, Melbourne, Australia
Professor Solomon Tesfaye, Sheffield, UK
Michelle Robins, Melbourne, Australia
Dr Ketan Dhatariya, Norwich, UK
Professor Michael Sampson, Norwich, UK

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Sital Harris (Birmingham, UK) – Nutritional Therapy
Professor Peter Scanlon (Cheltenham, UK) – Diabetic Eye Disease
Duality of interest statement

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Correspondence and related literature

Correspondence to: Professor Alan Sinclair, United Kingdom:
ajs Sinclair@diabetesfrail.org
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INTRODUCTION TO THE GUIDELINE AND THE RATIONALE FOR HIGH QUALITY DIABETES CARE IN ADULTS WITH TYPE 1 DIABETES

The majority of cases of type 1 diabetes represent an autoimmune condition disease with a strong inherited background, which although seen predominantly for the first time in children and young people, is present at consistent rates in all decades of adult life. There are few studies estimating the global burden of type 1 diabetes in adults but as of 2017, an estimated 425 million people have diabetes worldwide, of which type 1 diabetes accounts for between 5% and 10%. However, there is some indication that in high-income countries, between 10% and 15% of all diabetes is attributable to type 1 diabetes, while the estimate is likely to be lower in low- and middle-income countries. The incidence of type 1 diabetes appears to be increasing at a rate of 2–5% per year worldwide and about 25% of such cases are diagnosed in adulthood, and some even as late as the ninth decade of life. Those affected have very particular needs and irrespective of age many adults with type 1 diabetes who not receive insulin and skilled instruction after diagnosis, will die prematurely.

Many of the challenges associated with type 1 diabetes as a whole have been addressed in part by improvements in diabetes monitoring, systematic diabetes care processes and development of new treatments during the 1980s and 1990s and the publication of evidence on specific goals on treatment. This includes the introduction of self-monitoring of blood glucose, greater specialisation of the direct diabetes healthcare team, use of standardised measurement of glycosylated haemoglobin (HbA1c) to assess longer term diabetes control, and the improvements seen in adjunct lipid-lowering and blood pressure regulation. As a consequence, mortality rates in type 1 diabetes are beginning to fall in North America and some other countries and life expectancy has increased up to as much as 14 years which is creating an expanding population of adults with type 1 diabetes.

However, in public health terms, type 1 diabetes continues to remain a fundamental challenge to both clinicians and their employers (healthcare providers) who recognise the continuing burdens of high vascular complication rates, increased hospitalisation for diabetic ketoacidosis, suboptimal care strategies that leave a majority of adults with type 1
diabetes in poor glucose and other risk factors control, chronic diabetes complications with consequent increasing healthcare expenditure. The personal health burden of type 1 diabetes in adults has similar disappointing effects with lives complicated by intrusive care practices such as frequent monitoring of blood glucose, dietary restriction, worrying episodes of hypoglycaemia, and treatment regimens that appear complex and difficult to manage within the context of an ordinary day in their lives. The working group accepts that this problem is compounded by variations of diabetes care across different countries where there may be political, socioeconomic, and cultural factors that influence the quality and standards of care delivered.

**Considering the special needs of older adults with type 1 diabetes mellitus**

The working group has recognised that an important limiting factor for producing specific evidence-based clinical guidelines for adults with type 1 diabetes is the need to extrapolate evidence from earlier clinical studies carried out more than two decades ago as data from more recent large randomised controlled trials in older type 1 populations are not available. The working group has considered this implication and has attempted to seek evidence from a wide range of studies that provide enough some confidence for the basis of each recommendation. This limitation has influenced our decision not to grade our recommendations at a particular level of evidence but we have provided the rationale and key references for our recommendations in each chapter to offset this.

In a growing population of adults with type 1 diabetes, many of which are now in their 6th or 7th decades of life, we also feel that it is increasingly important that modern recommendations for managing their diabetes are more closely-aligned with additional individual characteristics such as functional status, presence of frailty and dependency, comorbidity profiles, and life expectancy. These are likely to influence treatment goals, the care model adopted, and how the clinician plans on on-going care. These additional descriptive characteristics are an imperative requirement for managing older adults with type 1 diabetes. In this Guideline, the working group has placed a strong emphasis on this approach. The working group has recognised that a number of clinical areas in diabetes
receive little or no attention in many published clinical guidelines. In response to this, the working group assessed the level of evidence available across a broad range of clinical areas but did not consider sufficient evidence in type 1 diabetes was available in the areas of home care and diabetes or end of life diabetes care at present to justify evidenced based recommendations in these two areas. However, where appropriate, recommendations have been provided relating to aged care home residents and those at end of life under category 3 in several chapters as well as emphasising the primary caring roles of close family members and other informal carers.

The working group also accepts a key limitation on developing this guideline: that is, the lack of data from published studies in type 1 diabetes where subjects included were over 70 years of age where the risk of complex comorbidity, frailty and dependency is so often seen. This introduces an obvious weakness in this guideline relating to treatment decisions based on recommendations that include older people. However, the United Nations (UN) recognise that people aged 60+ years are more representative of ageing populations in under-developed countries and as a consequence, we leave it to individual clinicians to decide how and why particular age thresholds for management should be applied in their local practices.

Key Actions to be prompted by this Guideline

The working group recognises that shortfalls in care of adults with type 1 diabetes are still reported in higher socio-economic countries where diabetes services are well-developed. These deficits in care are exaggerated in those countries where there are fundamental gaps in service provision and funding for organised healthcare: this is often manifested by poor access to services, lack of educational resources, poor follow-up practices, and a lack of strategic direction of local and national public health services. In line with the World Health Organization (WHO), the working group has emphasised the importance of directing healthcare resources towards improving the quality of preventative care in primary care settings and to public health interventions that control diabetes rates of all types. The authors of this Guideline appreciate that many of the newer advances in diabetes
management (newer insulin analogues, other therapies, specialist renal and vascular protocols, and new diagnostic tools) may not be familiar to many health professionals around the world, and emphasises the importance of ensuring that they acquire basic knowledge and skills in these areas where feasible.

We hope that this Guideline will assist diabetes services worldwide to move towards a consistent high quality provision of care in type 1 diabetes and accept that older adults with this condition may require additional attention. The recommendations are designed to support clinicians to provide an individualised multidimensional integrated approach to the comprehensive management of type 1 diabetes in adults. If the audit and assessment measures are applied in clinical practice, then it is also anticipated that these recommendations will support quality improvement activities and complement other national and international clinical guidelines.
2 KEY PRINCIPLES UNDERPINNING THE GUIDELINE

All clinical guidelines require a set of guiding principles that influence the decisions taken, recommendations provided, and which describe the philosophy expressed by the working group. In this guideline, we emphasise the importance of the individualised approach to care for adults with type 1 diabetes who are placed at the centre of care. We also have tried to encompass the needs of older adults by a focus on levels of physical and mental function and need for carer support. We have kept in mind cost considerations and cost effective analysis but we recognise the scarcity of data in this area which has limited our conclusions in this respect.

The guiding principles include:

- An all-inclusive, individualized care plan written for each adult with type 1 diabetes
- Reducing distress of older adults with diabetes and maintaining safety by avoiding unnecessary hospital/emergency department attendances due to diabetic ketoacidosis or hypoglycaemia
- Increased availability of educational support for all adults with type 1 diabetes and their families/carers
- Implementation of local health strategies that minimise vascular complication rates and unnecessary surgery for diabetic foot disease
- Assisting clinicians where possible to undertake therapeutic decisions that are based on a comprehensive assessment model and risk stratification approach including functional assessment in those with restriction of activities of daily living (e.g. bathing, dressing) (ADL) and walking limitation, assessment of skills in insulin administration and self-blood glucose monitoring, and assessing the risk of hypoglycaemia.
- The principle of quality use of medicines including pharmacovigilance that can be further developed by health professionals and their employers as a part of local health strategies
• The recognition that many older adults with type 1 diabetes may experience a deterioration in their functional status requiring carer support and even care home residency
• The importance of ensuring that all those with palliative care needs eventually experience a dignified death
• The quality of the care provided should be audited on a regular basis and the outcomes of the audits used to revise care
3 STRUCTURE OF CHAPTERS WITH DESCRIPTION OF CATEGORIES FOR RECOMMENDATIONS

Apart from Chapter 4 (Clinical Diagnosis) where ‘General’ recommendations only have been produced, the following chapter structure has been adopted:

RECOMMENDATIONS

General recommendations

These reflect the main principles of each chapter in this Guideline. They apply in general to all adults with type 1 diabetes where appropriate and feasible. Exceptions will be obvious for those in categories 2 and 3.

Specific recommendations are then made for each of three functional categories detailed below.

<table>
<thead>
<tr>
<th>Specific Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category 1</strong></td>
<td>independent in ADL and cognitively intact; responsible for diabetes self-management</td>
</tr>
<tr>
<td><strong>Category 2</strong></td>
<td>degree of ADL loss or limitation of walking associated with multi-morbidity or diabetes complications; may have some features of early to moderate frailty</td>
</tr>
<tr>
<td><strong>Category 3</strong></td>
<td>disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency</td>
</tr>
</tbody>
</table>

*This will include those with cognitive impairment or dementia*

The categories above which have been used to provide the basis for the recommendations are meant to reflect the following:
**Category 1** – a large number of adults with type 1 diabetes diagnosed early (<30 years of age) and those whose diabetes has been present across several decades of life remain independent and continue to be free of any major vascular complication and are responsible for their diabetes care; **classed as fully independent.**

**Category 2** – younger adults with a long history of type 1 diabetes (>25 years) may start to acquire some functional deficits, and evidence of vascular complications which can limit physical performance. Older adults at the time of diagnosis of type 1 diabetes may already have pre-existing medical comorbidities or functional limitations, or may begin to experience physical and cognitive changes within 3 years of diagnosis; this may be associated with an increased risk of frailty; **classed as partially independent.**

**Category 3** – a serious vascular event such as myocardial infarction or stroke in a younger or older adult can lead to early disability with accompanying dependency; disability arising from severe retinopathy or amputation for peripheral vascular disease can jeopardise diabetes self-management capability and enhance the need for carer support. Higher levels of disability which cannot be supported sufficiently in the community often lead to care home residency. Increasing age (>75 years) accompanied by a longer diabetes duration and evidence of cerebrovascular disease can lead to a dementia syndrome developing. A large number of adults in this category will have a limited life expectancy; **classed as dependent.**

**Evidence Base and Reasoning**
Consider why the topic is important and provides a brief review of the evidence base for adults with type 1 diabetes including any relevant information that considers older adults.

**Usual Clinical Practice**
Consider how the recommendations can be implemented in routine practice; how clinicians and the multidisciplinary diabetes team can update their knowledge and necessary skills and competencies that are also relevant to older adults with diabetes; how to improve access to services for adult people with type 1 diabetes and how to family and support carers where relevant.
Assessment and Clinical Audit Measures

Suggests how to evaluate the care of adults with type 1 diabetes, provides examples of data which could be collected in routine clinical practice, and gives examples of measures which can be used to audit the recommendations.

Potential Measure(s)

These will follow a generic pattern throughout each chapter with recommendations. The measure describes a ‘percentage’ of adults with type 1 diabetes who have received a particular form of assessment or care, whilst the denominator describes the total number of adults with type 1 diabetes who are available or eligible for that process of assessment or care. The third column of the diagram demonstrates how the measure is calculated, and the fourth column defines the data or information that is required:

<table>
<thead>
<tr>
<th>Measure</th>
<th>Denominator</th>
<th>Calculation of Measure</th>
<th>Data to be collected for calculation of measure</th>
</tr>
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4 CLINICAL DIAGNOSIS

Recommendations:

GENERAL

- Establish the diagnosis of diabetes based on recognised hyperglycaemic and glycosylated haemoglobin criteria with or without association with symptoms
- Although adults older than 45 years of age presenting with hyperglycaemia above diagnostic thresholds are likely to have type 2 diabetes, a proportion may have an evolving type 1 diabetic state: be particularly alert if they are thin (a BMI < 25 Kg/m²), have an atypical presentation, or have a family history of autoimmune disease
- ‘Classic’ presentations of type 1 diabetes in adults occur to varying degrees and may have features of an acute illness and additionally present with one or more of the following:
  - a ketotic state (ketonaemia > 3.0mmol/L ( > 17.4 mg/dl) or significant ketonuria (more than 2+ on standard urine ketone sticks)
  - a sudden loss in weight
  - a BMI of 24 Kg/m² or below
- The diagnosis of autoimmune type 1 diabetes may be assisted by the measurement of C-peptide and/or diabetes-selective autoantibody levels where these facilities are potentially available, for example, in University-linked hospitals or large clinical research centres
- The measurement of C-peptide in suspected cases of type 1 diabetes can be undertaken to assist diagnosis and can be employed in non-fasting and fasting states using the following approximate thresholds and description of clinical indications:

  **Absolute insulin deficiency/absolute insulin requirement**

  \(<0.2 \text{ nmol/l (}< 0.60 \text{ ng/ml})\) - non-fasting
<0.08 nmol/l ( < 0.24 ng/ml) - fasting  
Likely type 1 diabetes/inability to achieve glucose control with non-insulin therapies:  
<0.6 nmol/l ( < 1.80 ng/ml) - non-fasting  
<0.25 nmol/l ( < 0.75 ng/ml) - fasting  
- The measurement of diabetes-selective autoantibody levels (such as glutamic acid decarboxylase autoantibodies (GAD65), islet cell cytoplasmic autoantibodies (ICA), or insulin antibodies can be undertaken in suspected cases of autoimmune type 1 diabetes to assist diagnosis; the use of two different autoantibody tests may increase the sensitivity of the investigation and reduce the risk of missing the diagnosis.

**Evidence Base and Reasoning**

An early diagnosis is essential to reduce acute complications of a hyperglycaemic metabolic crisis and ensure appropriate insulin-based regimes are instituted. A clear diagnosis enables an individualised treatment plan to be established and a diabetes educational programme to be initiated.

There is now further recognition that type 1 diabetes occurs in consistent numbers in all adult decades, and healthcare providers have started to manage a higher number of older adults with type 1 disease who represent a small but unique population.

The diagnosis of type 1 diabetes in adults is not always straightforward and in some cases the actual type of diabetes present may not be clear until much later after the clinical diagnosis (1). The presentation of type 1 diabetes also varies in adults and this may be more pronounced in older people with the classic symptoms being invariably absent. C-peptide measures can have a degree of clinical utility by indicating the extent of beta cell destruction resulting in a variable or absolute deficiency of insulin secretion (2).

As an autoimmune destruction of pancreatic beta cells is a pathophysiological hallmark for type 1 diabetes, it has created the opportunity to more reliably diagnose type 1 diabetes by measuring sets of autoantibodies (biomarkers) to glutamic acid decarboxylase (GAD), islet
cells or insulin. This view is in line with guidance on the use of autoantibodies in diagnosis from the American Diabetes Association (1), American Association of Clinical Endocrinologists and American College of Endocrinology (3), and the NICE (National Institute for Health and Care Excellence) NG17 guideline (4).

The levels of autoantibodies varies during the pre-diabetes (but may be used to predict the onset of autoimmune type 1 diabetes) and clinical manifestation stages. For example, GAD65 antibodies are present in about 70–80% of Caucasian subjects newly diagnosed with type 1 diabetes (5). However, levels may be affected by sex, increasing age and obesity and no consistent recommendations for using diabetes-selective autoantibodies in older adults are yet available.

A small number of adults, often from Asian or African backgrounds, presenting with causeless ketoacidosis and had none of the associated HLA haplotypes or markers of β-cell autoimmunity commonly seen in individuals with immune-mediated type 1 diabetes may have idiopathic type 1 diabetes where the absolute need for insulin therapy may change over time (6,7).

**Usual Clinical Practice**

Increased clinical vigilance for the appearance of type 1 diabetes in adults of all ages in primary and community care settings is an important element of improved practice by the diabetes and primary care healthcare teams.

Clinicians should be trained in screening and early diagnosis of type 1 diabetes in adults with diabetes, and should be alert to the appearance of the condition in older adults. In addition, clinicians should have a low threshold for arranging C-peptide or diabetes-selective autoantibodies tests when they have doubts or uncertainties about the diagnosis of type 1 diabetes, remembering that autoantibody testing is more effective at the time of diagnosis. Particular situations that might prompt this additional testing include atypical presentations of type 1 diabetes in adults where the acute onset may be absent, the age at diagnosis is
greater than 45 years, or when the confirmation of diagnosis may help to guide future treatment modalities such as insulin pump therapy.

Effective communication between laboratory based services in secondary care and diabetes specialist teams and primary healthcare teams should be established to assist with diagnostic assays of autoimmune diabetes biomarkers. In cases of diagnostic uncertainty, access to appropriate specialist care should be available when needed.

**Assessment and Clinical Audit Measures**

The existence of protocols for type 1 diabetes diagnostic testing in primary and secondary care centres could be assessed and their evaluation undertaken by using audit procedures. Availability of access to C-peptide and autoantibody measurement in a local region should be identified.

**Potential Measure**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Denominator</th>
<th>Calculation of Measure</th>
<th>Data to be collected for calculation of Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of new cases of type 1 diabetes in adults that on request received access to confirmatory C-peptide autoantibody testing at diagnosis</td>
<td>Total number of new cases of type 1 diabetes that requested confirmatory C-peptide and autoantibody testing</td>
<td>Number of new cases of type 1 diabetes who received C-peptide/autoantibody testing as a percentage of the total number of new cases requiring these tests</td>
<td>Incidence data on new cases of type 1 diabetes, examination of requests for testing and number of cases tested</td>
</tr>
</tbody>
</table>
References


3 - American Association of Clinical Endocrinologists and American College of Endocrinology Clinical Practice Guidelines for Developing a Diabetes Mellitus Comprehensive Care Plan. ENDOCRINE PRACTICE Vol 21 No. 4 April 2015.

4 – Type 1 diabetes in adults: diagnosis and management. The National Institute for Health and Care Excellence. Available at: https://www.nice.org.uk/guidance/ng17


5  ESTABLISHING MANAGEMENT PLANS IN ADULTS WITH TYPE 1 DIABETES INCLUDING GLUCOSE REGULATION

In this longer chapter we include recommendations and rationale/evidence base in the following three areas of management:

- education and cardiovascular risk reduction and complication screening
- glucose regulation
- cardiovascular disease management.

We then complete the chapter with a series of potential service evaluation and audit measures.

Recommendations:

Education and cardiovascular risk reduction and complications screening

General

- All adults with type 1 diabetes should have a written management plan that reflects the outcome of a comprehensive and integrated assessment of need: this should include goal setting and focus on safety, risk management, and complication prevention.
- Structured diabetes education should be offered to all adults with type 1 diabetes in order for them to acquire the appropriate level of skills and knowledge, including goal setting, risk management, and complication prevention to self-manage their condition.
- Monitoring of blood glucose should only be used within a care package, accompanied by structured education on how the results can be used to reinforce lifestyle change, adjust therapy, or alert healthcare professionals to changes in health status.
• Individual risk factors which may influence management should be identified including current or previous CVD, atrial fibrillation, blood pressure, lipids, glycaemia, albuminuria, and smoking.

• Eye examinations/screening should be performed annually or as recommended by the eye care specialist.

• Concerns about social support and financial resources should be elicited, with referral to a social worker or other resources as needed.

• Older adults with long-standing type 1 diabetes should be regularly screened for new complications and the early features of frailty

Specific

Category 1 – Independent in ADL and cognitively intact; responsible for diabetes self-management

• There should be a regular review of self-care behaviours and abilities that may influence goal attainment by the management plan

• Modifiable individual cardiovascular risk factors should be treated in all adults with type 1 diabetes irrespective of age

• Functionally independent people with diabetes are encouraged to maintain activities of daily living and mobility and achieve and maintain a healthy body weight.

• The individualized blood glucose monitoring plan and the nutrition plan should be individualized with consideration of the adult’s food preferences, eating habits, and physical and cognitive health status.

• Aim to maintain a consistent high level of physical function, quality of life, and achieve a normal life expectancy for adults with type 1 diabetes where possible: this should involve twice-weekly resistance training and regular walking, swimming or personal preferred activity.

Category 2 – Degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty
The general principles are as for category 1, but additional precautions are required:

- Health professional support for self-management education should take physical and mental functional impairments into account and modified in adults with multimorbidities, vascular complications, and frailty.
- Blood glucose monitoring should be at a minimum level to avoid hypo- and hyperglycaemia.
- Encourage a low intensity home-based exercise program to improve physical performance and maintain activities of daily living and mobility.
- Encourage light to moderate -resistance training and balance training to improve physical performance, reduce falls, and prevent further deterioration in functional status.

**Category 3** – Disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia*

Similar recommendations to adults in category 2 where feasible but additional areas require consideration:

- The focus of educational support should be reassurance and preventing acute metabolic and vascular complications of diabetes.
- The blood glucose monitoring plan should be minimized where possible, undertaken by a family member or informal care, and take into account the estimated risk of frequent hyperglycaemia (capillary blood glucose levels >12 mmol/l; > 216 mg/dl) and hypoglycaemic episodes.
- Self-management education is often of limited relevance in those with cognitive impairment or dementia, and education and support should be directed to family, as well as informal and formal carers.
• Hyperglycaemia and hypoglycaemia are special risks in adults with dementia and can lead to a deterioration in mental performance leading to a confusional state or delirium.

Recommendations:

Glycaemic control

General

• Support adults with type 1 diabetes to achieve an individual target level of glycaemia taking into account their usual daily activities, occupation, current profile of vascular complications, physical and mental health status, and estimated risk of hypoglycaemia

• Few studies have compared glucose management approaches in older adults, and most recommendations are based on expert opinion.

• Clinicians should aim to achieve the primary goals of glycaemic regulation in type 1 diabetes which are: prevention of long-term vascular complications; relief of hyperglycaemic symptoms, prevention of diabetic ketoacidosis, avoidance of hypoglycaemia and attainment of a maximal quality of life

• Adults on intensive insulin therapy (shown to reduce rates of renal disease, cardiovascular disease, and all-cause mortality) are at increased risk of severe hypoglycaemia and they should be encouraged to test (by self-monitoring of blood glucose, SMBG) frequently (between 4-6 times/day) to ensure satisfactory control and reduced risk of hypoglycaemia

• The use of continuous glucose monitoring (CGM) may have a role in those adults with type 1 diabetes and hypoglycaemic unawareness and also assist in an effective but safe lowering of HbA1c; the concomitant use of a low glucose warning feature device may be helpful in reducing episodes of nocturnal hypoglycaemia

• Measurement of HbA1c levels should be undertaken at a minimum of 2-4 times per year according to factors such as stability of glucose control, recent history of
hypoglycaemia, a change in insulin regimen/dose, recent medical illness, and availability of laboratory services

- Where available, encourage adults with type 1 diabetes to participate in a structured diabetes education programme which should support them to manage excursions in glucose control, an increase in hypoglycaemic episodes, legal requirements associated with occupation, and their participation in physical exercise including sporting pastimes

- All adults with type 1 diabetes should perform regular exercise to maintain physical fitness including lower limb strength and balance, and to assist lowering of HbA1c levels towards target

**Specific**

**Category 1** – independent in ADL and cognitively intact; responsible for diabetes self-management

- In general, adults with type 1 diabetes should aim for a target range of 48-53 mmol/mol (6.5 - 7%) unless this is associated with an unacceptable risk of hypoglycaemia

- In adults with type 1 diabetes and aged 70 years and over, the target range should be 53 – 58 mmol/mol (7-7.5%) to allow for the increased risk of hypoglycaemia and likely presence of other medical comorbidities

- Regular pre- and post-prandial capillary glucose level testing by the adult with type 1 diabetes should be asked for according to an agreed individualized plan:
  
  **pre-prandial** – 5-7 mmol/l (90 -126 mg/dl)

  **post-prandial** - <10 mmol/l (< 180 mg/dl)

- In older adults (>70 years) with type 1 diabetes, pre-prandial levels should not be below 6 mmol/l (108 ng/ml) to reduce the risk of hypoglycaemia
**Category 2** – Degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty

The general principles are as for category 1, but additional precautions are required:

- Avoid complex regimens to reduce the risk of medication errors and hypoglycaemia.
- A less stringent HbA1c target range of < 58 mmol/mol (<7.5%) can be aimed for.
- Older frail adults with type 1 diabetes have a high risk of acute illness and hospitalization, and may require frequent insulin dose adjustments with changes in their overall health status: in these cases, the HbA1c target range can be increased to < 64 mmol/mol (<8.0%)
- Discuss care goals, medicine dose, and regimens with the individual and principal carer.

**Category 3** – Disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia

Many of the general principles in this section will not be warranted but key areas for consideration are:

- The management target during treatment is to avoid symptomatic hyperglycaemia and hypoglycaemia: this should be achieved without the need for excessive glucose monitoring.
- Adults with type 1 diabetes residing in long-term care facilities need careful assessment to establish a glycaemic goal with appropriate choice of insulin therapy and regimen.
- An HbA1c target range up to 69 mmol/mol (8.5%) may be appropriate in those with severe disability or moderate to advanced dementia.
Carers and/or family should be educated to recognize the subtle Measures of hypoglycaemia and hyperglycaemia

**Recommendations:**

**Cardiovascular disease management**

This section is meant to compliment recommendations in Chapter 12.

**General**

- Routine measurement of blood pressure should be carried out at each healthcare encounter with the adult with diabetes and steps taken to re-measure blood pressure if initially raised
- Every clinical effort should be carried out to optimize blood glucose levels, lipid and blood pressure levels within the individualized care plan
- Ensure that the lifestyle plan adopted provides advice on smoking, nutritional goals that assist in management and sodium/potassium balance, active intervention for abdominal obesity, and achievable exercise regimens
- All adults with type 1 diabetes should receive written information about the choice of medications available for lowering blood pressure and raised lipids; this should be reinforced by the clinician who must point out the advantages of each medicine available, the possible side-effects, and the results of any recent major clinical trials in the area
- All older adults with type 1 diabetes should be actively managed to reduce cardiovascular risk
- Concerns about social support and financial resources should be elicited, with referral to a social worker or other resources as needed.
- Periodontal disease is more common in diabetes, and referral for dental care should be considered.
- The immunization history should be reviewed, and the adult with type 1 diabetes should receive an annual influenza vaccination.
Specific

Category 1 – independent in ADL and cognitively intact; responsible for diabetes self-management

- The goal for treatment of hypertension in healthy adults who have type 1 diabetes is <140/90mmHg.
- Given the increased risks of cardiovascular disease and progressive kidney disease in type 1 diabetes, lower blood pressure targets (such as <130/80 mm Hg) may be appropriate if the specific target can be achieved with an acceptable treatment burden.
- Older adults with type 1 diabetes acquire no additional cardiovascular benefit from intensive treatment of blood pressure below a systolic level of 130 mmHg or a diastolic level below 75 mmHg; excessive lowering of blood pressure below these thresholds may increase mortality.
- Lipid management, particularly in the presence of other cardiovascular risk factors, should be similar in adults with either type 1 diabetes or type 2 diabetes.
- All older people with diabetes are at high CVD risk and should be considered for treatment with statins (see chapter 12 for specific recommendations).

Category 2 – degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty

The principles are as for category 1, but additional precautions are required:

- Carers should be provided with sufficient knowledge for safe administration of blood pressure-lowering therapy.
- Carers should be provided with sufficient knowledge for safe administration of lipid-lowering therapy and to monitor side effects.
In frail older adults without end-stage chronic illness, the blood pressure goal can be modified by consideration of the functional status and comorbidity profile; a target blood pressure of up to 150/90 mmHg may be appropriate in these circumstances.

- Lipid targets and frequency of lipid measurement can be relaxed.

**Category 3** – disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia

- The same overall precautions are as indicated for people in category 2.
- Unless blood pressure readings are immediately life-threatening, strict control of blood pressure may not be necessary, and in some circumstances (e.g. those receiving palliative care or who are severely disabled living in a care home), withdrawal of blood pressure-lowering therapy may be appropriate.
- Among individuals with advanced dementia, strict control of blood pressure may not have any added advantage and antihypertensive pharmacotherapy should be approached with caution in people with advanced dementia with poor carer support.
- Anti-hyperlipidemic pharmacotherapy should be approached with caution in people with advanced dementia with poor carer support, and lipid targets and frequency of lipid measurement can be relaxed.
- Generally, statin treatment should not be discontinued based on increasing age and increasing dependency only.

**Evidence Base and Reasoning**

**Education and cardiovascular risk reduction and complications screening**

High quality care for all adults with type 1 diabetes is an important goal for national diabetes care services although the challenges are rising as the incidence of type 1 diabetes is increasing at a rate of 2–5% per year worldwide (1-4) with 25% of such cases being
diagnosed in adulthood at a consistent rate across all decades well into the ninth decade of life. There is optimism that some of these challenges are being overcome with decreasing mortality rates and an increase in life expectancy (6). As a consequence, the population of adults with type 1 diabetes is growing and now comprises an expanding cohort of older adults with the condition. Establishing management plans must therefore reflect the individual characteristics of the population with type 1 diabetes.

Diabetes self-management education and training is essential and should involve the older adult with diabetes, carers, family and friends. Education and training include instructions concerning monitoring, medical nutrition therapy, proper administration of medications, sick day rules, and physical activity guidelines. Addressing barriers such as vision and hearing impairments, pain control, carer stress, difficulty swallowing, cognitive decline, depression, and problems obtaining or administering medications are important (7,8) Blood glucose monitoring frequency should be individualized, and for those using a basal-bolus insulin regimen, blood glucose monitoring should be performed before meals, at bedtime, and as needed.

**Medical Nutrition Therapy**

Medical nutrition therapy is an essential component of diabetes care for all adults with type 1 diabetes. Older adults are at risk for malnutrition, including micronutrient deficiencies caused by anorexia, altered taste and smell, swallowing difficulties, and oral/dental issues. Functional impairments leading to difficulties in preparing or consuming food result in dependence on others for meals and shopping and other medical comorbidities (9,10). In adults aged 40 years and over, weight loss may contribute to nutritional deficits and worsen sarcopenia. In the presence of poor and unpredictable food intake, the use of carbohydrate-consistent meals may be helpful, and consideration should be given to administering rapid-acting insulin immediately after meals, so lower doses can be given if less food is consumed (11). The diet should be individualized to conform to a person’s lifestyle, food preferences, nutritional needs, and socioeconomic factors. Changes may need to be introduced gradually to enhance adherence (10,12,13).
**Physical Activity**

All adults with type 1 diabetes who are otherwise healthy and have no major mobility limitations should be encouraged to engage in aerobic activity. If the individual has been sedentary, this activity may need to be gradually introduced. Those with known heart disease or multiple cardiovascular risk factors, osteoarthritis, chronic lung disease, osteoporosis, or other serious comorbidities should have exercise recommendations revised appropriately, and fall prevention is critical. Exercise programs prescribed by specialized physical trainers should take into account physical and psychological capabilities which may be of particular value in the older adult with type 1 diabetes (14). It is important to convey that concept that hypoglycaemia may occur not only during activity but also for a prolonged period after the activity. Glucose monitoring should be used.

**Body weight**

Obesity is a known independent risk factor for cardiovascular disease in nondiabetic populations, but the impact of obesity in type 1 diabetes has not been fully established. Central obesity in type 1 diabetes can be accompanied by greater visceral adiposity, higher blood pressure, adverse lipid profiles, and insulin resistance (15), although the exact effect of increased adiposity on cardiovascular risk in type 1 diabetes is not clear. In the Pittsburgh EDC study, the body mass index (BMI) for people with type 1 diabetes associated with the lowest mortality was between 25 and 30 kg/m², which was higher than that for the general population (16).

**Smoking Cessation**

Smoking is a major risk factor for cardiovascular disease in those with diabetes, who are already at high cardiovascular risk (15). In individuals with type 1 diabetes, cigarette smoking increased the risk of diabetic nephropathy, retinopathy, and neuropathy, possibly through the adverse effects of inflammation on endothelial function (15). Smoking cessation should be strongly recommended to all those with type 1 diabetes.
Eye Care

Eye examinations should be performed annually or as recommended by the eye care specialist (ophthalmologist) (7). Screening for diabetic retinopathy and macular oedema as well as for glaucoma should be performed. Cataracts are also more common in diabetes. If there is impaired vision, appropriate evaluation, treatment, and correction for refractive errors or recommendations for vision aids can improve quality of life and help prevent errors in medication administration.

Foot Care

Examination of the feet should occur at each medical visit (7). Referral to a podiatrist should be considered in the presence of foot deformities, neuropathy, peripheral vascular disease, or a history of foot ulcers or other foot disease. Carers should be involved in the regular inspection of feet and the proper cleaning of feet when necessary.

Renal Function

Regular review of measures of renal function are mandatory in adults with type 1 diabetes who are high risk of renal impairment and nephropathy. Monitoring renal function in the older adult is particularly important, because a decline in renal function is common and necessitates dose adjustments of medications or even their withdrawal. In healthy older adults, annual screening for albuminuria should be considered (7).

Usual Clinical Practice:

Diabetes education should include blood glucose monitoring, appropriate modifications in bolus or basal insulin administration, food intake, exercise, and lifestyle habits, as well as minimizing hypoglycaemia. In addition, older people with diabetes should be evaluated to
monitor lipid profiles, HbA1c, albuminuria, and issues related to cardiovascular risks. These procedures and lifestyle programmes can be incorporated within existing local diabetes services and be an integral part of an annual review system.

**Evidence Base and Reasoning**

**Glycaemic control**

According to the Diabetes Control and Complications Trial (DCCT), conducted between 1983 and 1993, and its observational Epidemiology of Diabetes Interventions and Complications (EDIC) follow-up study, it was demonstrated that intensive therapy reduces microvascular complication rate including renal and cardiovascular disease (17-19). Further, after a mean of 27 years’ follow-up, intensive diabetes therapy was associated with a modest lower all-cause mortality compared with conventional therapy (20).

In a study of 64,609 German adults with type 1 diabetes, it was shown that those aged > 60 years had greater prevalence rates of microalbuminuria, diabetic retinopathy, myocardial infarction or stroke compared with those in the ≤ 60 years age group (21). This emphasizes the importance of earlier preventative measures to reduce vascular complications in older adults all of which are associated with reduced health status and quality of life. Unfortunately, there is a paucity of studies examining the benefits of glucose regulation in older subjects with type 1 diabetes and management is often based on evidence extrapolated from studies in type 2 diabetes mellitus. These data are available in earlier guidance (22).

Participation in a structured diabetes education course may be associated with a reduction in HbA1c levels and reduction in hypoglycaemia rate (23), with improvement in quality of life being maintained up to 4 years afterwards (24). Studies in older subjects with type 1 diabetes are limited.

Although not in routine clinical practice, the use of continuous glucose monitoring (CGM) has been associated with intermittent benefits but there is no consistent benefit seen over self-monitoring of blood glucose (SBGM) (25). However, the use of a low glucose ‘suspend’
feature device in insulin pumps combined with CGM may reduce nocturnal hypoglycaemia rates (26).

**Usual Clinical Practice:**

More awareness of the special needs of adults with type 1 diabetes is needed in both primary care/community care and hospital settings is required. Staff from rehabilitation facilities and care homes should be educated in the areas of different actions of different glucose lowering treatments, their potential side-effects, and related precautions. There are major limitations through lack of recent specific studies in the optimal management of glycaemia with the newer insulins in type 1 diabetes and their safety in older adults. In addition, adults with type 1 diabetes and cognitive and/or functional impairment are not included in clinical trials and these variables are hard to assess in observational studies, and usually not considered in outcome analyses.

For older adults with type 1 diabetes, this clinical *guideline* can be implemented within clinical settings and is supported by previous recommendations on glycaemic targeting (27-30). There are limited data concerning the use of an insulin pump in adults with type 1 diabetes living in rural or other community settings. In older adults, data on pump therapy is further limited, but can be continued as long as individuals are capable of properly using a pump or their partner or caretaker is capable and willing to take over this responsibility (31,32).

Older adults with type 1 diabetes living in the community pose several additional challenges to local healthcare services: older adults with frailty have reduced life expectancy and are either unable to perform or have difficulty performing self-care tasks thus requiring additional nursing and social services support (33). In addition, as glycaemic control appears to play a role in cognitive performance (34), and cognitive dysfunction affects the ability of older adults with type 1 diabetes to self-manage their disease (35), an active community-based programme of review and assessment of older adults needs to be implemented. In each local healthcare delivery service, an active hospital avoidance programme should be
aimed for to reduce unnecessary hospital admissions due to diabetic ketoacidosis or severe hypoglycaemia.

**Evidence Base and Reasoning**

**Cardiovascular disease management**

Cardiovascular disease is a major cause of mortality in type 1 diabetes mellitus and epidemiological studies have identified factors important to its incidence and prevalence (15, 36-37). Finally, age and diabetes duration, and unhealthy behaviours also play an important role in CVD risk. At present, there is a paucity of literature on effective strategies for the management of CVD risk in older aged individuals with type 1 diabetes, and management has been based on evidence obtained from studies in type 2 diabetes mellitus (38).

**Usual Clinical Practice**

A local public health programme of cardiovascular disease prevention is essential to reduce its impact in type 1 diabetes. This programme could have important targets for risk reduction, including hypertension, obesity, number of new cases of diabetic kidney disease, HbA1c targets, and lipid levels.

Community-based strategies of cardiovascular risk reduction and management require adaptation for older adults with type 1 diabetes since greater reductions in morbidity and mortality are likely to result from non-glucose risk factors such as blood pressure regulation (39). Lipid lowering strategies for type 1 diabetes should be familiar to all diabetes care team members who should be reassured that benefits are similar to those adults with type 2 diabetes (40). Even in frail older adults with diabetes, statins are generally safe, and even provide some cardiovascular benefits (41,42). Creating a care pathway that integrates both hospital and primary care/community teams provides a platform for an individualized approach even for frail polymedicated older adults (43).
Assessment and Clinical Audit Measures

Local diabetes care systems should be evaluated for their capability of providing a comprehensive integrated assessment programme for all adults with type 1 diabetes which should be designed to collect information on medical history, medication regimens, cognitive and mental health, functional capabilities, and achievement towards individualized management plans for all adults with the condition. Surveillance rates of emergency room and hospital visits for hypoglycaemia, medicine errors/overdose, use of agents with high risk of hypoglycaemia, rate of falls, and quality of life are particularly important data. Management plans should focus on delivering individualized education plans, materials, and assessments for all adults with type 1 diabetes.

The proportion of adults with type 1 diabetes who are able to achieve optimal blood glucose, lipids, and blood pressure levels should be ascertained.

### Potential Measures

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<td>Documentation and date of the most recent assessment</td>
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References
1. Dhaliwal R, Weinstock RS. Management of Type 1 Diabetes in Older Adults. Diabetes Spectr 2014;27:9-20


6  DIABETES SELF-MANAGEMENT EDUCATION

Diabetes self-management education is an ongoing process that provides a platform for adults with type 1 diabetes to acquire the necessary information, skills and capability to effectively manage their own diabetes care. This process should incorporate the needs, goals, and life experiences of the person with diabetes, guided by evidence-based standards. The overall objective of diabetes self-management education in both type 1 and type 2 diabetes is to support informed decision-making, self-care behaviours, problem-solving and active collaboration with the health care team and to improve health status and outcomes, and overall wellbeing and quality of life.

RECOMMENDATIONS

GENERAL

- Education must focus on the management of type 1 diabetes and not a modified version of insulin requiring type 2 diabetes.
- Education is delivered by the multidisciplinary diabetes team, who must deliver clear, relevant and consistent messages.
- Structured diabetes education should be offered to all adults with type 1 diabetes with the teaching strategy and learning environment modified to suit each adult and/or their carer(s) as appropriate, and must take into account learning styles and learning ability.
- Education strategies/aids, in particular, the increasing use of technology and social media should be encouraged bearing in mind that older adults may need additional support to use these approaches.
- Education should be individualised, include goal setting and focus on safety, risk management, and complication prevention.
- All adults with type 1 diabetes require individualised plans that include:
  - Insulin regimen
  - Blood glucose and blood ketone monitoring
Hypoglycaemia treatment and prevention
Sick day management.

- Appropriate decision aids and cues to action should be developed with the individual and their family caregivers as appropriate
- Education strategies focusing on monitoring blood glucose and/or blood ketones and administration of insulin by others must be considered as an integral component if self-care deficits exist.

SPECIFIC

Category 1: independent in ADL and cognitively intact; responsible for diabetes self-management

- The focus should be on individualised self-management education with on-going review of self-care behaviours and self-care capacity.
- Self-management is likely to include a variety of plans/strategies addressing insulin administration including dexterity skills, blood glucose and blood ketone monitoring, carbohydrate intake and sick day management.

Category 2: degree of ADL loss or limitation of walking associated with multi-morbidity or diabetes complications; may have some features of early to moderate frailty

The same principles as for category 1 but with additional recommendations:

- All efforts should be directed to enable people with diabetes to make informed self-management choices
- An individual’s values and needs should continue to guide decision-making
- Self-management education should take account of physical and mental functional impairments, comorbidities, vision, hearing, manual dexterity and the social situation.
- The characteristics of older learners need to be considered when planning, delivering, and evaluation diabetes education
Category 3: disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia

- Insulin administration, blood glucose and blood ketone testing will need to be undertaken by a family member, informal carer, or healthcare professional, depending on the individual circumstances of the person and support network.
- Education should be provided to carers: health care professionals and informal carers.
- Self-management education is often of limited relevance when the individual has dementia and education and support should be directed to family, informal, and formal carers.
- Educational support should focus on reassurance and preventing acute complications of diabetes at the end of life.
- The diabetes healthcare team should liaise closely with the family and other clinicians including palliative care and aged care home staff.

Evidence Base and Reasoning

Diabetes self-management education should be a mandatory approach to achieving the best clinical outcomes for each adult with type 1 diabetes (1). It has been shown to be associated with a wide range of benefits in adults with type 1 and type 2 diabetes such as improved glucose control, increased quality of life, reduced weight, and lower healthcare costs (2-4).

Improved outcomes have been achieved when programmes were culturally appropriate and age-specific (5,6).

Various evidence-based guidelines (7,8) highlight that diabetes education programs across the lifespan need to address a number of key areas that include:

- The pathogenesis of type 1 diabetes and its natural history,
- Living with diabetes:
- The role of nutrition,
• Physical activity,
• Medications,
• Goal setting,
• Monitoring,
• Acute and chronic complications,
• Psychological support.

It has been long recognised that as a chronic and complex disease, type 1 diabetes places a substantial and often relentless burden of treatment demands on the person with diabetes and their family (9). This burden can lead to reduced participation in diabetes self-care (10) and contribute to self-management burnout.

Many educational strategies and publications have focused on children, adolescents and young adults living with type 1 diabetes, but with the increasing numbers of middle-aged and older adults with this condition, new approaches need to be considered. The opportunities for learning and engagement with others with type 1 diabetes that have been available for younger people for some time, for example, camps, age-specific education and social media activities, need to be opened up to allow for the needs of a growing number of older adults. Older adults with type 1 diabetes may also have poor self-esteem and social, economic and functional deficits that affect their capacity to participate in education. Healthcare professional educators need to adapt their teaching to take account functional and cognitive impairments and learning style. It is important that multidisciplinary healthcare and diabetes teams who use high technological approaches, for example, mobile phone apps that support diabetes education/smart blood glucose meters, do not marginalise those adults with type 1 diabetes who are unable to embrace this technology.

**USUAL CLINICAL PRACTICE**

Local healthcare and diabetes teams should receive support and funding to offer structured diabetes educational approaches for all adults with type 1 diabetes. In particular, a focus on
diabetes self-management education is desirable that allows diabetes care to be individualised to the person’s unique medical, cultural and social situation.

Close liaison between healthcare and diabetes teams with social services may improve the level of support required by the more disadvantaged to participate in educational sessions. Programmes of education should be available for both formal and informal carers and concentrate on basic diabetes knowledge and skills, but provide opportunities for more advanced learning. This may be particularly important in older adults with type 1 diabetes who may develop a decline in physical or cognitive function, and will require help with other self-care tasks.

Local educational programmes should also allow for adults with type 1 diabetes having sensory impairments which particularly affects older adults with diabetes in the senses of vision and hearing. This may require access to specific specialist educators and services if available.

**ASSESSMENT AND CLINICAL AUDIT MEASURES**

Evaluation should focus on the extent by which a healthcare organisation delivering diabetes care for adults with type 1 diabetes has invested time and resources to ensure that the education and other support materials are ‘fit for purpose’. This will include the extent of promoting individualised educational plans, making educational materials sensitive to the presence of conditions that influence learning such as visual health or other sensory impairments, and the appropriate insulin regimen/self-monitoring of blood glucose and blood ketones. Audits should also focus on the level of knowledge, ability to problem solve and degree of confidence that the individual with type 1 diabetes and their care giver(s) have.
Potential measure

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<td>Documentation and date of education plan</td>
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7 NUTRITIONAL THERAPY

The primary goal of nutritional therapy for adults with type 1 diabetes is to achieve optimal levels of glycaemia throughout the day, reduce the risk of cardiovascular disease, optimise blood pressure and lipid levels, maintain a satisfactory weight and prevent unnecessary weight loss. Nutritional therapy should lead to an individualised meal plan for each adult with type 1 diabetes which is practical, enjoyable and affordable.

RECOMMENDATIONS

General

- Basic aspects of nutritional therapy for all adults with type 1 diabetes should be included in a structured diabetes education programme that is locally available; carbohydrate counting can be offered to adults who are willing to learn this procedure.
- Each adult with type 1 diabetes should have a central role in the design of their own self-management programme and in nutritional planning with their healthcare and diabetes teams towards agreeing an individualised eating plan: this should be developed as soon as possible after initial diagnosis.
- Meal planning and meal patterns should be based on advice on optimal foods to consume, snacking behaviour, content of foods that align with insulin regimen in use, safe alcohol intake, sodium intake (<2300 mg/day), and how to reduce excessive glucose fluctuations throughout the day.
- All adults with type 1 diabetes should aim to maintain a healthy body weight and waist circumference that is considered satisfactory for their gender and race.
- The use of 3-day food diaries, questionnaires and dietary analysis as tools for early identification of nutritional shortfalls and challenges with carbohydrate counting should be considered.
- All adults with type 1 diabetes should have access to a specialist nutritional therapist to plan their nutritional programmes.
Dietary advice should ensure that sufficient provision is made to allow for adequate protein intake to prevent muscle loss and/or muscle related conditions, that the level of suitable hydration is maintained, and that drug-nutrient interactions are considered.

Local education programmes for type 1 diabetes should provide specific training/education for carers and/or family members on carbohydrate control and advice on creating a balanced diet for the older adult with type 1 diabetes.

Speech and language therapists may be required for those individuals who have swallowing difficulties.

**SPECIFIC**

**Category 1:** independent in ADL and cognitively intact; responsible for diabetes self-management

- Functionally independent adults with type 1 diabetes should be encouraged to eat a variety of foods and maintain a healthy body weight.
- Education on the benefits of carbohydrate counting, insulin dose adjustment and physical activity management should be part of the dietary advice given by the local healthcare or diabetes team; this may be particularly important in those on flexible insulin regimes.
- On-going behaviour change to encourage positive diet and lifestyle changes/behaviours should be promoted.
- The use of dietary analysis may be beneficial to address nutritional deficiencies and as a teaching tool to demonstrate the effects of food on glycaemic control.
- Nutritional counselling on dietary meal planning/food preparation/dietary choices using dietary assessments tools (Mini-Nutritional Assessment tool, food diaries, dietary analysis) can be offered to improve dietary knowledge and nutritional understanding.

**Category 2:** degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty.
• Adults with type 1 diabetes who have moderate to severe renal impairment, or hypertension, or evidence of associated cardiovascular disease should have a revision of their nutritional plan to optimise clinical outcome
• Nutritional assessments using tools such as the malnutrition universal screening tool (MUST) or the mini nutritional assessment (MNA), or the use of dietary software analysis, may assist in revealing important dietary shortfalls in those with frailty or excessive comorbidity
• Promote each adult with type 1 diabetes to maintain adequate dental care to optimise the right variety of food intake in relation to their nutritional plan
• Consider the use of oral nutritional supplements (ONS) to prevent functional decline
• The local diabetes or healthcare team should re-enforce the need for specific training and education for carers and healthcare professionals on meal planning and nutritional needs: this should include discussions on the reason for good nutrition for those with multiple conditions

**Category 3** - disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia*

• All adults with type diabetes in this category require nutritional assessment to exclude undernutrition particularly those who are housebound or residing in aged care homes
• Carers should allow additional time for meals, snacks and drinks
• The use of specific cutlery, dishes, cups should be considered to provide safety of the individual and consistency
• Allow individuals to make food choices using food images and provide a calm environment during mealtimes
• Management of dementia should consider nutritional support & care offered, including difficulties with swallowing
• Individuals should be encouraged to have sufficient fluid to avoid dehydration
Evidence Base and Reasoning

Nutrition therapy is an integral component of diabetes management and of diabetes self-management education and ideally advice and instruction should be provided to each adult with type 1 diabetes by a qualified/registered nutritional therapist. Nutrition recommendations that have little or no supporting evidence are still being provided to persons with diabetes and at best are a reflection of best clinical practice rather than being evidenced based.

Evidence for the effectiveness of nutritional therapy in type 1 diabetes is available in the latest version of the 2019 American Diabetes Association’s Standards of Medical Care (1) and from evidenced-based nutrition guidelines produced by the American Dietetic Association in 2008 for ambulatory adults with type 1 and type 2 diabetes with additional evidence subsequently updated (2).

In most studies of nutritional therapy in diabetes (multiple individual or group), glycosylated haemoglobin (HbA1c) has been a consistent outcome measured. Falls in HbA1c ranging from 0.5% to 2.6% (average of 1% to 2%) which are similar to the effects of many glucose-lowering medications, have been reported (3). The effectiveness appears to be most pronounced at initial diagnosis and measurable at as early as 6 weeks after commencing the programme. Applicable to all adults with type 1 diabetes it is essential to customise nutritional advice with regard to current features such as obesity, underweight, and other health conditions, eating disorders or behaviours (4).

Fewer studies have been conducted in older adults with type 1 diabetes and special considerations are important (5). In addition, older people with diabetes require additional nutritional care and planning to prevent further decline, malnutrition and/or weight loss, and meeting nutritional needs (6,7).

The quality of diet for older people is equally valid and should form part of the clinical assessment process (8,9). An increase in protein may prevent the development of sarcopenia and frailty in older adults (10) and greater consideration is required for those with type 1 diabetes residing in an aged care home (11). Overall, there is a greater need to monitor food
intake for older people allowing for early nutritional intervention and prevent malnutrition (12).

The use of assessment tools such as the MUST, MNA, and specialist dietary analysis can help to identify key nutrients deficiencies and early analysis of food diaries may allow for specific and person meal planning (13-15).

Discussion on oral nutritional supplements (ONS) or tube feeding must be discussed as part of a care provision with other health professionals and family/carers in disabled adults with severe medical illness in type 1 diabetes particularly those at end of life and all relevant aspects of ethics should be reviewed as part of on-going care (16). It is essential to observe respect and dignity for the individual regarding food choices and timing of food and drinks.

**Usual Clinical Practice**

Cooperation between adults with type 1 diabetes, carers and healthcare professionals involves regular sharing of information and good communication systems in operation locally within the remit of the diabetes and healthcare teams. Education courses/training delivered by appropriately trained personnel on meal planning, carbohydrate control and medication should be an ongoing process involving appropriate follow-up practices.

Specific training and support for carers and healthcare professionals on carrying out nutritional assessments, understanding the benefits of three-day food diaries, and dietary analysis should be part of the overall nutritional care pathway in the community and hospital clinics. An ‘at-risk’ list should be compiled in each locality relating to adults with type 1 diabetes who are the most vulnerable such as those who are housebound or residing in aged care homes.

**ASSESSMENT AND CLINICAL AUDIT MEASURES**

There are multiple potential measures of nutritional well-being in adults with type 1 diabetes. These include: weight loss recordings, anthropometric measures, evaluations based on food
diary/questionnaires/MNA/MUST and information from carers and family members. Audits and nutritional protocol reviews should be considered.

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Additional Reading

8 PHYSICAL ACTIVITY, EXERCISE AND LIFESTYLE MODIFICATION

In this chapter, recommendations with their associated evidence base, usual clinical practice, and assessment measures have been provided separately for physical activity/exercise and lifestyle modification.

RECOMMENDATIONS

General

- Physical activity is recommended as an important component of diabetes care and should consist of (a) a minimum 120-150 minutes of moderate aerobic activity per week; (b) a minimum of two sessions of resistance training per week each lasting at least 20 minutes
- All older adults with type 1 diabetes should be encouraged to limit the daily amount of time sitting
- Supervised home or community-based exercise programs (e.g. yoga, Tai Chi, or other flexibility and strength-balance activities) should be encouraged
- Before undertaking exercise, short-acting insulin dose at the previous meal should be reduced or omitted or a carbohydrate snack supplied to avoid hypoglycaemia.
- A reduction in basal insulin dose the night following exercise may reduce the risk of delayed post-exercise hypoglycaemia.
- A source of simple carbohydrate should be available during and after exercise to prevent or treat hypoglycaemia.
- Persons with diabetes and their carers should be educated about the prevention and management of hypoglycaemia that may occur during or after exercise.

SPECIFIC

Category 1: – independent in ADL and cognitively intact; responsible for diabetes self-management

- Regular exercise to maintain ideal body weight is recommended.
Category 2: Degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty

- Light intensity physical exercise is recommended to maintain function.
- Provide physical or occupational therapy to maximise physical function.

Category 3: disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia

As for category 2 with additional recommendations:

- Exercise tailored to functional ability is recommended.
- Carers’ education about safe ways of exercise for older adults with diabetes with cognitive dysfunction.

Evidence Base and Reasoning

Exercise has many positive health and psychological benefits including physical fitness and weight management. It reduces the risk of cardiovascular disease, all-cause mortality and cancer and improves cardio-metabolic profile and general wellbeing in the general population and in those with diabetes. A 2016 ADA Position Statement has provided detailed recommendations relating to the exercise type and frequency with both aerobic and resistance training being considered to be essential activities (1).

Diabetes is associated with muscle mass loss, worse muscle quality, reduced upper and lower body strength and greater visceral fat content (2). Exercise may improve these by reducing visceral fat and increasing muscle mass which leads to improvement in insulin resistance and muscle function (3). Physical activity increases the risk of hypoglycaemia during, immediately after and a few hours post-exercise. This delayed susceptibility to hypoglycaemia is referred to as the “lag effect” of exercise and is due to muscle replenishment with glycogen stores (4). However, exercise induced hypoglycaemia should not be a barrier to physical activity as it can be managed by adjusting insulin dosage and/or
carbohydrate consumption. Physical activity and exercise may improve glycaemic control. Although there is a limited direct evidence of glycaemic control benefits in adults with type 1 diabetes, exercise is associated with a reduction in insulin requirements and this reduction may indirectly reflect better glycaemic control. Exercise showed benefit in improving lipid profile, insulin resistance, and endothelial function in those with type 1 diabetes. The benefit on blood pressure reduction is not clear. Some studies showed benefits while others did not. This inconsistency may be due to the fact that those with type 1 diabetes are young and likely to have normal blood pressure making it difficult to demonstrate a benefit. Physical activity has shown some benefit in reducing microvascular complications in those with type 1 diabetes. Physical activity seems also to improve macrovascular disease. Men who had participated in team sports during high school were three times less likely to report macrovascular disease and had mortality rates three times lower than those who did not after 25 years of having diabetes. This was not demonstrated in women possibly due to their lower physical activity level.

As for adults with type 2 diabetes, a reduction in sedentary behaviour in adults with type 1 diabetes may be associated with improvements in glucose regulation, blood pressure and other cardiometabolic factors that could influence longer term cardiovascular risk. Older adults should also be encouraged to seek out any local or community-based activities that provide regular balance and strength exercise and flexibility training.

Physical activity also improves quality of life and general well-being in those with type 1 diabetes. Even light-intensity physical activity has been associated with self-reported improvements in physical health and psychosocial well-being as well as improvement in balance and overall functional status of older adults. Exercise in care home residents above the age of 80 years appears feasible despite the frail nature of this population.

**Usual Clinical Practice**

Supervised home and community-based exercise programs are needed. Aerobic exercise which recruits large groups of muscles and includes activities such as walking, cycling, swimming or jogging can be implemented in independent and fit adults while resistance
exercise which uses muscular strength to lift a weight or to move a load causing isolated and brief activity of a single muscle group can be implemented in those who are dependent or those with arthritis, cardiovascular disease, peripheral vascular disease, neuropathy or poor mobility. Increased awareness of health care providers, adults with diabetes and carers about risks and ways to avoid hypoglycaemia during and after physical activity as well as safe exercise especially in those with cognitive dysfunction is required.

**Assessment and Clinical Audit Measures**

Annual reviews should address physical activity and exercise undertaken with assessment of the ideal body weight achievement on regular basis. Referral to occupational and physiotherapists should be regularly considered for appropriate individuals. Care homes should have protocols which include physical activity as part of comprehensive care.

**Potential measure**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Denominator</th>
<th>Calculation of the Measure</th>
<th>Data to be collected for calculation of the Measure</th>
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<tbody>
<tr>
<td>Percentage of adults with type 1 diabetes who have exercise plan adjusted for their physical function.</td>
<td>Total number of adults with type 1 diabetes who are eligible to receive an exercise plan adjusted for their physical function.</td>
<td>Number of adults with type 1 diabetes who have an exercise plan as a percentage of the total number of adults eligible to receive such a plan.</td>
<td>Documentation and date of exercise plan</td>
</tr>
</tbody>
</table>

**Lifestyle modification**
General recommendations

- Adequate nutrition is an essential component of diabetes care.
- Each individual should have an individualised food plan based on preferences, culture, cognitive function and the ability to adjust insulin dosage.
- Individuals should have a structured educational programme about flexible meal pattern and insulin dose adjustments.
- Older adults with diabetes on fixed insulin dosages should have consistent daily carbohydrate consumption.
- Frequent consumption of food and beverages with a high glycaemic index should be discouraged.
- Routine micronutrient supplementation is not recommended.
- Smoking cessation and low alcohol consumption is encouraged.

SPECIFIC

Category 1: – independent in ADL and cognitively intact; responsible for diabetes self-management

- Achievement of ideal body weight is recommended.

Category 2: Degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty

- Eating difficulties should be identified to maintain nutrition.
- Higher calorie diets may be required in frail older adults with diabetes.

Category 3: disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia
• Adequate hydration should be maintained.
• Carer and family education about adjusting hypoglycaemic therapy in relation to erratic eating pattern should be provided.

**Evidence Base and Reasoning**

Lifestyle modification protects and maintains health by promoting a healthy way of life. This is largely influenced by socioeconomic, cultural and educational factors of the individual. Apart from exercise and physical activity, the variables most commonly studied in lifestyle modifications include adequate nutrition, smoking cessation and avoidance of excessive alcohol consumption. Other variables such as socioeconomic status, emotional stress, sleep duration or unhealthy behaviour such as illicit drug use are less well studied.

The diet recommended for patients with type 1 diabetes does not generally differ from the healthy diet suggested for the general population. It should not interfere with their lifestyle. Minimal restriction may be required when pre-mixed or fixed basal-bolus insulin regimens are used. It will be important to have consistent day to day carbohydrate intake to maintain good glycaemic control as variations in carbohydrate consumption may lead to uncontrolled diabetes (19). On the other hand, patients on a variable dose insulin regimen adjusted according to carbohydrate portions will not need such restrictions (3). A flexible meal pattern and content do not have a negative impact on glycaemic control as long as patients are educated about using the appropriate treatment regimen (20). Structured patient education programmes about variable insulin dosage adjusted according to free dietary choices and carbohydrate counting has a significant impact on glycaemic control, better quality of life, treatment satisfaction and general wellbeing (21,22). Frequent consumption of food and beverages with a high glycaemic index should be avoided as it may lead to poorly controlled diabetes, persistent postprandial hyperglycaemia and decreased serum HDL-cholesterol concentration (23). Diets higher in saturated fat and lower in carbohydrate are associated with worse glycaemic control while replacing saturated with monounsaturated fat will have a lower glycaemic index and a lower atherosclerosis risk (24,25). There is no clear evidence of the benefits of routine micronutrients
supplementation to improve glycaemic control in the absence of specific deficiencies. Vitamin D may have some favourable effects on oxidative stress and insulin resistance but the evidence for routine clinical use is insufficient (26). Excessive alcohol consumption should be discouraged as it inhibits gluconeogenesis, causes hypoglycaemia and results in neglecting diabetes self-care (27). Smoking has negative effects on general health especially when added to the cardiovascular adverse effects conferred by diabetes. In those with type 1 diabetes, smoking increases cardiovascular mortality, increases insulin resistance, inhibits insulin secretion and increases the risk of microvascular disease (28-31).

Usual Clinical Practice

Dietary counselling and education for those with diabetes and carers is required. Ready meals such as “meals on wheels” may be helpful for more dependent people. Fortified foods and nutritional supplements may be needed in the frail with weight loss. Oral problems and dental decay should be regularly checked to adjust for suitable food consistency. In the presence of an erratic eating pattern, rapid-acting insulin can be administered immediately after meals instead of before so that it can be omitted or lower doses given if less food is consumed.

Assessment and Clinical Audit Measures

Nutritional assessment should be part of annual review procedures with attention to unintentional weight loss for early identification and treatment of frailty. Referral to dietician and speech and language therapists for those with poor dietary intake or swallowing difficulties should be checked. Care homes should have protocols which include nutritional assessment as part of comprehensive care.
## Potential measure

<table>
<thead>
<tr>
<th>Measure</th>
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<th>Calculation of the Measure</th>
<th>Data to be collected for calculation of the Measure</th>
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<tr>
<td>Percentage of adults with type 1 diabetes who have had a nutritional assessment as part of their overall care plan in the previous year.</td>
<td>Total number of adults with type 1 diabetes who are eligible to have a nutritional assessment as part of their overall care plan in the previous year.</td>
<td>Number of adults with type 1 diabetes who have had a nutritional assessment in the previous year as a percentage of the total number who are eligible.</td>
<td>Documentation and date of nutritional assessment.</td>
</tr>
</tbody>
</table>

## References


25. Strychar I, Cohn JS, Renier G, et al. Effects of a diet higher in carbohydrate/lower in fat versus lower in carbohydrate/higher in monounsaturated fat on postmeal triglyceride
RECOMMENDATIONS

GENERAL

- Preferentially offer a basal-bolus insulin regimen at the time of diagnosis for all adults with type 1 diabetes that can self-manage; if available use rapid-acting insulin analogues preferentially as prandial insulin.

- Ensure that the local diabetes education programme can provide support to newly-diagnosed adults with type 1 diabetes in relation to self-managing a basal-bolus insulin regimen.

- As an alternative basal insulin regimen in adults with type 1 diabetes, consider offering a twice-daily regimen of a longer-acting insulin such as insulin glargine or detemir.

- The use of higher concentration insulins (U200, U300) may be considered in those individuals with sub-optimal control on other insulin regimens or where nocturnal hypoglycaemia is a frequent problem.

- Educate adults with type 1 diabetes to adjust prandial insulin doses in the light of daily carbohydrate intake, pre-meal capillary glucose estimates and level of physical activity.

- In older adults with type 1 diabetes or those unable or unwilling to manage a basal-bolus insulin regimen, consider offering a twice-daily mixed insulin regimen (analogues preferentially to reduce hypoglycaemia).

- Adapt insulin therapy to overcome barriers presented by ageing and long duration of diabetes. For example,
  - If an individual is unable to follow a complex regimen requiring frequent pre-meal adjustment to insulin dose, provide fixed-dose prandial regimen.
- If someone is unable or unwilling to monitor aggressively, provide schedule that require less monitoring by staggering the timing of finger-sticks for pattern management

- If the individual misses prandial doses frequently, change regimen to longer acting and/or mixed dose insulin that requires less frequent administration

- Assess for new clinical, functional, or psychosocial barriers if someone suddenly feels overwhelmed, shows deterioration in glycaemic control, or errors in self-care abilities

- Educate about how ageing impacts their ability to manage diabetes, so they do not feel frustrated when tight control is not possible

- Educate people with diabetes and their family regarding consequences of hypoglycaemia that are different than those when those with diabetes were younger

- Repeated education and gentle counselling about risks and benefits of tight control is needed in cases where previous instruction/learning leaves adults with type 1 diabetes unwilling to change behaviour or practice.

**SPECIFIC**

**Category 1:** independent in ADL and cognitively intact; responsible for diabetes self-management

- If available, consider offering continuous subcutaneous insulin pump therapy as an alternative to a basal-bolus regimen when previous regimens have failed to achieved glycaemia targets or subjects are experiencing worrying hypoglycaemia

- Reassess someone’s ability to continue a complex insulin regimen should be done periodically, especially after acute illness or diagnosis of new medical conditions

- Assist each adult with type 1 diabetes to minimize the risk of hypoglycaemia and explain how the consequences of hypoglycaemia such as falls, fractures, or
deterioration in cognitive function can impact ability to manage diabetes or live independently and may affect their quality of life

**Category 2:** Degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty

- Where hypoglycaemia risk is high, for example, in frail or highly comorbid adults with type 1 diabetes, consider using metformin therapy adapted for renal function as an adjunct to the insulin regime to reduce daily insulin dosage
- Assess the manual dexterity ability of each person to perform insulin injections; this may involve an assessment of their vision
- Self-care behaviours that are difficult to perform should be identified and carer support should be sought.
- Goal of glycaemic control should be partially liberated according to the self-care ability and agreed individualized glycaemia targets

**Category 3:** disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia

- Glycaemic goal may be simplified to avoiding too low and too high glucose levels
- Frequent finger-stick readings should be avoided based on individual preference
- Combination of basal and mixed insulin can provide reasonable control while avoiding frequent injections and/or monitoring.

**Evidence Base and Reasoning**

There is convincing evidence from the Diabetes Control and Complications Trial (DCCT) that tight glycaemic control with intensive insulin therapy reduces the risk for diabetic
microvascular and macrovascular complications in adults with type 1 diabetes but was associated with high rates of hypoglycaemia (1,2). Insulin was given either three or more times per day or as a continuous subcutaneous insulin infusion (CSII). The more recent introduction of a number of rapid-acting and long-acting insulin analogues has been shown to be associated with reduced hypoglycaemia rates. These analogues are associated with less hypoglycaemia in type 1 diabetes, while matching the A1C lowering of human insulins (3,4). This also allows the use of longer acting insulins (determir or glargine) given twice daily as basal insulins as part of a modern approach to flexible insulin treatment (5).

The pharmaceutical and health professional communities continue to look for advances and innovations in insulin delivery and glucose monitoring that enhance glucose regulation and minimize any inconvenience in daily living for adults with type 1 diabetes. These advances include continuous subcutaneous insulin infusion (CSII) and real-time continuous glucose monitoring (rtCGM). A recent systematic review and meta-analysis concluded that a continuous subcutaneous insulin infusion and frequent daily injections regimens have similar effects on glycaemic control and hypoglycaemia, but the benefits of CSII are more pronounced in adults with type 1 diabetes mellitus (6). There are few studies that have looked at insulin pump therapy in the older population. Small case series in highly functional older people with type 1 under the age of 75 years show improvements in glycaemic control and symptomatic hypoglycaemia (7).

However, there are very few studies on insulin therapy in older adults, and most of those studies were conducted in subjects with type 2 diabetes. Insulin can be used safely in many older adults, although increasing complexity of illness can lead to difficulty coping and increases the risk of frequent high and low glucose levels and wide excursions with aging (8). The presence of multiple medical conditions, frailty and dependency can also interfere with an individual’s ability to perform self-care management. Hypoglycaemia avoidance on insulin therapy is a major challenge and a study using continuous glucose monitoring (CGM) has shown that older adults on insulin therapy suffer from frequent unrecognized hypoglycaemia and wide glucose excursions, during both day and night (9).

New basal insulin analogues appear to have less day to day variability and a more prolonged duration of action compared with earlier insulins which have significant advantages in the modern treatment with insulin. In addition, the pharmacokinetics and pharmacodynamics of
the newer insulin, degludec and the combination of insulin degludec and insulin aspart, as well as currently available premix formulations of insulin aspart are similar in young and old subjects with type 1 diabetes [10]. In a previous study in those with type 1 diabetes has confirmed that insulin degludec, administered at the same time once daily, effectively reduced HbA1c and fasting plasma glucose, with a lower risk for nocturnal hypoglycaemia compared with insulin glargine (11). High concentration insulins (deglutec U200, glargine U300) may be alternative basal insulins to treat type 1 diabetes as they are associated with improved HbA1c levels and decreased hypoglycaemic episodes (12). Studies in older people with type 1 diabetes are limited but in older people with type 2 diabetes, when compared with lower strength basal insulins, their use is associated with a reduced risk of nocturnal hypoglycaemia without change in HbA1c levels (13).

Apart from pramlintide, an amylin analogue, the use of other noninsulin adjunctive therapy for type 1 diabetes is not recommended.

**Usual Clinical Practice**

Glucose sensors and other technologies discussed elsewhere in detail will play an increasingly important role in the management of adults with type 1 diabetes in the future and local diabetes teams should play their part in introducing these into routine practice. Continuous glucose monitoring (CGM) may not be feasible in many because of cost and complexity, but intermittent use of weekly sensors may be critical in avoiding hypoglycaemia and allowing finer adjustments to insulin therapy.

Health and social care professionals in local diabetes and healthcare teams must be educated about how worsening medical, functional and psychosocial barriers to self-care (such as memory problems, depression, vision/hearing impairment and difficulty performing activities of daily living), can undermine the resolve of many adults with type 1 diabetes who have hitherto been typically highly disciplined and pro-active in regards to their diabetes self-care management.
At diagnosis and at the annual review process, a comprehensive assessment of physical and cognitive function screening tests should take place to ensure that individuals can effectively participate in self-care.

**Assessment and Clinical Audit Measures**

Adults with type 1 diabetes should be regularly screened for clinical, functional, and psychosocial barriers that may start to interfere with their self-care abilities to follow complex insulin regimens. This could be undertaken at the annual review process. In older adults (aged > 70 years), screening programmes for cognitive dysfunction, depression, frailty, and physical disability (e.g. hearing or vision loss) should be introduced by the local diabetes or healthcare team.

Audits could evaluate how often there are reassessments of goals and treatment complexity in adults with type 1 diabetes after events such as hospitalization or new medical diagnosis.

**Potential measure**

<table>
<thead>
<tr>
<th>Measure</th>
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<tbody>
<tr>
<td>Percentage of adults with type 1 diabetes who have had an assessment of their diabetes self-care skills to manage their insulin regimen</td>
<td>Total number of adults with type 1 diabetes seen in the previous year</td>
<td>Number of adults with type 1 diabetes whose self-care skills were assessed for insulin management as a percentage of total number seen in the previous year</td>
<td>Documentation and date of assessment</td>
</tr>
</tbody>
</table>
References


3 - DeWitt DE, Hirsch IB. Outpatient insulin therapy in type 1 and type 2 diabetes mellitus: scientific review. JAMA 2003;289:2254–2264


9 - Munshi, M.N., et al., Frequent hypoglycemia among elderly patients with poor glycemic


10 USE OF TECHNOLOGY IN DIABETES MANAGEMENT

RECOMMENDATIONS

GENERAL

- Technological advances in insulin delivery and blood glucose monitoring should be implemented in local diabetes care teams to improve the range of support for adults with type 1 diabetes and lessen the adverse effects of insulin injections and monitoring.
- All members of the local diabetes team should become aware of the newer automated injection devices such as insulin pens and pumps, as well as the latest durable insulin delivery devices for adults with type 1 diabetes.

SPECIFIC

Category 1: – independent in ADL and cognitively intact; responsible for diabetes self-management

- Where feasible, all adults with type 1 diabetes in category 1 should be made aware of the latest technological developments in insulin delivery (including insulin pens and pumps) and considered if current insulin regimens are failing to achieve objectives and targets.
- These individuals may be able to use self-controlled technologies such as finger-stick glucose monitoring and continuous glucose monitoring (CGM), as long as physical and cognitive abilities remain satisfactory.
- The use of real-time CGM may be considered in those individuals who are failing to achieve agreed glycaemic goals or in those who have lost the ability to recognise symptoms of hypoglycaemia.
- All individuals being offered CGM must receive appropriate training, education and support in order to optimise the benefits of this technology.
• It is important to assess coping skills periodically, as a functionally independent individual may become dependent, or develop cognitive decline, and become unable to handle the use of technology over time.

**Category 2:** Degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty

• Technology can be used to avoid excessive hyperglycaemia and hypoglycaemia in this group of individuals.
• These individuals may benefit from the use of auto-controlled technologies such as CGM and smart-phone based apps which allow participation by the carers. The carers can assist by receiving glucose data on their smart phones and following up with reminders to take insulin doses or eat on time.
• Some of the technologies requiring complex decision-making, for example, the insulin pump, may not be appropriate for use by this group.

**Category 3:** disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia

• Goal for diabetes management in this group is mostly comfort care and avoidance of severe hypoglycaemia and hyperglycaemia.
• Most technologies are not useful at this stage of life and should be avoided to prevent unnecessary cost, stress, and burden on both older people with diabetes and their families.

**Evidence Base and Reasoning**

People with type 1 diabetes are typically a diligent, disciplined, and proactive group of adults that has managed a difficult disease over a variable life-time. Type 1 diabetes is a
unique disease that has had significant technological advances for its management in the past decade. New technologies in the areas of glucose monitoring, insulin administration, and disease management applications (apps) have transformed the management of type 1 diabetes in recent years.

Technology is typically perceived as a domain used only by younger people but as a more technology-savvy generation ages, we are likely to see older adults with type 1 diabetes using new technologies to manage their chronic diseases.

**Technologies for insulin administration**

People with type 1 diabetes typically need multiple daily insulin injections that can be overwhelming. Insulin pumps use a thin catheter placed under the skin to release a small amount of short acting insulin continuously over 24-hours a day. In addition, the person with diabetes can push a button to release an additional bolus of insulin to cover carbohydrates ingested during a meal or a snack. The use of insulin pump requires individuals to check finger-stick readings multiple times a day and use that data to give insulin bolus dose from the pump. The subject can use the inbuilt bolus calculator in the pump by entering in their BG and the number of carbohydrates they’re eating. The insulin pump then uses their Insulin:Carbohydrate ratios predetermined by an individual’s diabetologist. These calculations require subjects to recognize grams of carbohydrates they are going to ingest in the next meal or a snack. Thus problem-solving abilities remain critical and are constantly utilized when using an insulin pump. Adults with executive dysfunction may not be able to perform these tasks. The newest generation of pumps, combined with built-in CGM, can predict insulin dosing requirements and, more importantly suspend insulin administration when glucose levels are going low in order to prevent severe hypoglycaemia.

To assess the benefits of the insulin pump, a large meta-analysis combining 33 randomized controlled studies in adults and children comparing insulin pump and multiple daily insulin injection (MDI) was performed [1]. The results showed mostly equal benefits from the use of the pump and MDI for achieving glycaemic goals and for preventing hypoglycaemia. However, satisfaction with the treatment and the quality of life parameters were better in those participants using the insulin pumps. Thus, an individualized approach is
recommended based on a person’s preference and quality of life when choosing the method of insulin administration. Only a few studies have looked at insulin pump use specifically in the older population. A randomized controlled trial of insulin pumps versus MDI in older people with type 2 diabetes found no difference in glycaemic control, rates of hypoglycaemia, treatment satisfaction, or glycaemic variability [2], [3]. However, a small case series in highly functional older subjects with type 1 diabetes showed improvements in glycaemic control and symptomatic hypoglycaemia [4], [5], [6]. This study showed that the ability to calculate basal/bolus ratio and to use more advanced pump features was similar in younger and older subjects (<75 years of age) with type 1 diabetes [6]. Many devices are now available in the market. As yet, there is no data favouring one device over the other, although devices that are easier to operate may be preferred in the older people.

Further advances in the pump technology include a sensor-augmented insulin pumps that offer automatic suspension of insulin when glucose levels are shown to be going low in the accompanying CGM. In the preliminary studies, this technology has shown reduction in severe hypoglycaemia especially in those with hypoglycaemic unawareness [7]. A closed-loop insulin delivery system is one step closer to developing an “artificial pancreas” and includes built-in continuous glucose sensing with automated insulin delivery without significant subject intervention. Early studies are encouraging in adolescent and adult people with diabetes [8] [9] [10].

**Glucose monitoring technologies**

Continuous glucose monitoring (CGM) devices are now becoming widely available for use, especially in those with type 1 diabetes. Recent studies have shown that hypoglycaemia unawareness is highly prevalent in older adults with a high risk for unrecognized hypoglycaemia during the daytime, as well as at night [11, 12]. CGM is the best technology to identify unrecognized episodes of hypoglycaemia, which may result in poor outcomes, such as falls in the older adults. CGM devices include a thin filament with a sensor that is inserted under the skin and a receiver kept close to the body. The sensor measures interstitial fluid glucose levels every 5 minutes for up to 10 days. CGM devices may be used in either a blinded or a real-time fashion. Blinded CGM devices are used for pattern
management. The subject wears a blinded CGM for up to 7 days and the data is downloaded at the end of this period. Any adjustment in the treatment regimen is recommended based on the pattern seen over the previous week. On the other hand, a real-time CGM (rt-CGM) shows continuous glucose levels based on which a subject may decide to change the insulin doses on an ongoing basis. These devices have capacity to set up alarms for high or low glucose levels to help alert those with diabetes. However, relatively little is known about the use of rt-CGM in older adults with type 1 diabetes but this technology may have the capacity to reduce episodes of hypoglycaemia (13). The concern is that many adults may become overwhelmed with continuous data received from the device and may overreact to high or low numbers resulting in more glucose excursions. More recently, FLASH sensors are being employed to assist in diabetes self-management (14) and may reduce the time anyone with type 1 diabetes remains in a hypoglycaemia state. A recent consensus document on flash glucose technology has been published in the United Kingdom (15).

**Technologies to improve medication adherence:**

Technological advances have improved medication adherence in many adults over the past decade. These technologies are well-suited for oral medications requiring multiple doses/day. However, improving compliance for multiple doses of insulin injections has remained a difficult task. Recently, smart insulin pens with a cap that records the timing and dose of the insulin injections have raised hopes in this area. The pens themselves may have the capacity to record the dose and timing, or can be used with a separate cap that can do the same. With blue tooth capabilities, this data can be accessed by a family member or a carer to improve reminders. These data will not only provide better information on dose adjustment, but also help with overtreatment or under treatment that may occur due to dosing errors made by people developing with visual or cognitive deficits.

**Self-management technologies:**

With the explosion of smart phones and mobile devices, there is a widespread interest in applications (apps) that support self-management in those with with diabetes. These apps
include wireless communication between providers and people with diabetes regarding diabetes education and medication management, between subjects and carers regarding medication and self-care activity reminders, and between peers for networking forums and motivational support. The effectiveness of such technologies and technical platforms to improve patient-related outcome can be seen in their potential for ease of usability and user satisfaction [16,17]. However, these types of technologies still depend heavily on actual user behaviour and adaptation, and require a user-centred process to show benefits for diabetes management [18]. In any case, recently, web-based and mobile-based technologies have shown successful improvement in self-management in those with diabetes [19].

**Usual Clinical Practice:**

Most of the technologies discussed above are still costly and not accessible to larger populations around the world. However, there are clear benefits and challenges for their use in routine clinical practice. It is important that as these technologies permeate through a larger population, we identify their benefits and potential cost-benefits. The table below provides a summary of the advantages and limitations of technologies in the modern management of type 1 diabetes in adults.

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Benefits in adults with type 1 diabetes</th>
<th>Challenges in adults with type 1 diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Glucose monitoring</strong></td>
<td>key method to identify hypoglycaemia in those with hypoglycaemia unawareness&lt;br&gt;-Identify glucose excursions commonly seen in older people</td>
<td>Anxiety associated with too much information access in the form of glucose levels&lt;br&gt;Alarm fatigue and anxiety if multiple high glucose or low glucose alarms go off frequently</td>
</tr>
</tbody>
</table>
| **Medication adherence** | Missed insulin doses are difficult to assess without technology  
- Cognitive decline can lead to missed or extra insulin doses |
|--------------------------|-------------------------------------------------------------|
| **Insulin delivery/administration** | Frequent dosing is difficult in the presence of cognitive decline  
Arthritis of hands or vision problems may interfere with multiple insulin injections a day |
|--------------------------|-------------------------------------------------------------|
| **Self-management support** | Many adults live alone and have no support system to help manage this difficult disease  
Support by carers, nurses, aids, family members, and clinicians can be provided from any distance |
|--------------------------|-------------------------------------------------------------|

**Assessment and Clinical Audit Measures**

The management of adults with type 1 diabetes should include assessment of available socio-economic support and person preferences for the use of technology. The barriers and
enablers of the use of technology should be reassessed periodically and after events such as hospitalization or new medical diagnosis.

**Potential Measure**

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<tr>
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<th>Data to be collected for calculation of Measure</th>
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<td>Percentage of adults with type 1 diabetes using newer technology to monitor or inject insulin</td>
<td>Total number of adults with type 1 diabetes seen in a previous year</td>
<td>Number of adults with type 1 diabetes who are using technology to monitor or inject insulin as a percentage of total number of adults with type 1 diabetes seen in the previous year</td>
<td>Documentation and date of assessment</td>
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**References**


11 HYPOGLYCAEMIA

Recommendations

GENERAL

- Explain to all adults with type 1 diabetes that hypoglycaemia is an almost inevitable consequence of treatment with insulin and that you will provide sufficient support to them to minimise this adverse consequence whilst maintaining satisfactory glycaemic control where possible.

- All members of the diabetes and healthcare team should have (a) knowledge of the risk factors for hypoglycaemia in adults with type 1 diabetes on insulin and the additional risks seen in older adults; (b) an awareness of the additional modifying factors which may contribute to or complicate hypoglycaemia.

- Assessment of risk factors and the modifying factors for hypoglycaemia should be undertaken routinely (in each visit) through a structured interview using a validated questionnaire method or scale: the following can be considered: the Hypoglycemia Patient Questionnaire, the Edinburgh Hypoglycaemia Scale, or the Hypoglycemia Perspectives Questionnaire (HPQ).

- All adults with type 1 diabetes should be carefully reviewed for hypoglycaemic unawareness at review procedures (at least annually).

- In the presence of impaired awareness of hypoglycaemia, ensure that the individual receives appropriate education about its importance and implications (preferably through a structured diabetes education programme).

- In adults with type 1 diabetes who remain persistently troubled by hypoglycaemic episodes exacerbated by impaired awareness, consider management with continuous subcutaneous insulin infusion (CSII, pump therapy) or continuous glucose monitoring (CGM).

- Members of the healthcare team should be aware that the symptoms of hypoglycaemia in older adults with type 1 diabetes may be non-specific such as:
weakness, changes in mood, blurred vision, falls and that autonomic symptoms such as hunger or anxiety are less common

- The administration of 15-20 mg of simple carbohydrates with quick absorption (for example, 5-6 dextrose tablets, 200 ml of smooth orange juice, 5 large jelly babies or 7 large jelly beans, 2 tubes of 40% glucose gel into the buccal cavity if subject is able to swallow, 60 mls of Gluco juice, are the treatments of choice in mild (self-treating). See [https://trend-uk.org/wp-content/uploads/2018/09/HCP_Hypo_TREND_FINAL.pdf](https://trend-uk.org/wp-content/uploads/2018/09/HCP_Hypo_TREND_FINAL.pdf)

- In severe episodes (where assistance from a 3rd party is required) with impaired or loss of consciousness, with no access to intravenous treatment (usually, subjects with severe hypoglycaemia at home), the administration of intramuscular glucagon (1mg) is the starting treatment of choice. Intravenous glucagon can be given by a suitable trained clinician if available. In cases of no immediate recovery, intravenous glucose must be given as soon as possible

- If an episode of severe hypoglycaemia occurs within an adequately resourced clinical setting, the Intravenous administration of 75-80 ml 20% glucose or 150-160 ml of 10% glucose (the volume will be determined by the clinical scenario) is recommended. Once the subject is more alert, 15 mg of simplex carbohydrates with quick absorption should be given

- After each episode of hypoglycaemia, a careful review of likely causes, identification of any new risk factors and an assessment of the treatment given to assist recovery from hypoglycaemia is recommended

**SPECIFIC**

**Category 1** – Independent in ADL and cognitively intact; responsible for diabetes self-management

All general recommendations apply to this category

**Category 2** – Degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty
Where diabetes self-care management is still adequate and the physical and cognitive status of the adult with type 1 diabetes is satisfactory, all the recommendations are for category 1

Risk assessment for hypoglycaemia with regular review of risk and modifying factors is essential: adults with under nutrition or erratic meal plans, presence of frailty, or the onset of memory difficulties are at particular risk

Category 3 – disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia

- Adults with type 1 diabetes in this category (such as care home residents) will be at the highest risk of hypoglycaemia and consideration should be given to relaxing strict glucose targets and reviewing insulin doses and associated regimens
- Recognise that hypoglycaemia may present similarly to dementia in adults in this category with symptoms and signs of agitation, increased confusion or behavioural changes
- Ensure that all carers (formal and informal) are aware of the risk of hypoglycaemia in the adult with type 1 diabetes in this category, and have a low threshold for measuring capillary blood glucose levels whenever any potential symptom or sign is present

Evidence Base and Reasoning

Hypoglycaemia is a common occurrence in adults with type 1 diabetes and its impact on an individual associated with difficulties in achieving glucose targets, a decreased quality of life (1), and a fear of future episodes that in younger people with type 1 diabetes has been shown to impair diabetes self-care activities and worsen glucose control (2). Moreover, hypoglycaemia is associated with poor adherence to treatment and increased health costs (3).
In the short term, frequent episodes of hypoglycaemia can lead to difficulties maintaining employment status (driving, operating heavy machinery) and regular admission to hospital. An association between intensive insulin therapy and cognitive decline type 1 diabetes has not been demonstrated and impaired cognitive function in type 1 diabetes appears to be related to the presence of microvascular complications but not with the occurrence of severe hypoglycaemic episodes or with poor metabolic control (4,5). Even in older subjects with diabetes not on insulin, hypoglycaemia can lead to an increase in the risk of fractures, falls and motor vehicle accidents (6).

Hypoglycaemia is commoner in older adults with type 1 diabetes because of the associated comorbidities, geriatric syndromes, polypharmacy, long duration of diabetes and the increased prevalence of hepatic and renal dysfunction. The reported incidence of severe hypoglycaemia may vary in the literature owing to differences in the definition used and the age of the populations studied, but in one large retrospective study, the incidence of severe hypoglycaemia was 1.23 episodes per 100 person-years for people treated with sulfonylureas and 2.76 episodes per 100 person-years in those treated with insulin (7). In aged care homes, the incidence of hypoglycaemia is likely to be much higher than in a community setting reaching up to 41.9% in one study over one year period (median 2, range 1-10 episodes per patient per year) because of the higher levels of comorbidities of residents with diabetes (8).

Recognition of hypoglycaemia in older adults with type 1 diabetes may also pose challenges to the clinician since owing to the predominance of neurological rather than autonomic symptoms, hypoglycaemia may present with symptoms such as dizziness or visual disturbance resulting in misdiagnosis (9). In the Action to Control Cardiovascular Risk in Diabetes (ACCORD) study in type 2 diabetes, nonspecific fatigue or weakness were the commonest symptoms of hypoglycaemia experienced by the participants (mean age 62.2 ± 6.8 years) (10).

The factors associated with a high risk of hypoglycaemia have been well documented and may be more prevalent in older adults with type 1 diabetes; they include diabetes of long duration, previous episodes of hypoglycaemia, HbA1c <7% or > 9%, low (<18.5%) BMI, autonomic neuropathy, peripheral pressure ulcers, renal failure, intensification of previous
treatment, use of other drugs (specially beta-blockers, neuroleptics, ACEIs, and non-steroidal anti-inflammatory drugs), micro-albuminuria (with and without renal failure), polypharmacy (≥ 5 drugs), frailty and functional impairment, cognitive impairment/dementia, visual impairment (11-12).

Various instruments (questionnaires, scales) are now being used to assess the risk of hypoglycaemia and identify potential risk factors and include the Hypoglycemia Patient Questionnaire (11,13), the Edinburgh Hypoglycaemia Scale (14), or the Hypoglycemia Perspectives Questionnaire (HPQ)(15). Additional assessment tests to assist in identifying impaired awareness of diabetes such as the Clark and Gold methods are being recommended although their use may be associated with some limitations (16).

Usual Clinical Practice

Prevention, detection and treatment of hypoglycaemia are key aspects of the total management of adults with type 1 diabetes. All staff within the local diabetes and healthcare teams who provide direct diabetes care must acquire the skills to recognise symptoms and signs of hypoglycaemia and how to assist all subjects to minimise this event occurring. Training provided locally to staff must also be adapted to accommodate the learning needs of those with diabetes, as well as formal and informal carers. Every effort should be made to offer this training to social services staff who frequently attend older adults with type 1 diabetes and liaison and discussion with aged care home staff to ensure that they are aware of this acute complication and have the resources to manage it.

Where possible, local diabetes teams should keep a list of ‘at-risk’ adults with type 1 diabetes who are particularly prone to hypoglycaemia including those on large daily doses of insulin, those who are housebound or are disabled from a previous stroke, adults of advanced age (>80 years), those with frailty or dementia, and those where diabetes self-management skills may have deteriorated.
Assessment and Clinical Audit Measures

It is important to assess the frequency and severity of hypoglycaemia in adults with type 1 diabetes in a local diabetes team or healthcare setting. These include both audits of care including review of cases of avoidable hospital admission for hypoglycaemia. Some measures may be oriented to assess the percentage of subjects with detected hypoglycaemias, percentage of office interviews where the occurrence of an episode of hypoglycaemia has been assessed, the use of instruments in the assessment of these episodes and its risk factor/modifying conditions, adults with functional deterioration with non-strict glycaemic control and those (staff, patients and carers) receiving diabetes education relating to hypoglycaemia detection and management.

Potential Measure

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<th>Measure</th>
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<th>Calculation of the Measure</th>
<th>Data to be collected for calculation of Measure</th>
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<td>Documentation and date of assessment</td>
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behaviors, immediate consequences and association with glycemia medication usage:


12 MANAGING CARDIOVASCULAR RISK INCLUDING BLOOD PRESSURE AND LIPID MANAGEMENT

Cardiovascular disease (CVD) is a major complication of type 1 diabetes mellitus, and is a leading cause of death in many Western societies. Mortality from CVD has fallen since the 1980s with rates having fell more in older age groups (50% reduction in the 55–64 year age group) but morbidity has increased with an associated extra burden on healthcare costs.

CVD includes coronary artery disease (CAD), peripheral artery disease (PAD), cerebrovascular disease (CD). Heart failure and cardiomyopathy have also been evidenced although information about these conditions in type 1 diabetes is less robust than for CAD and cerebrovascular disease (1).

This chapter is in three parts – cardiovascular risk, blood pressure management, and lipid management. Each part will be reported with its own evidence base/reasoning, usual clinical practice, measures for assessment, and reference section.

RECOMMENDATIONS

CARDIOVASCULAR RISK

General

- The approach strategies to preventing and identifying CVD in adults with type 1 diabetes are the same used in the general population.
- The use of a risk assessment tool to assess cardiovascular risk in type diabetes may be misleading and provide an incorrect estimate of this risk
- All adults with type 1 diabetes aged 70 years and over should already be considered to be at high cardiovascular risk (10 year atherosclerotic cardiovascular disease risk >15%)
- It should be noted that other factors my influence cardiovascular risk in type 1 diabetes and these include ethnicity, body mass index, and family history of early cardiovascular disease
Individual risk factors which may influence management should be identified including current or previous CVD, atrial fibrillation, blood pressure, lipids, glycaemia, albuminuria, and smoking.

**SPECIFIC**

**CATEGORY 1:** independent in ADL and cognitively intact; responsible for diabetes self-management

- Each modifiable cardiovascular risk factors should be optimally treated
- Give advice to those with a high cardiovascular risk assessment or those with early evidence of cardiovascular disease to make lifestyle alterations including dietary modification, increased exercise, and behaviour changes in line with their structured education programme

**CATEGORY 2:** Degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty

Recommendations are as for category 1 with additional measures according to the health status of the individual:

- For those adults with some features of frailty less aggressive risk factor modification may be appropriate
- A greater focus should be on evaluating and managing more easily modifiable risk factors
- Educate carers to support measures for cardiovascular risk protection

**CATEGORY 3:** disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia

Recommendations as for category 2 with an additional measures:
• Those who are severely disabled with limited life expectancy, or who are fully dependent living in an aged care home, or at end of life, the detection and management of risk factors is usually unnecessary

Evidence Base and Reasoning
Cardiovascular disease (CVD) is a main cause of mortality in type 1 diabetes mellitus (1). Despite individuals with type 1 diabetes being at high risk of cardiovascular disease, the associated pathophysiology is not well understood. In the absence of renal disease, there is still no consensus about of assessment of cardiovascular risk in adults with type 1 diabetes because of the multitude of specific risk factors that have been reported.

Management approaches to CVD in type 1 diabetes are similar to those for type 2 diabetes and include the additional requirements of older adults (2, 3). The atherosclerosis process seems to be different between type 1 and type 2 diabetes and from those in the general population, with studies suggesting atherosclerosis in type 1 diabetes is more diffuse and more concentric (4).

Established and potentially modifiable risk factors for CVD include:

• **Smoking.** There is no evidence regarding the efficacy and safety of smoking cessation pharmacotherapy in adults with type 1 diabetes. An accurate smoking history is vital when assessing CVD risk and every attempt should be made to encourage the person to stop smoking, irrespective of age (5);

• **Blood Pressure.** Hypertension is more common in those with type 1 diabetes but management and target blood pressures remain uncertain (considered later in this chapter)

• **Dyslipidaemia.** There is an established link between abnormal lipid profiles and cardiovascular risk (see later in this chapter)

• **Renal Dysfunction.** Diabetic kidney disease is a complication of type 1 diabetes that is strongly linked to CVD (6). This may present as microalbuminuria or
macroalbuminuria, impaired glomerular filtration rate (GFR) or both. Regular testing for albuminuria and calculation of GFR are part of the risk assessment

- **Glycaemic Control.** Poor glycaemic control is predictive of CVD events in subjects with type 1 diabetes as demonstrated by a strong association between HbA1c variability and CVD events (7);

- **Depression.** Depression is much more frequent in people with diabetes than in their age-matched counterparts and is frequently under diagnosed and undertreated in older people (8). Depression is considered a significant independent risk factor for CVD and worsens its prognosis. Identification of depression with the use of a short screening tool may be useful in identifying these individuals;

- **Peripheral arterial disease.** The ankle-brachial index (ABI) is a useful method for detecting atherosclerotic disease and is a good marker of peripheral arterial disease but in long standing diabetes where significant medial calcification is likely to be present, false elevations of the ABI may occur limiting its utility (9);

- **Obstructive Sleep Apnoea.** Obstructive Sleep Apnoea is associated with an increased risk of CVD morbidity and mortality and where clinically indicated and where facilities are available, it should be considered, identified, and treated appropriately (10);

- **Periodontitis.** Careful dental examination should be considered as part of CVD risk assessment and protection (11);

- **Obesity.** Obesity is a risk factor for CVD in older people and has been linked to both morbidity and mortality instead (12);

- **Socio-Economic Status:** Low socio-economic status in older populations including those with diabetes, or those who are isolated or disconnected from others, increase the risk of death from CVD (13);

**USUAL CLINICAL PRACTICE**

The available data suggest a significant cardiovascular burden in those with type 1 diabetes and poor management of CV risk factors. Few studies have investigated the benefits of treating early cardiovascular disease in type 1 diabetes and data for older adults with type 1
diabetes is scarce although during the last 20 years we have seen a decrease in CVD related mortality in subjects with type 1 diabetes (14).

Local diabetes and healthcare teams who provide direct patient care to adults with type 1 diabetes should closely liaise with primary care and public health services to develop and implement CVD prevention and early treatment programmes. This should include advice on smoking cessation and aggressive CVD management in those with a recent myocardial infarction or non-disabling stroke.

ASSESSMENT AND CLINICAL AUDIT MEASURES

Adults with type 1 diabetes should be included in primary and secondary care audits and surveys of CVD prevention and management. By close liaison between hospital specialists, primary care teams and public health medicine (where available), and by adopting locally agreed care pathways, the inclusion of risk factor assessment in annual review procedures can be promoted.

POTENTIAL MEASURE

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<th>Measure</th>
<th>Denominator</th>
<th>Calculation of Measure</th>
<th>Data to be collected for calculation of Measure</th>
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<td>Percentage of adults with type 1 diabetes who have had a comprehensive cardiovascular risk assessment in the past year</td>
<td>Number of adults with type 1 diabetes who have been seen in the past year</td>
<td>Number of adults with type 1 diabetes who have had a comprehensive cardiovascular risk assessment in the past year as a percentage of those with type 1 diabetes who have been seen in the past year</td>
<td>Documentation and date of the most recent assessment</td>
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REFERENCES


**BLOOD PRESSURE MANAGEMENT**

Hypertension is common in those with type 1 diabetes and is a powerful risk factor for CVD (1).

**RECOMMENDATIONS**

**GENERAL**

- Hypertension should be diagnosed by at least three different blood pressure measurements, taken on more than two separate visits.
- In general, in all adults with type 1 diabetes mellitus and hypertension, antihypertensive drug treatment should be initiated at a BP of 130/80 mm Hg or higher with a SBP treatment target goal of 130 mm Hg and diastolic BP target of 80 mmHg or less if tolerated.
• In older adults with type 1 diabetes, the SBP target range should be 130-140 mm Hg if tolerated.
• Blood pressure should be measured at every routine clinical visit, including standing blood pressure to exclude orthostatic hypotension.
• Lifestyle interventions should be tried initially centered on reducing salt intake, stopping smoking, restricting alcohol consumption, and promoting physical activity (2).
• Drug therapy should be began in addition to lifestyle interventions after 6 weeks of non-pharmacological therapy fails to achieve blood pressure targets (3).
• Renal function and electrolytes should be checked at the beginning of pharmacotherapy.
• Angiotensin converting enzyme (ACE) -inhibitors should be the first choice for initiating therapy, particularly in the presence of diabetic nephropathy (3).
• Angiotensin receptor blockers (ARB) can be used as first therapy in people who cannot tolerate ACE-inhibitors.
• Diuretics or calcium channel blockers (CCBs) can be used as the first add-on therapy to ACE-inhibitors and ARBs if they fail to achieve target blood pressure.
• Beta-blockers should be considered for combination therapy in people with coronary artery disease or tachycardia.
• Alpha-blockers may be helpful in older people as add-on therapy, especially in men with prostate enlargement.
• Combinations of ACE-inhibitors and ARBs, potassium-sparing diuretic plus either an ACE inhibitor and ARB, and beta-blocker plus verapamil should be avoided.
• Anti-hypertensive should be began at the lowest dose and gradually increased.
• If the response is insufficient, a second medication from another class should be added. A single-medication combination may improve medication compliance.
• In presence of adverse effects or therapeutic failure, another drug class should be utilized.
• The possible reasons for the inadequate response should be investigated before adding medications or increasing the dose.
• Down-titration of medications may be necessary, especially in the presence of polypharmacy and declining renal function.
**SPECIFIC**

**CATEGORY 1**: independent in ADL and cognitively intact; responsible for diabetes self-management

All general recommendations apply

**CATEGORY 2**: Degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty

As for category 1 but with added measures:

- Some lifestyle interventions may not be possible including exercise or unwillingness to stop smoking.
- Diuretics and alpha-blockers should be prescribed with caution in those who are frail or have mobility disorders
- Less aggressive goals may be appropriate in those whose functional health is irreversibly compromised

**CATEGORY 3**: disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia

- A target blood pressure of up to 150/90 mmHg may be appropriate
- In those with dementia, a lower blood pressure target (140/90 mmHg) may aimed for to optimize remaining cognitive performance
- Among individuals with advanced dementia, strict control of blood pressure may not have any added advantage.
- Review of carer support essential to optimize management
- In those at end of life, strict control of blood pressure may not be necessary, and withdrawal of blood pressure lowering therapy may be appropriate.
- If blood pressure lowering therapy is considered necessary, ACE-inhibitors and ARBs remain the medicines of choice.
Evidence Base and Reasoning

Hypertension is a frequent comorbidity in people with type 1 diabetes (4). Poor glucose control may also contribute to hypertension. In the DCCT/EDIC cohort, higher HbA1c was strongly associated with increased risk of hypertension, while intensive diabetes therapy reduced the long-term risk of hypertension by 24% (5). Antihypertensive therapy has been clearly shown to reduce the risk of cardiovascular disease among people with type 1 diabetes. The American Diabetes Association (ADA) recommends a target BP of 140/80 mmHg for individuals with DM of both types (3). Lifestyle modification is recommended for all those with T1DM with BP >120/80 mmHg. Hypertensive people with diabetes are also at increased risk for diabetes-specific complications including nephropathy and retinopathy and treating hypertension reduces the risk of adverse cardiovascular events and stroke (3). ACE-inhibitors have been shown to prevent microvascular and macrovascular complications of type 1 diabetes and delay progression of diabetic kidney disease (6). They should be considered the medication of choice in older people with type 1 diabetes and hypertension as they proven survival benefits even in the presence of CAD, microalbuminuria, and diabetic nephropathy. ARBs should be considered first-line treatment and as an alternative to ACE-inhibitors in subjects with hypertension who cannot tolerate ACE-inhibitors (3). The renoprotective effects of ARBs and ACE-inhibitors may be independent of their blood pressure lowering properties. Beta-blockers can be considered, especially in people with an elevated pulse rate (2). The main concern is the masking of hypoglycaemic symptoms. Beta-blockers should be considered as part of combination therapy for people with tachycardia and/or coronary artery disease (3). A double or triple therapy using two agents may also be required to control blood pressure. Combination therapy should include medications from different classes. The usual approach is to add a CCB or diuretic to an ACE-inhibitor or ARB if monotherapy fails to control blood pressure.

USUAL CLINICAL PRACTICE

Measurement of blood pressure should take place during every routine visit of an older person with diabetes. A baseline and regular evaluation of organ damage and other comorbidities should be performed. It is important to consider and exclude secondary causes of hypertension which could be potentially reversible. Healthcare, professionals and
carers should be informed on the adverse medicines effects of all anti-hypertensive therapies.

**ASSESSMENT AND CLINICAL AUDIT MEASURES**

All local diabetes teams should audit the numbers of adults with type 1 diabetes who achieve their individualized blood pressure targets and identify those with consistent poor target achievement rates. The latter should prompt a review of the pharmacotherapy and any potential factors that lead to poor drug compliance.

**Potential Measure**

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<td>Number of adults with type 1 diabetes and hypertension, seen in the previous year with blood pressure levels within target range for functional category</td>
<td>Number of adults with type 1 diabetes and hypertension seen in the previous year</td>
<td>Number of adults with type 1 diabetes and hypertension with blood pressure levels in the target range as a percentage of total number with type 1 diabetes and hypertension seen in the previous year</td>
<td>Documentation and time of assessment</td>
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REFERENCES


MANAGEMENT OF DYSLIPIDAEMIA

Adults with type 1 diabetes demonstrate a lesser risk of dyslipidemia than adults with type 2 diabetes and lipid profiles of those adults with well-controlled diabetes are similar to non-diabetic individuals (1).

RECOMMENDATIONS

GENERAL

• Total cholesterol, LDL-cholesterol, HDL-cholesterol, and triglyceride levels should be assessed at diabetes diagnosis and at clinically relevant intervals.

• Always attempt to exclude common secondary causes of abnormal lipid profiles dyslipidaemia such as poor diabetes control, hypothyroidism, liver disease, nephrotic syndrome and excess alcohol intake

• Lifestyle interventions should include a full review of weight management, smoking status, alcohol intake and exercise undertaken and the dietary review should also include advice to reduce saturated fat, trans fat and cholesterol levels, and increase the intake of omega-3 fatty acids and observe the principles of nutrition for older adults (2).

• In the absence of definitive data, similar statin treatment approaches should be considered for those with type 1 or type 2 diabetes, particularly in the presence of other cardiovascular risk factors

• The risks and benefits of statin treatment should be explained to all adults with type 1 diabetes and must take into account information relating to the medical comorbidity profile, category of physical or cognitive function, and subject expectations/preferences

• Consider using a low dose statin for the primary prevention of cardiovascular disease in all adults with type 1 diabetes who have had diabetes for at least 10 years, have evidence of moderate to severe renal impairment, or are at high cardiovascular risk.

• Following an assessment of cardiovascular risk, all adults with type 1 diabetes can be considered for statin therapy using a low or middle intensity regimen as part of the secondary prevention of CVD

• All adults with type 1 diabetes and evidence of confirmed clinically significant cardiovascular disease, high-intensity statin therapy should be added to lifestyle therapy
• For adults with type 1 diabetes over 75 years of age, there is very limited information from clinical trials data relating to the benefits and risks of statin therapy and clinical decisions on treatment with a statin should be based on an individual assessment of cardiovascular risk; the threshold to commence statins should be low
• Bile acid sequestrants, folic acid derivatives, nicotinic acid or omega-3 compounds are not advised for CVD prevention in adults with type 1 diabetes
• Additional LDL-lowering therapy such as ezetimibe or a PCSK9 inhibitor may be of benefit in those with high atherosclerotic cardiovascular disease risk where levels of LDL remain higher than 1.8 mmol/l on other therapy.
• In adults with type 1 diabetes and high triglyceride levels (>4.5 mmol/l, >398 mg/dl) optimise glucose regulation, exclude other causes such as excess alcohol, and if necessary consider treatment with a fibric acid derivative or a fish oil if levels of triglycerides remain in excess of 10 mmol/l (>885 mg/dl) which is general advice given to adults with type 2 diabetes including older adults (5)
• The use aspirin therapy (75–162 mg/day) as secondary prevention of further atherosclerotic cardiovascular disease should be considered taking into account the risk of bleeding
• Lipid targets are as follows: LDL cholesterol < 2.0 mmol/l (< 80 mg/dl), triglyceride < 2.3 mmol/l (< 200 mg/dl), HDL cholesterol > 1.0 mmol/l (> 39 mg/dl), non-HDL cholesterol < 2.5 mmol/l (< 97 mg/dl). LDL cholesterol should be < 1.8 mmol/l (< 70 mg/dl) in established CVD (3,4).

SPECIFIC

CATEGORY 1: independent in ADL and cognitively intact; responsible for diabetes self-management

All general recommendations apply including the following emphasis:

• These individuals should be actively managed to reach agreed lipid targets.
• Statins should be considered as first-line therapy

**CATEGORY 2:** Degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty

• Lifestyle interventions should be attempted in the light of a subject’s capabilities
• Lipid lowering therapy should be prescribed with caution in the frail or those with significant medical comorbidity and less aggressive goals may be more appropriate
• Particular attention to muscular side-effects of therapy is needed particularly in those with mobility disorders

**CATEGORY 3:** disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia

• Lipid targets and frequency of lipid measurement can be less aggressive.
• The threshold for prescribing lipid lowering therapy in those with dementia or residing in an aged care home should be high
• Lipid lowering therapy in those at end of life is not usually necessary, and withdrawal of therapy may be appropriate.

**Evidence Base and Reasoning**

Poor glycaemic control, higher weight and insulin resistance are associated with a more atherogenic cholesterol presence in subjects with type 1 diabetes, while better glycaemic control improves lipid values (6). The metabolism of HDL-C in type 1 diabetes may be altered because of abnormal hepatic lipase and lipoprotein lipase activities related to exogenously administered insulin, and a subclass of HDL determined by nuclear magnetic resonance is associated with increased CHD risk in type 1 diabetes (7). Considerable advantages are present by lipid lowering therapy to reduce cardiovascular morbidity and mortality in subjects with type 1 diabetes (8). Lowering serum cholesterol by 1 mmol/l (38 mg/dl) reduces risk of CAD mortality by 50% in people aged 40-49 years, 33% in those aged 50-69 years and 15% in those aged 70-89 years (9). However, the benefits of treatment in people aged over 80 years are limited. Statin therapy in older people has recently been
reviewed (10, 11). Statin therapy is favourable for preventing cardiovascular events in those with diabetes who already have CAD and they reduce vascular events and mortality, and its efficacy in the primary and secondary prevention of CVD and reducing cardiovascular morbidity and mortality including sub study analyses in those with diabetes has been widely reported (12-16). The effect of statins on cognition are contradictory. In those with dementia, statins do not significantly affect cognitive decline, global function, behaviour or activities of daily living (17). However, statin withdrawal was associated with improvements in cognitive function in people with Alzheimer’s disease (17). Their use should be discontinued when the potential benefits are no longer clinically relevant. In subjects with severe physical or cognitive impairments, or in those in their last year of life, lipid lowering therapy might not be indicated. Fibrates can be considered as monotherapy or for adjunctive therapy for treatment of dyslipidemias, particularly in people who have hypertriglyceridemia and/or low HDL cholesterol. Concurrent use of gemfibrozil and statins in older people or those with chronic kidney disease (CKD) should be avoided.

In individuals with atherosclerotic cardiovascular disease the addition of exetimibe (18) or a PCSK9 inhibitor (19) may be helpful in lowering LDL to more satisfactory levels and improving clinical outcomes. Whilst aspirin use in those with diabetes and a previous history of myocardial infarction or stroke for secondary prevention is well established the evidence for its use in primary prevention is less consistent (20) and its modest benefits may not outweigh the bleeding risk in older adults. In cases of aspirin allergy, clopidogrel (75mg/day) can be used.

**USUAL CLINICAL PRACTICE**

Lipid evaluations have a pivotal role in the assessment of CVD risk. Secondary causes of elevated lipids, particularly metabolic dyslipidemia should be considered. The threshold for prescribing statins should low in older adults with type 1 diabetes to ensure benefits are widely available. Frequent monitoring of lipid levels may not be necessary in those with poor functional health but careful monitoring for potential statin side-effects is essential.
ASSESSMENT AND CLINICAL AUDIT MEASURES

Managing lipids in all adults with type 1 diabetes should be part of a complex approach to diabetes care. An audit of processes that have taken place to review the prescription of statins to those with CVD and audit to review monitoring of treatment side-effects are potential measures. A search for atherosclerotic disease such as coronary, periphery and symptomatic carotid artery disease or abdominal aortic aneurysms, and a family history of premature coronary artery disease should be part of a complete screen at diagnosis and should be evaluated.

Potential measure

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<td>Documentation and date of serum lipid measurement</td>
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REFERENCES


13 MANAGEMENT OF MICROVASCULAR RISK AND ASSOCIATED PATHOLOGIES

Section A: DIABETIC EYE DISEASE

RECOMMENDATIONS

GENERAL

- Where feasible, all adults with type 1 diabetes should have their eyes examined at the time of diagnosis and at least every 1-2 years thereafter. Where a screening program is in place, this should be part of a formal recall process.

- Where local eye screening programmes are available, primary care clinicians should promptly refer for screening all newly diagnosed subjects with type 1 diabetes.

- Depending on available resources, the eye examination could be done by direct fundoscopy through dilated pupils (using tropicamide) or fundus photography.

- Eye examination should include a check of visual acuity and measurement of intraocular pressure.

- All adults with type 1 diabetes should have optimal control of blood glucose, blood pressure, and blood lipids to minimise the risk or slow the progression of diabetic retinopathy.

- Specialist referral (to an ophthalmologist) and the urgency of appointment is as follows:
  - Same day: sudden loss of vision; evidence of retinal detachment.
  - Within 1 week: evidence of pre-retinal and/or vitreous haemorrhage; new vessel formation or rubeosis iridis.
Within 1-2 months: advanced retinal lesions (microaneurysms, venous beading, IRMAs in one quadrant; unexplained deterioration of visual acuity; macular oedema; unexplained retinal findings, cataract, inability to visualize fundus).

- All adults with type 1 diabetes and evidence of proliferative or severe non-proliferative retinopathy should be considered for laser photocoagulation to minimise visual loss.

- Intravitreal injections of anti-vascular endothelial growth factor (VEGF) agents and corticosteroids have been shown to be an effective treatment for center-involving diabetic macular oedema and also as an alternative therapy for proliferative diabetic retinopathy.

- All older adults with type 1 diabetes and/or their carers should have the reasons for having an eye examination explained to them.

- Cross-disciplinary data linkage of longitudinal data is essential.

**CATEGORY 1**: independent in ADL and cognitively intact; responsible for diabetes self-management

- All general recommendations apply to this category.

**CATEGORY 2**: degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty.

As for Category 1 but with the following added recommendations:

- Primary care clinicians should ensure that all adults in category 2 are not lost to diabetic eye service follow up and that domiciliary assessment is offered where available.

- Every endeavour should be made to ensure frail, housebound, and aged care home residents with type 1 diabetes receive clinically appropriate eye examination and care.
**CATEGORY 3:** disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia*

- A person with diabetes who lacks the mental capacity to consent to having an eye examination should not be permanently or automatically removed from a screening recall programme unless a ‘best interest decision’ to do so has been taken on his or her behalf.

- Convenient options for assessment should be considered and the least restrictive option chosen.
  - Routine eye examinations for detecting diabetic retinopathy will not usually be warranted, but eye health should be assessed as a part of regular general health assessments and scheduled physical examinations.
  - Ongoing treatment of known eye problems should be made on an individual basis after discussion between the person, attending physician, and carers.

- Management decisions relating to processes and procedures for optimising eye health should consider the person’s mental capacity, glucose control management and targets, and blood pressure management.

**Evidence Base and Reasoning**

Diabetic retinopathy is the most common complication of diabetes and a major cause of visual loss. Many adults with type 1 diabetes are likely to have had the disease for over 20 years by the time they reach 60 years of age (the older age-group). The overall 25-year incidence of any retinopathy (97%), rates of progression of retinopathy (83%), and progression to proliferative retinopathy (42%) for persons over 30 years of age with Type 1 diabetes is high, and the strongest most consistent relationship is with current retinopathy level, glycaemic control and duration of diabetes (1-3).
Duration of diabetes and glycaemic control are the two major risk factors for developing diabetic retinopathy (4-7). After 5 years of type 1 diabetes, approximately 25% will have retinopathy, and this rises to nearly 60% after 10 years and 80% after 15 years (4,5). The important influence of glucose control on retinopathy progression is well founded on evidence from randomized clinical studies and longer term follow studies (6,7). Several early clinical trials have provided a firm evidence-base for the effectiveness of photocoagulation in reducing the progression of proliferative diabetic retinopathy and severe sight loss in high-risk diabetic retinopathy eyes (8,9).

Early detection by regular surveillance is essential if people with sight-threatening retinopathy are to be identified in time to offer laser treatment or anti-VEGF to prevent visual loss.

Quality screening procedures are crucial to ensure timely detection of retinopathy and intervention to prevent or minimize visual loss (10).

All adults with type 1 diabetes in good mental and physical health should be offered regular eye examinations for diabetic retinopathy unless they choose not to be invited for retinal screening. Guidance that has been previously developed (11) enables several of the recommendations in category 3 to be implemented. Screening staff should be satisfied that the best interest decision has been reached in accordance with their local code of practice.

**USUAL CLINICAL PRACTICE**

Clinicians should be aware of the importance of the prevention of diabetic eye disease. Screening where a programme is in place, and early detection of visual loss in adults with type 1 diabetes are important objectives of a local diabetes eye screening service. This will involve ensuring that all services and pathways developed are adapted according to local availability and include those who may be less likely to be included in routine care.

The availability of treatment options, particularly sub-specialist care in relatively low resource settings may be a challenge. This requires prioritisation of clinical care based on what might be practical and feasible (preferred practice) versus aspirational (best practice).
There is merit in recognising that eye care needs and the value placed on various care options may vary depending on individual context. While life expectancy may be lower on average for a person with type 1 diabetes relative to a person with type 2 diabetes, there is a significant proportion of older persons with type 1 diabetes who have multiple co-morbidities. For example, vision impairment may have a detrimental effect on the ability of a person to self-manage the diabetes; including being able to draw and inject the correct dosage of insulin, check feet and perform foot-care, use appropriate spectacles for visually demanding tasks etc.

Training and education of healthcare teams should also include a focus on older people with high levels of dependency who are less likely to receive routine eye screening services. Clinicians should consider the functional status of the individual and the safety and benefit of any eye screening services when deciding referral strategies.

Cross-disciplinary data linkage is essential. Longitudinal diabetes-relevant data and eye health records from young adulthood through to older adults should be available for clinicians to track clinical progression.

**ASSESSMENT AND CLINICAL AUDIT MEASURES**

Monitoring of an eye screening programme performance against a set of quality assurance standards is essential. Access to case records that contain evidence of eye examinations is important. These will need to demonstrate evidence of referral to various members of the diabetes eye team according to evidence of specific eye disease.

Eye services should be routinely evaluated for quality and for their coverage of all eligible people including those in aged care homes or housebound older adults with type 1 diabetes.

**POTENTIAL MEASURE**

Unless there is a well-managed diabetes registry or a national screening program, the meaningfulness of the following metric is dependent on the accuracy of the denominator and the numerator.
<table>
<thead>
<tr>
<th>Measure</th>
<th>Denominator</th>
<th>Calculation of Measure</th>
<th>Data to be collected for calculation of Measure</th>
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<tbody>
<tr>
<td>Percentage of adults with type 1 diabetes who were comprehensively examined for diabetes eye disease in the last year</td>
<td>Number of adults with type 1 diabetes who require comprehensive examination for diabetes eye disease</td>
<td>Number of adults with type 1 diabetes who were examined comprehensively for diabetes eye disease as a percentage of all adults with type 1 diabetes who require this process</td>
<td>Documentation and date of the Eye examination procedure</td>
</tr>
</tbody>
</table>

References


Section B: DIABETIC RENAL DISEASE

RECOMMENDATIONS

General

- Screening for kidney disease should be performed at diabetes diagnosis and annually by measuring:
  - Serum creatinine and determining the estimated glomerular filtration rate [eGFR].
  - A urine test for albuminuria (albumin/creatinine ratio [ACR])
- Chronic Kidney Disease (CKD) is diagnosed when the GFR is <60 ml/min/1.73m² measured using the MDRD (Modification of Diet in Renal Disease) or CKD-EPI (CKD-Epidemiology Collaboration) formula with or without albuminuria (1)
- Urinary ACR measurement as a first morning void is the preferred method. If this is not possible, a random urine sample is appropriate.
- If ACR is elevated in the absence of infection, it should be repeated 6 weeks later
  - ACR>30 μg/mg is moderate albuminuria
  - ACR>300 μg/mg is severe albuminuria
- Once CKD is established more frequent monitoring of eGFR and ACR is required.
- Subjects with more advanced CKD may have reduced insulin requirements and insulin regimens must adapt accordingly
- Individuals with CKD should be managed as follows
  - Use of RAAS blockade (Ace inhibitor or angiotensin receptor blocker) in subjects with albuminuria
  - Management of elevated blood pressure
  - Management of glycaemia with an emphasis that those with CKD are prone to hypoglycaemia
  - Management of cardiovascular risk factors
  - Stop smoking
  - Avoid high protein diet
  - Adjust medications for level of kidney function
Avoid nephrotoxic medications including non-steroidal anti-inflammatory agents (NSAIDs).

Avoid whenever possible imaging studies with contrast agents

Encouraged to increase physical activity as tolerated

- Referral to a nephrology specialist service is indicated when there is diagnostic uncertainty, when GFR<30 ml/min/1.73m², rapid deterioration of GFR, uncontrolled hypertension, electrolyte and volume abnormalities and/or severe proteinuria.

**SPECIFIC**

Specific recommendations made for each of the categories detailed as follows:

**Category 1** – independent in ADL and cognitively intact; responsible for diabetes self-management

- All general recommendations are pertinent to this category. A lower BP or glycaemic goal should be considered in this category compared with other categories

**Category 2** – Degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty

- All general recommendations to prevent and treat CKD are pertinent to this category.
- Those with CKD develop frailty at a younger age so interventions to maintain appropriate ADL should be started earlier.
- Interventions to decrease sarcopenia include exercise as well as treatment of acidosis.

**Category 3** - disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency
*This will include those with cognitive impairment or dementia*

- All general recommendations to prevent and treat CKD are pertinent to this category.
- Conservative management rather than dialysis should be considered for those with limited life expectancy in this category, for example, in aged care home residents
- Palliative care should be considered for those with severe CKD or who are at end of life.

**Evidence Base and Reasoning**

It is important to screen individuals with type 1 diabetes for CKD as excess mortality is observed only in those that develop CKD (2,3). Albuminuria and chronic kidney disease are both important risk factors for development of cardiovascular disease (4,5).

In addition, they are also predictors of development of end-stage renal disease (ESRD) (6). In older adults with diabetes both albuminuria and CKD have been independently associated with mortality (7).

Older adults are the fastest growing age group on dialysis. In 2015, the mean age in incident dialysis subjects in the USA was 62.5 years with 43.9% of those having diabetes (8). CKD accentuates common geriatric symptoms such as frailty, cognitive decline, falls and functional decline (9).

Nephropathy is a common complication of type 1 diabetes developing in about 40% of subjects. However, not every individual with type 1 diabetes will develop nephropathy. In the Joslin Medalist study, only 6.7% of individuals living with diabetes for more than 50 years reported nephropathy (10). However, these individuals were more likely to have cardiovascular disease. Similar results were found in the Finnish Diabetic Nephropathy (FinnDiane) Study where 9.9% developed ESRD during a median 12.5 years of follow-up (11). However, development of ESRD varied according to albuminuria and GFR level. Individuals with non-albuminuric non-CKD developed ESRD only in 0.3% of cases compared to individuals with albuminuric CKD that developed ESRD in 63%.
Glycaemic control remains very important to control development of albuminuria and deterioration of eGFR (12). However, glycaemic targets must be defined taking in account that subjects with CKD are at higher hypoglycaemia risk (13,14) which has associated with increased mortality risk (15).

Albuminuria should be monitored over time as it has been shown that over half return to normoalbuminuria even without use of ACE-inhibitors (16). A lower prevalence of albuminuria was found in older individuals with type 1 diabetes using insulin pump therapy (17).

It is important to note that progression to CKD may occur in up to 25% of subjects with type 1 diabetes without having albuminuria (18). Rapid GFR decline has been found to be an important risk factor for progression in the non-older population (12,19).

**Usual Clinical Practice:**
Primary care providers should be trained in the prevention, screening and management of chronic kidney disease. Clinical decision-making includes using the safest medication for level of GFR. It is important to have guidelines for appropriate referral to nephrologist when clinically indicated. Laboratories that measure creatinine should also indicate the eGFR in the report. Multidisciplinary teams should include medical nutritional support as subjects may require increasing nutritional support as CKD progresses. It is important to consider the functional status when deciding treatment for an older individual with diabetes.

**Assessment and Clinical Audit Measures:**
The percentage of individuals with type 1 diabetes who had a screening for albuminuria and eGFR annually should be determined. Once CKD is established more frequent monitoring is required. The percentage of individuals with albuminuria and type 1 diabetes who are on RAAS blockade should be determined. Individuals with a contraindication for RAAS blockade should be documented (angioedema, hyperkalaemia, etc). Adequate blood pressure control individuals with type 1 diabetes and albuminuria should be determined.
### Potential Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Denominator</th>
<th>Calculation of Measure</th>
<th>Data to be collected for calculation of Measure</th>
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<tbody>
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<td>The percentage of adults with type 1 diabetes who had a measure for albuminuria during the last year</td>
<td>Number of adults with type 1 diabetes seen during the last year</td>
<td>Number of adults with type 1 diabetes with a measure of albuminuria as a percentage of adults with type 1 diabetes seen during the last year</td>
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<td>The percentage of adults with type 1 diabetes who had a measure for eGFR during the last year</td>
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<td>Documentation and date of creatinine measurement (and calculated eGFR)</td>
</tr>
</tbody>
</table>

### References

3. Orchard TJ, Secrest AM, Miller RG and Costacou T. In the absence of renal disease, 20 year mortality risk in type 1 diabetes is comparable to that of the general population: a


Section C: Diabetic Foot Disease

Recommendations

General

- All adults with type 1 diabetes should receive a comprehensive assessment of their feet annually which includes a detailed history of their functional health, co-morbidities, treatment and risk factor identification for prevention of ulcers and amputations; in cases with vascular insufficiency or loss of protective sensation, or previous history of ulceration or amputation, foot examination is recommendation at each visit.

- Foot examination should include: a detailed inspection of foot wear, presence of infection, callus, and deformities; assess risk for neuropathy using 10gm monofilament, 128-Hz tuning fork for vibration or bioesthiometer; assess peripheral vascular circulation through palpation of dorsalis pedis and posterior tibial arteries or by ankle–brachial pressure index (ABPI). Note: ABPI value <0.9 indicative of vascular insufficiency but readings may be misleading in severe atherosclerotic stiffness.

- In cases who are at high risk of a foot ulcer or amputation (previous ulcer/amputation, Charcot foot, subjects with severe renal impairment on dialysis) an integrated approach to foot care is recommended using a skilled multidisciplinary team.

- All adults with type 1 diabetes should receive education about preventative foot care from their local diabetes or healthcare team: ideally, this should be part of a structured diabetes education programme.

- All adults with type 1 diabetes should have access to specialist teams to assess worsening lower limb vascular function.
• All adults with type 1 diabetes who smoke should be positively encouraged to stop smoking

**SPECIFIC**

**Category 1:** Independent in ADL and cognitively intact; responsible for diabetes self-management

All general recommendations apply with added measures:

• Annual review procedures should make an assessment of future risk by continued risk factor detection and management

• Optimisation of glucose, blood pressure and lipids should be aimed for to reduce vascular risk

• Foot care education can be reinforced to reduce future foot complications

• In cases of moderate (1-2 risk factors – neuropathy or ischaemia) to high risk (>2 risk factors or previous ulcer or amputation), increase reviews by the clinician or foot care team to 3-6 monthly, reinforce foot education, and consider specialist referral as appropriate

• In cases of active ulceration, with or without infection, refer to multi-disciplinary specialist team to consider off-loading methods, debridement, active treatment of infection and exclusion of osteomyelitis, vascular surgical review, or acute hospitalisation

**Category 2** - Degree of ADL loss or limitation of walking associated with multi-morbidity or diabetes complications; may have features of moderate frailty

As for category 1 with added measures:

• Assess for undernutrition, review comorbidity profile, and detect features of frailty if present

• Assess the impact of any visual loss or falls history on foot health
• Ensure that carers have received education in the basics of diabetes foot care and have knowledge of how to prevent foot injury

**Category 3** - disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia

As for category 2 with added measures:

• Consider less stringent treatment targets for glycaemic control if frail and have high co-morbidity, and review insulin regimens

• Consider conservative measures in severe disability or dependency concentrating on symptomatic management if life expectancy less than 6 months

• Take into account a subject’s quality of life and overall health status particularly when any invasive vascular or surgical procedures are being considered

• Involve family members and carers in all clinical decision making.

**Evidence Base and Reasoning**

Diabetic foot disease leading to foot amputation is recognized as a major complication of diabetes and is associated with significant morbidity, prolonged hospitalisation, poor quality of life and significant cost (1-3). Despite the seriousness of this condition, the majority of ulcers are preventable and the prospect of preventing foot disease was the focus of the previous St Vincent declaration which aimed to reduce the number of amputations by 50%. Diabetic foot disease is more common in older adults with type 1 diabetes and presents with additional challenges. Presence of co-morbidities, visual impairment poor mobility and inability to self-care are all associated with increased risk of foot disease in this age group (4). Moreover, some of the established management approaches that have been advocated for younger adults may not be suitable in older adults and may require an individualised approach (5). With improved care and increasing life expectancy, more people with type 1
diabetes are now living longer and there is a clear need to understand how the evidence for appropriate foot care in individuals with diabetes can be applied to older subjects with this condition.

There is extensive evidence surrounding the pathogenesis and management of foot disease in those with diabetes. Unfortunately, many studies have not differentiated between type 1 and type 2 diabetes specifically and there is scanty evidence in age groups above 75 years as they are generally excluded from clinical trials. Nevertheless there is a common recognition that the key principles of management of diabetic foot disease applies across all types of diabetes and age groups.

Most diabetic foot ulcers occur within the setting of neuropathy and peripheral arterial disease (PAD) and often precipitated by trauma and infection. Chronic exposure to hyperglycaemia, through complex mechanisms leads to accumulation of advanced glycation end-products (6) and nerve damage leading to loss of protective sensation (sensory neuropathy), abnormal distribution of pressure and callus formation (motor neuropathy) and absence of sweating (autonomic neuropathy) all of which are known to contribute to development of a foot ulcer (7). Loss of protective sensation and poor vibration sense can be particularly relevant in older adults who are prone to injuries and falls leading to foot ulceration (8). PAD is present in up to 70% of older adults with foot ulcers and is known to be associated with delayed wound healing (9). PAD may occur on its own in those with diabetic foot disease but more frequently co-exists with neuropathy and dependent on the predominant cause, ulcers can be classified as neuropathic, ischaemic and neuro-ischaemic. Other risk factors include trauma, foot deformities and ill-fitting foot wear (10). There are established classification systems to assess diabetic foot ulcers which assess wound depth, vascularity and infection and can be easily applied in routine clinical practice (11,12).

The principal aim of management of diabetic foot disease is to prevent foot ulceration and need for amputation (13). This is achieved through education and annual foot checks. In those with foot ulcers, a multi-disciplinary approach involving adequate immobilisation, wound management, revascularisation and treatment of infection is highly effective in achieving wound closure and reducing amputation rates (2,14-18). Rarely, amputation may be necessary especially in the face of life threatening infection or ischaemia.
Usual Clinical Practice

Effective implementation of the recommendations requires strategies to educate people with diabetes and their carers where present. Awareness campaigns encouraging subjects to check their feet must be encouraged. As most individuals are likely to be cared for in a primary care setting, education and training of general practitioners, nurses and podiatrists to screen for risk factors and early signs of foot disease is essential. Training must be supplemented by availability of basic tools to undertake risk assessment and access to protocols and guidelines. Although most guidelines can be applied to older individuals without much alteration, the specific needs of older adults, need for carer input into decision making, and impact on their co-morbidities and quality of life must be considered when planning invasive interventions. Establishing foot care pathways involving a multidisciplinary team with ready access to imaging and vascular services and specialist services is vital. Management of foot disease in individuals with diabetes requires considerable resource. Health care commissioners must therefore take this into account where possible and ensure provision of adequate preventative and treatment facilities.

Assessment and Clinical Audit Measures

Routine clinical audits to evaluate the care of those with foot disease must be undertaken to identify areas of concern and make improvements. Data collected must include demographics with identification of type of diabetes and age group, ability to self-care, place of residence, details of contact, description of the problem, intervention and outcomes. Audits should ideally measure structures in place to deliver the recommended care, the processes (compliance with the guideline) and the outcomes, for example, ulcer healing rates and amputation rates.
Potential measure

<table>
<thead>
<tr>
<th>Measure</th>
<th>Denominator</th>
<th>Calculation for Measure</th>
<th>Data to be collected for the calculation of Measure</th>
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<td><strong>Number of adults with type 1 diabetes having at least one foot examination in the past year</strong></td>
<td>Number of adults with type 1 diabetes who were seen in the previous year</td>
<td>Number of adults with type 1 diabetes who had at least one foot examination in the previous year as a percentage of adults with type 1 diabetes seen in the previous year</td>
<td>Documentation and date of assessment</td>
</tr>
</tbody>
</table>

References


18. Diabetic Foot problems: prevention and management

https://www.nice.org.uk/guidance/ng19; Date accessed 26/09/2016
Section D: DIABETIC NEUROPATHY

RECOMMENDATIONS

GENERAL

- All adults with type 1 diabetes should undergo examination of the peripheral nerves at the initial visit and as part of the annual review using a 10 g monofilament or 128 Hz tuning fork; a biothesiometer (cut-off point for ulcer risk > 25 volts); or non-traumatic pin-prick.

- Management of adults with type 1 diabetes and peripheral neuropathy includes:
  - Optimising glucose control
  - Regular foot care
  - Management of cardio-vascular risk factors (hypertension, hyperlipidaemia, smoking cessation, etc.)
  - Pain relief (if indicated).
    - Exclude other causes of pain in the limbs.
    - A systematic, stepwise approach to different therapies with consideration of safety, tolerability, careful dose titration, treatment adherence, and adverse events.
    - Therapeutic options include antidepressants (amitriptyline, duloxetine), anticonvulsants (e.g. pregabalin, gabapentin), opiates (e.g. tramadol, oxycontine), capsaicin cream, lidocaine patch, alpha-lipoic acid and transcutaneous electrical nerve stimulation.
    - Antidepressants, anticonvulsants and opiates may adversely affect stability, balance, and cause cognitive problems and careful titration is essential.

- Consider the presence of gastroparesis if clinically indicated:
  - A definitive diagnosis for gastroparesis requires measurement of gastric emptying by scintigraphy.
Management consists of optimizing glucose control; maintaining adequate hydration and nutrition (small low fat/fibre meals); prokinetic agents (metoclopramide, domperidone) or erythromycin for symptomatic gastroparesis.

- Consider the presence of neurogenic bladder in the presence of urinary retention and incontinence
  - A definitive diagnosis requires an objective assessment of bladder emptying using ultrasound as part of an urodynamic evaluation.
  - Organize an individualized management programme to decrease incontinent episodes.
  - Intermittent catheterization may be required for the atonic bladder.

- Consider the presence of cardiovascular autonomic neuropathy (CAN) if clinically indicated.
  - Diagnose cardiovascular autonomic neuropathy by resting tachycardia and heart rate response to provocation tests (lying-standing, Valsalva, deep breathing), and by lying and standing blood pressure.
  - Treatment options for postural hypotension include stopping drugs that cause or exacerbate postural hypotension (e.g. diuretics, β-blockers, anti-anginal agents, tricyclic antidepressants), increasing salt and fluid intake with caution in heart failure, and drug treatment (fludrocortisone, midodrine).

- Enquire about erectile dysfunction (ED) as part of the annual review.
  - The diagnosis is based on history and exclusion of endocrine conditions (consider measuring prolactin and testosterone).
  - The presence of ED should prompt a review of cardiovascular risk factors.
  - Treatment options include psychosexual counselling, hormonal therapy, pharmacotherapy, mechanical devices, and vascular surgery. Phosphodiesterase type-5 (PDE5) inhibitors are the usual first-line therapy in the absence of contraindications.
Consider referral surgical management if PDE5 inhibitors are ineffective or contraindicated.

**SPECIFIC**

**CATEGORY 1:** – independent in ADL and cognitively intact; responsible for diabetes self-management

- All general recommendations apply to this category.

**CATEGORY 2:** Degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty

As for category 1 but with added measures:

- In the presence of frailty, treatment approaches will in general be cautious and tailored to a prediction of likely benefits, use limited procedures for evaluation, and an optimal and safe dosage regimen of therapeutic agents

**CATEGORY 3:** disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia

- Residents of aged care homes have a high prevalence of untreated pain and every effort should be made to detect and treat this symptom
- In cases of dementia, pain assessment is particularly important and should be formally evaluated in people with neuropathy
- Adequate pain management may lessen agitation and increase oral intake in people with dementia who are unable to explain their symptoms or ask for pain medicines.
- Opiates should be used with great care because they may produce confusion in older adults with existing cognitive problems.
- For those at end of life, detailed assessment procedures are not usually warranted and conservative management is recommended.
- Pain relief remains an important consideration and pharmacotherapy indicated for maximum pain relief commensurate with acceptable side-effects and improvement in quality of life.

**Evidence Base and Reasoning**

Diabetes-related neuropathy contributes not only to foot problems but also results in a range of troublesome symptoms including pain/paraesthesia, postural hypotension, gastrointestinal, bladder, and sexual problems.

Around 20% of people with diabetic polyneuropathy have painful neuropathic symptoms including tingling (paraesthesiae), burning, electric shock type, aching, cramping and contact (e.g. with bed-cloths) pains also known as allodynia. In the majority of suffers with painful neuropathy can continue to have painful symptoms for several years. It is important to consider and exclude other causes of pain in the limbs by careful assessment. The most common of these are claudication, Morton’s neuroma, Charcot neuroarthropathy, fasciitis, osteoarthritis, and radiculopathy. Management of diabetic neuropathy requires treatment of the underlying disease (diabetes) and the treatment of the neuropathy itself. It is important to consider the safety and tolerability of different therapies for neuropathic pain. Dosages must be started at lowest doses and titrated gradually based on efficacy, adverse events and treatment adherence.

The medical management of neuropathy for people with frailty and/or dementia or those in an end of life scenario poses many challenges. Intensive investigation and strict glucose control become less important but relief from pain and avoiding hypoglycaemia are paramount. In people with dementia, these measures can reduce the risk of agitation and confusion.
Aspects of neuropathy which do not relate directly to foot care have received increasing attention in evidence-based guidelines (1-3). There is general agreement that stabilizing glycaemic control is important in the medium and longer term. The effect of hyperglycaemia on disease progression is well established in type 1 diabetes by the Diabetes Control and Complications Study (DCCT) (4). Exclusion of non-diabetic causes of neuropathy (e.g. B12 deficiency) is important. Treatment of painful neuropathy can be challenging as only around 50% have 50% pain relief with any single drug (5). Recent Cochrane reviews (6-9), meta-analyses (10-12), consensus guidelines (3,13,14) and NICE 173 (15) support the choice of amitriptyline (25-75mg/day), duloxetine (60-120mg/day) and the anticonvulsants pregabalin (300-600mg/day) and gabapentin (0.9-3.6g/day) as first line agents for painful diabetic neuropathy. Second-line drugs include opioids (e.g. tramadol, oxycodone) either alone or in combination with other agents and this approach can improve symptom control in individuals not controlled with other agents or monotherapy (5). Treatment with oral alpha lipoic acid 600 mg once daily in people with symptomatic painful diabetic polyneuropathy who are refractory to or intolerant of antidepressants or anticonvulsants, may be of beneficial (5). Electrical nerve stimulation is probably effective for reducing neuropathic pain and results in a modest improvement in pain on the visual analogue scale after 6 weeks (16). Severe painful neuropathy unresponsive to pharmacotherapy may be managed by electrical spinal cord stimulation but this has to be undertaken at specialist centres only (17).

There are a variety of manifestations of autonomic neuropathy including gastroparesis, urinary retention and incontinence, ED, and CAN. Gastroparetic symptoms may improve with dietary changes and prokinetic agents such as metoclopramide, domperidone (lowest doses used for a short periods due to risk of QT abnormalities and arrhythmias) or erythromycin. Although there is limited research on specific dietary changes for improving gastroparetic symptoms, recommendations for low-fibre and small, frequent meals, with a greater proportion of liquid energy has been helpful for some individuals (18). Despite the relatively poor predictive value of symptoms, it is reasonable to suggest a trial of prokinetic therapy for about 4 weeks, rather than initially establishing the diagnosis by measurement of gastric emptying. Refractory gastroparesis may be treated with gastric electrical stimulation (GES)(19). Urinary retention and incontinence is common and cause a feeling of discomfort in older people with diabetes. Ultrasound scan of the urinary tract, intravenous
urography and urodynamic studies may be required. Treatment includes mechanical bladder emptying using suprapubic pressure or intermittent self-catheterization. ED is also a common but often overlooked complication of diabetes, especially in older people. However, ED may greatly decrease quality of life. Therefore, specific enquiry should be included as part of the annual review and contributory factors reviewed. Treatment options include PDE5 inhibitors and other medical or surgical management. PDE5 inhibitors are the usual first-line therapy in the absence of contraindications (20). CAN should be suspected by a resting tachycardia (> 100 bpm) or orthostatic reduction in blood pressure (a fall in SBP > 20 mmHg on standing without an appropriate heart rate response). It is associated with increased cardiac event rates (20).

Older people with frailty, functional disability, or multiple comorbidities are usually excluded from clinical trials which makes applying current evidence to clinical practice difficult. Finally neuropathy in type 1 diabetes is driven by vascular risk factors in addition to hyperglycaemia and hence cardio-vascular risk reduction is considered important (21).

**USUAL CLINICAL PRACTICE**

Appropriate protocols should be developed for sensory testing and may include formal assessment using the Neuropathy Disability Score or the Toronto Clinical Scoring System (1). Healthcare professionals should be trained in the diverse manifestations of autonomic neuropathy and be aware of appropriate investigative procedures. Recommended medicines should be available.

**ASSESSMENT AND CLINICAL AUDIT MEASURES**

Evaluation of quality diabetes neuropathy care is by having systems in place for regularly screening for peripheral neuropathy in both inpatient and community clinical sectors, assessing the annual incidence of confirmed neuropathy, neuropathy related foot ulceration and associated morbidities, and hospitalization due to severe neuropathic pain.
### Potential measure

<table>
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<tr>
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<th>Denominator</th>
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<td>Documentation and date of assessment</td>
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</table>

### REFERENCES


7. Duloxetine for treating a painful neuropathy, chronic pain or fibromyalgia obtained from www.cochrane.org/CD007115/NEUROMUSC_duloxetine-for-treating-painful-neuropathy-chronic-pain-or-fibromyalgia


14 INPATIENT MANAGEMENT OF TYPE 1 DIABETES AND KETOACIDOSIS

RECOMMENDATIONS

General

- The over-riding principle should be that if the adult with type 1 diabetes manages their condition effectively and safely at home, then they should be deemed competent to self-manage their diabetes in hospital, unless there are specific reasons why this should not be the case.

- Admitting institutions and hospitals should make provisions to allow adults with type 1 diabetes to diabetes self-manage and have written policies to support this; this should include enabling subjects to take responsibility for their capillary glucose readings and act on them accordingly, or self-administer (i.e. give themselves their insulin) if they are well enough to do so.

- All admitting institutions and hospital should have evidence of regular mandatory staff education in insulin management, and carbohydrate content displayed on menus.

- Glycaemic targets for inpatients vary; for those undergoing surgery or who are admitted acutely unwell, a target level of glucose in line with the Joint British Diabetes Society (JBDS) guidance is 6-10 mmol/l if it is not associated with hypoglycaemia; for those who are non-critically ill subjects, a target of 7.0 mmol – 12.0 mmol/l (126 – 180 mg/dl) is reasonable and acceptable particularly in older adults, as long as these targets can be safely achieved.

See:
For inpatients who are not critically unwell, are able to eat, and where subcutaneous insulin administration is feasible and safe, consider using a subcutaneous basal–bolus insulin regime to main satisfactory glucose levels.

For inpatients who are acutely unwell, or who are scheduled for major surgery, or who are demonstrating wide fluctuations in glucose, use an agreed intravenous insulin regimen which is familiar to the clinical team managing the subject; at all times, liaise with the anaesthetist and surgical team to agree best practice before, during and after major surgery.

All adults with type 1 diabetes admitted into hospital should receive an assessment of their diabetes management (both general and self-management) by an in-hospital diabetes specialist team as soon as possible after admission and ideally within 24 hours.

Each admitting institution or hospital should have a ‘Hypoglycaemia treatment’ protocol in place which is regularly audited.

Each admitting institution or hospital should ensure that all health professionals involving in managing diabetic ketoacidosis have received wide training and education in safe and effective care of this acute complication.

The definition and diagnosis of diabetic ketoacidosis (DKA) consists of the demonstration of the biochemical triad of ketonaemia (ketosis), hyperglycaemia, and acidaemia.

**SPECIFIC**

**Category 1:** Independent in ADL and cognitively intact; responsible for diabetes self-management

- All general recommendations apply

**Category 2:** Degree of ADL loss or limitation of walking associated with multimorbidity or diabetes complications; may have some features of early to moderate frailty

As for category 1 with added measures:
• The diabetes specialist team and dietetic team should work collaboratively on developing agreed pathways with ward teams, to allow early assessment of risk based on capacity and meal patterns, for all insulin treated inpatients whose functional level has changed adversely
• Assessment of inpatient risk and insulin regimen(s) should not be automatically translated to circumstances following discharge, where meal patterns and type will be different.
• Wherever possible if the subject has the cognitive and physical ability to do so, they should be allowed to manage their own diabetes in hospital if that is what they have been doing successfully at home
• Frail older inpatients with type 1 diabetes are at particular risk of hypoglycaemia, with an increased risk of falls and cognitive impairment, and hypoglycaemia avoidance should be an important concern
• Older vulnerable adults with DKA require immediate specialist medical and nursing care to reduce adverse clinical outcomes

**Category 3:** disabled due to vascular disease, or requiring carer input, or unable to self-manage*, or care home residency

*This will include those with cognitive impairment or dementia*

• In those adults with marked cognitive impairment or dementia, or who recently been admitted from an aged care home, assess social and nursing care needs, ensure the early involvement of the specialist diabetes team to implement the most effective insulin regimen and treatment and to plan effective safe insulin regimens and plans following discharge
• Adults with reduced life expectancy who develop features of DKA should be assessed for fluid replacement, insulin therapy, their tolerability for regular close monitoring, and the goals of treatment promptly agreed by the admitting team and patient/family where possible
Evidence Base and Reasoning

Life expectancy in the population with type 1 diabetes may have improved in absolute and relative terms over the last 40 years, and although excess mortality is still evident (1-3), the population of older adults with long standing type 1 diabetes is increasing. One of the best estimates of prevalence of type 1 diabetes in a national inpatient population is derived from the UK National Diabetes Inpatient Audit (NaDIA) which has run annually since 2012 (4). This programme (last published data from 2015) is derived from a snapshot analysis of clinical care over one day in 206 UK sites with inpatient beds, and with data from 15,229 inpatient with diabetes. The prevalence of type 1 diabetes was 7%, and this population were significantly more likely (32.9%) to have been admitted with diabetes specific issues than other diabetes groups, who were predominantly admitted with diabetes rather than because of it. In the overall population with diabetes, 53.5% were aged > 75 years old, and 19.9% were > 85 years old, although type 1 diabetes is likely to under-represented in this older age group. The NADIA inpatient population with diabetes suffered very high rates of medication errors (38.3%), prescription errors (22.2%), and severe inpatient hypoglycaemia (9.8%), and in older adults with type 1 diabetes, these errors may be exacerbated because of cognitive and frailty issues.

In UK and European populations severe hypoglycaemia requiring emergency attendance and admission is a particular issue in adults with diabetes on insulin or sulphonylurea therapy (mainly type 2 diabetic populations) many of which have complex comorbidity or frailty problems (5-11). This high rate of admission is exacerbated by inappropriate glucose targets for the various age groups (12,13). The risk of development of diabetic ketoacidosis (DKA) in older adults with type 1 diabetes is increased by increasing dependency, inability to self-care, co morbidities and sepsis (14), and its associated mortality remains high (14,15), which is striking when national surveys suggest a relatively low mortality for DKA in an all age population (16).

Recent data has confirmed that people with dysglycaemia are hospitalised more frequently than those with normal glucose concentrations. People with prediabetes have a 1.3 times greater risk of hospitalisation; those with previously undiagnosed diabetes, 1.6 times higher;
and those with diabetes are between 3.1 and 1.5 times higher, depending on glycated haemoglobin concentrations (greater than or less than 53mmol/mol [7.0%] respectively) (17). A large proportion of these individuals will be on insulin. Intravenous insulin is also used as the treatment of choice e.g. during periods of prolonged starvation (18,19).

Glycaemic targets for inpatients with diabetes vary, with an acceptable range being 6-10 mmol/l for adults with type 1 diabetes who are critically ill, although for non-critically ill subjects, a target of 7.0mmol – 12.0mmol/l (126 – 180 mg/dl) is acceptable in older subjects because there is little evidence that stricter targets are associated with better outcomes. In order to help achieve these targets, the American Diabetes Association advocates the use of electronic insulin order sets (20). However, education of the staff providing the care remains a priority because the harms associated with insulin use are well documented. In the UK, insulin is high on the list of medications associated with medication errors (21,22), and insulin related avoidable harm is on the list of ‘Never Events’ from the UK Department of Health (23). There are a number of reasons why those on insulin are vulnerable to the potential harms of insulin therapy. Hypoglycaemia in any age group, regardless of whether caused by insulin or not, is associated with increased hospital length of stay, and increased mortality (24,25).

Deciding what is the best level of glycaemia in adults with type 1 or type 2 diabetes in hospital is often a matter of best clinical practice as clinical trial evidence is limited although there are data to show that hyperglycaemia in surgical subjects is associated with harm, and guidelines are available on how this should be managed (26). Many subjects in hospital may be on glucocorticoid treatment which raise glucose concentrations (27). There are algorithms available to help counteract these, sometimes unpredictable, rises in glucose, and these should be used when high dose glucocorticoid therapy is used (28).

**Development of Diabetic Ketoacidosis**

An improved understanding of the pathophysiology of DKA together with close monitoring and correction of electrolytes has resulted in a significant reduction in the overall mortality rate from this life-threatening condition (29). Mortality rates have fallen significantly in the last 20 or so years from 7.96% to 0.67% (30,31) Unfortunately, the mortality rate is still high in developing countries and among non-hospitalised adults (32). This high mortality rate
illustates the necessity of early diagnosis and the implementation of effective prevention programmes.

**Usual Clinical Practice**

Hospitals should have written policies in place that allow the individual with diabetes, in conjunction with the nursing staff, to be given the choice to self-manage (i.e. take responsibility for their capillary glucose readings and act on them accordingly) or self-administer (i.e. give themselves their insulin) if they are well enough to do so (33). To allow them to do so, meals should be provided regularly, and the carbohydrate content of meals should be clearly displayed on menus. Nevertheless, it may well be that during their hospital admission an individual’s clinical condition changes, e.g. they become more confused, more unwell, or under the influence of an anaesthetic whilst in hospital. In these situations the decision to allow self-management needs to be reviewed regularly to ensure that good diabetes care is maintained. Regular education, e.g. from the diabetes specialist team or from e-learning, should be undertaken by medical and nursing staff to ensure they remain confident and competent in managing diabetes in inpatients, something that has been shown to be lacking (34).

Care and consideration is needed when looking after people with diabetes on a continuous subcutaneous insulin infusion. Many of these individuals will have received a great deal of high quality education from the specialist diabetes team surrounding the use of the equipment and will be very familiar with how it works, and what to do when glucose readings are out of range. If the person with diabetes is unable to self-manage, and ward staff are unfamiliar with the equipment, then advice should be sought from the specialist diabetes team as soon as possible. Institutions also have a duty of care towards their other adults with diabetes, and thus care must be taken to safely store the insulin, needles, lancets, devices, etc. in a secure cabinet at times when they are not needed.

It is well recognised that the immobility associated with even a brief hospital stay is associated with loss of muscle strength in many older inpatients (35). This, together with the reductions in the ability to correct an unsteady gait and slower reaction times, increase the
risk of falls. Symptomatic hypo- or hyperglycaemia are likely to increase the risk of falls, and thus glycaemic targets in hospitalised subjects should be between 7.0mmol/l and 10mmol/l (126 – 180 mg/dl), as long as these targets can be safely achieved (20, (36)). However, those who have the physical and cognitive capacity to do so, should be allowed to continue to self-manage should they wish to, and are deemed competent to do so by the attending clinical team.

There are few data to look specifically at the needs of those with type 1 diabetes and dementia in hospital. In this group of vulnerable adults, the ability to self-care will be diminished. The care of someone with insulin treated diabetes will depend on a number of factors e.g. their underlying co-morbid state, their oral intake, their activity level, and the degree of cognitive ability to co-operate with feeding. Where these activities of daily living are diminished, then the carers will already have taken responsibility for their diabetes at home but in hospital, help should be sought from the diabetes inpatient specialist team on how their diabetes management should be changed to address the specific needs of the individual with diabetes.

For insulin treated inpatients with a history of stroke, diabetes management can present a challenge. In hospitalised stroke subjects fed by the enteral route, the management of hyperglycaemia should be balanced against the risks of hypoglycaemia. Both are associated with potential short and long term harm, but hypoglycaemia – in particular between feeds, is a potentially life threatening event (20). There are many factors that need to be considered in this circumstance. These include the age of the person with diabetes, the type of insulin regimen, the level of pre-morbid glycaemic control, the type and duration of feed.

As with other situations, in people who take a basal insulin as part of their regimen, this should be maintained (36). This should be given subcutaneously, even if the subject has an intravenous insulin infusion. Wherever possible the use of the variable rate intravenous insulin infusion should be kept to a minimum, and if it is used, then a 10% dextrose infusion should be administered if no feed is being given (20). Subjects should have their capillary glucose concentrations measured regularly – every 4 to 6 hours as a minimum. As in other situations, the glycaemic targets are between 7.0mmol/l (126 mg/dl and 10.0mmol/l (180 mg/dl) whilst on the enteral feed (unless critically ill), as long as these targets can be safely
achieved (20,(36)). If an individual was on a basal bolus regimen, then the basal insulin should be given at the start of the feed and the bolus doses given at 6 and 12 hours later.

In individuals on premixed human insulin, 50% of the total daily dose should be administered subcutaneously at the start of the feed, and the remaining 50% at the midpoint of the feed. If isophane insulin is used, then the whole dose should be given subcutaneously at the start of the feed and, if necessary, and depending on the length of action of the insulin, at the midpoint of feed. For those on a basal bolus regimen, then the basal insulin should be continued, and soluble human insulin given at the start and, if necessary, at the midpoint of the feed ( (36)). If the insulin has been given and the feed is stopped for any reason at an unplanned time, then glucose concentrations should be monitored more frequently (e.g. hourly, or every 15 minutes if there are signs or symptoms of hypoglycaemia), and if hypoglycaemia does occur, then appropriate action should be taken.

In the event of persistent hyperglycaemia (glucose values of >12mmol/l (216 mg/dl) on two consecutive occasions) then urine or capillary ketone concentrations should be checked. If they are normal, then the dose of insulin will need to be increased accordingly, but if the ketone levels are >2+ or >3.0mmol/l ( >17.43 mg/dl) respectively, and the bicarbonate is <15 mmol/l (15 mEq/L), or he venous pH is <7.3, then treatment for diabetic ketoacidosis (DKA) should be started (29).

**Key Principles in Managing Diabetic Ketoacidosis**

- Specialist care is particularly recommended for younger adults (less than 30 y age), older adults (>70 years age), those with serious co-existing medical illnesses, and type 1 adults who are pregnant
- Use isotonic saline for fluid replacement in adults with DKA which must not be given too rapidly (except in cases of significantly reduced circulatory volume or collapse) but noting that for a 70Kg individual, up to 7 litres may have been lost
- Remember that the main pathophysiological aims of fluid replacement are: maintenance of the circulatory volume; correcting electrolyte instability, and the clearance of ketones
• Insulin treatment: a fixed rate intravenous insulin infusion (FRIII) calculated on 0.1 units/per kilogram body weight is recommended

• The main targets for resolving DKA are: reduction of the blood ketone concentration by 0.5mmol/L (2.9 mg/dL) /hour • Increase the venous bicarbonate by 3.0mmol/L (3 mEq/L) /hour • Reduce capillary blood glucose by 3.0mmol/L (54 mg/dl)/hour • Maintain potassium between 4.0 and 5.5mmol/L (4 -5.5 mEq/L)

• Throughout the critical management of an adult with DKA, maintain close monitoring/supervisory control of the change in ketones and glucose levels, examine for signs of fluid overload, and prevent hypokalaemia. If the subject is not already on a high dependency unit or intensive care unit (recommended), be prepared to transfer the subject to one of these latter units when there are increasing concerns that recovery is not taking place satisfactorily

• Subjects recovering from DKA should have timely access to snacks and food in addition to their insulin treatment when this is appropriate

In people with type 1 diabetes, indeed all insulin treated diabetes, who are at receiving end of life care, special measures should be taken to ensure that the person does not develop symptoms of hypo or hyperglycaemia, by ensuring that the glucose targets are adjusted appropriately, and keeping glucose concentrations between 6.0 and 15.0mmol/l (108 – 270 mg/dl) (37).

Assessment and Clinical Audit Measures

With the advent of newer technology allowing the integration of results from all blood glucose meters across a hospital, assessment of adults with type 1 diabetes who experience hypo- or hyperglycaemia whilst in hospital is now possible.

Potential measure

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Number of adults with type 1 diabetes who have experienced an episode of hypoglycaemia as a percentage of the number of adult inpatients with type 1 diabetes in hospital during the same period

Documentation and details/method of survey

References


of severe hypoglycaemia requiring emergency treatment in Andalusia (Spain): the PAUEPAD project. *Diabetic Med* 2015; 32:1520-1526


