National Diabetes Services Scheme

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Clinical Guiding Principles for Sick Day Management of Adults with Type 1 Diabetes or Type 2 Diabetes

A Guide for Health Professionals

June 2020

Your trusted partner in diabetes care

ADEA is a National Health Professional Body Agent for the NDSS.

The NDSS is administered by Diabetes Australia

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The Commonwealth, Diabetes Australia and ADEA take no responsibility for any adverse consequences that arise as a result of using the content of this resources for clinical purposes. Health professionals need to consider the individual circumstances and needs of people with diabetes when they are applying these guidelines in their clinical practice.

If you require further information about this resource, please contact ADEA on **02 6287 4822** or email. **admin@adea.com.au**.

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The NDSS is an initiative of the Australian Government administered by Diabetes Australia. The NDSS aims to enhance the capacity of people with diabetes to understand and self-manage their life with diabetes. Please refer people with diabetes to the NDSS Helpline on **1800 637 700** or **ndss.com.au** for information, self-management support or products.

The ADEA is the leading Australian organisation for health care professionals providing diabetes care and education. The ADEA actively promotes evidence-based best practice diabetes education to ensure optimal health and wellbeing for all people affected by, and at risk of, diabetes.

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Abbreviations

The following abbreviations are used throughout this document:

ADEA	Australian Diabetes Educators Association
ADS	Australian Diabetes Society
BGL	Blood glucose level
CGM	Continuous glucose monitoring
DKA	Diabetic ketoacidosis
HHS	Hyperosmolar hyperglycaemic state
IPT	Insulin pump therapy
NDSS	National Diabetes Services Scheme
ORS	Oral rehydration solutions
TDD	Total daily dose

Definitions

Sick day is a short-term illness or infection which requires a person with diabetes to make changes to their usual diabetes management to prevent hyperglycaemia, hypoglycaemia and the development of Diabetic Ketoacidosis (DKA) or Hyperglycaemic Hyperosmolar State (HHS).

Intercurrent illness in people with diabetes is an illness which is unrelated to diabetes, but which may impact a person's diabetes management.

Hyperglycaemia is a high blood glucose level which may occur for several reasons including the stress of an illness or infection. While hyperglycaemia is generally defined as a blood glucose level above 10.0 mmol/L, symptoms of hyperglycaemia may not occur until blood glucose levels are even higher. Blood glucose levels above 15.0 mmol/L, particularly in the setting of illness and/or positive ketones, require prompt treatment to reduce the risk of a hyperglycaemic emergency (DKA or HHS).

Ketones are produced by the liver when glucose is not readily available, providing the body with an alternative source of energy. There are three ketones produced in the body: acetoacetate (AcAc), 3-beta-hydroxybutyrate (3HB) and acetone.

Diabetic ketoacidosis (DKA) is a severe, life-threatening acute complication of diabetes, resulting from absolute or relative insulin deficiency. It occurs mostly in people with type 1 diabetes but can also develop in those with type 2 diabetes who have low insulin secretion or who are taking sodium-glucose co-transporter-2 inhibitors (SGLT2i). It is characterised by hyperglycaemia, hyperketonaemia, and metabolic acidosis, although euglycaemic DKA can also develop, particularly in those who are taking SGLT2i. Diagnostic criteria include a blood glucose level above 11.0 mmol/L or known diabetes, arterial pH below 7.3 and serum bicarbonate below 15.0 mmol/L, and ketonaemia (>3.0 mmol/L) or significant ketonuria[1].

Euglycaemic DKA is the presence of metabolic acidosis (arterial pH below 7.3 and serum bicarbonate below 15.0 mmol/L) and ketosis (moderate ketonuria or ketonemia) without hyperglycaemia)[2].

Hyperglycaemic hyperosmolar state (HHS) is a severe, life-threatening acute complication of diabetes, occurring mostly in elderly people with type 2 diabetes and characterised by severe hyperglycaemia and dehydration. Diagnostic criteria include a plasma glucose level above 33.0 mmol/L, serum osmolality above 320 mmol/kg, and no appreciable metabolic acidosis and ketonaemia[3,4].

Hypertonic fluids are fluids with higher concentrations of solutes (such as salts and sugars) compared to plasma and intracellular fluid. They are absorbed from the stomach more slowly than weaker fluids so don't rehydrate as quickly, and also draw water from body tissues into the gut, potentially increasing dehydration. Examples include undiluted fruit juices and sugar-sweetened soft drinks.

1 Australian Institute of Health and Welfare and Commonwealth Department of Health and Family Services. 1997. First report on National Health Priority Areas 1996.

2 National Diabetes Services Scheme. Data Snapshot, September 2019.

3 Australian Institute of Health and Welfare. Australia's Health 2018.

4 Bach L, Ekinci E, Engler D, Gilfillan C, Hamblin P, MacIsaac R, Soldatos G, Steele C, Ward G & Wyatt S. 'The high burden of inpatient diabetes mellitus: the Melbourne Public Hospital Diabetes Inpatient Audit'. Medical Journal of Australia (2014), vol. 201, 334–338.

Background

In 2006 the ADEA released *Guidelines for Sick Day Management for People with Diabetes*. The guidelines were reviewed in 2011 by the Baker IDI, with input from the ADEA Clinical Practice Committee and Australian Diabetes Society (ADS) and updated again in 2016 by the ADEA Clinical Practice Committee.

In 2020 the guidelines and associated consumer education materials were reviewed and updated. This version of the guidelines reflects current evidence and expert opinion from a project Expert Advisory Group along with feedback from ADEA members on the previous versions of the guidelines and consumer materials and input from consumers with diabetes.

Introduction

Managing diabetes during an intercurrent illness is a challenging and crucial aspect of diabetes care.

Intercurrent illness in people with diabetes, if not managed appropriately and expediently, can result in hyperglycaemia, diabetic ketoacidosis (DKA), hyperosmolar hyperglycaemic state (HHS), hypoglycaemia or other adverse outcomes.

Sick day management plans are an integral component of diabetes education. The development of a sick day management plan along with education on sick day management should be provided at diagnosis and reviewed or updated at regular intervals. This is one of the most important activities Credentialled Diabetes Educators can undertake.

Sick day management education should empower people with diabetes to:

- recognise the signs and symptoms of illness.
- understand the impact illness can have on blood glucose and ketone levels.
- understand the self-management interventions that can minimise the effects of illness on glycaemic management.
- recognise when medical assistance is required, who to contact and how to contact them, and when to present to emergency.

The purpose of these clinical guiding principles is to:

- Assist health professionals in providing best practice self-management advice and support for adults with type 1 and type 2 diabetes when they experience an intercurrent illness. They may also be suitable for adults with other types of diabetes.
- Reduce the risk of further acute deterioration of glycaemic management in people with diabetes who are unwell, resulting from either insufficient or ineffective sick day management intervention strategies.

The guidelines apply to non-inpatient management of adults with type 1 or type 2 diabetes (including pregnant women with pre-existing type 1 or type 2 diabetes) experiencing periods of minor intercurrent illness which require changes to the person's usual diabetes self-management practices. Non-inpatient settings include home, residential care, and correctional facilities. The guidelines do not discuss diabetes management for hospital inpatients or the management of diabetic emergencies that require hospitalisation i.e. DKA, HHS and lactic acidosis. They also don't discuss the sick day management of children or adolescents, or women with gestational diabetes.

For information on sick day management in children and adolescents, refer to the International Society for Paediatric and Adolescent Diabetes (ISPAD) Clinical Practice Consensus Guidelines 2018: Sick day management in children and adolescents with diabetes, available from **ispad.org/page/ISPADGuidelines2018**.

Diabetes and intercurrent illness

Acute illness may affect diabetes management in several ways, causing hyperglycaemia, hypoglycaemia or having no significant effect on blood glucose levels. Being unwell can also impact a person's ability to self-manage their diabetes or require increased support from a carer.

Illness, particularly when severe, can lead to hyperglycaemia due to the activation of counter-regulatory hormones (including cortisol and adrenaline), which increase glucose production by the liver (gluconeogenesis) and reduce glucose uptake by peripheral tissues due to increased insulin resistance[5]. Blood glucose levels and insulin requirements are sometimes increased for a few days before the onset of the illness, during the incubation period, and may persist for a few days after the illness has passed.

Illnesses most likely to increase blood glucose levels include viral illnesses or bacterial infections, particularly if associated with fever[6]. If not managed appropriately, acute illness or infection can quickly lead to hyperglycaemia and in some cases may develop into diabetic ketoacidosis (DKA) and hyperosmolar hyperglycaemic state (HHS).

DKA and HHS are serious acute complications of diabetes that can be life-threatening. Both conditions are characterised by significant hyperglycaemia resulting from relative or absolute insulin deficiency and an increase in counter-regulatory hormones[4,7].

DKA usually occurs in type 1 diabetes, where hyperglycaemia is accompanied by hyperketonaemia and metabolic acidosis[4]. It can also occur in people with type 2 diabetes with low insulin production and those taking sodium-glucose transport protein 2 inhibitors (SGLT2i)[8,9]. HHS is most commonly seen in older adults with type 2 diabetes and usually results in more severe hyperglycaemia, dehydration and plasma hyperosmolality without any appreciable metabolic acidosis and ketonaemia[4].

Illness associated with vomiting and diarrhoea (e.g. gastroenteritis) may lower blood glucose levels and result in hypoglycaemia rather than hyperglycaemia[6]. Gastrointestinal illness can also increase the risk of euglycaemic DKA. Pregnant women with diabetes are at higher risk of hypoglycaemia and ketosis if emesis occurs[6].

Key concepts of sick day management plans

A number of key concepts are vital in the development of a sick day management plan for individuals with both type 1 and type 2 diabetes.

- All individuals with diabetes and members of their support team require appropriate, timely and ongoing education from a CDE or other diabetes health professional to correctly and confidently manage their diabetes when unwell.
- Sick day management education and a sick day management plan must be provided soon after initial diagnosis as an integral part of survival skills information, particularly for people with type 1 diabetes, and be regularly reviewed for their understanding of implementing a diabetes sick day management plan. The latter could be done as part of an annual cycle of care and/or complications assessment.
- Sick day management plans should identify and clearly articulate the role of the person with diabetes and of relevant members of their multidisciplinary team. This will potentially include their support person(s), their diabetes care team (including the endocrinologist/diabetologist, Credentialled Diabetes Educator, general practitioner, nurse practitioner and dietitian) and other relevant team members (e.g. indigenous health worker, mental health case worker, residential staff). Ideally, all members of this team should be offered the opportunity of being involved in developing and/or reviewing the sick day management plan. A sick day management plan should be followed at the first signs of the person with diabetes feeling unwell.
- Factors that might dictate the need for a review of the sick day management plan include changes in diabetes treatment, the development of diabetes-related complications or other comorbidities, a recent hospital admission due to illness, transition from paediatric to adult services, changes in employment, geographical relocation, pregnancy, or travel.
- Sick day management plans for other medical conditions should be cognisant of diabetes.
- Sick day management concepts and strategies will be different for people with type 1 diabetes and those with type 2 diabetes. They may differ within the population of people with type 2 diabetes depending on their diabetes management (e.g. with insulin, other glucose lowering agents or diet only). They will also vary with different types and severity of intercurrent illness and with the presence or absence of vomiting and/or diarrhoea.
- The sick day plan and sick day education also needs to take into account factors such as type of diabetes and treatment, other medical conditions, life expectancy, remoteness from acute medical services, available support persons and services, previous experiences with acute illness, physical and cognitive capacity and the health literacy and English literacy of the person with diabetes and their carers.
- Individual sick day management plans should be developed for people with diabetes in the supported residential care environment and correctional institutions. Organisations caring for people with diabetes also need to develop clear policies and procedures to support individuals with diabetes during times of illness[10,11]. The *NDSS Diabetes management in aged care: A practical handbook* and *2014 Position Statement on Diabetes Management in Correctional Institutions* provide recommendations for the identification and management of sick days in people with diabetes in care[10,11].
- All aspects of education related to sick day management plans and their development must be documented in the person's medical record as well as a copy given to the person with diabetes or their carers for safekeeping and future reference.
- The person with diabetes should see their GP or other relevant health professional for treatment of the underlying illness or infection.
- People with diabetes and their carers should be familiar with the signs and symptoms of illness that warrant immediate emergency care and should act accordingly.

- The person with diabetes (and support team) should remain alert to the signs and symptoms of hypoglycaemia during illness.
- The use of sugar-free medicines is not essential.
- Health professionals must recognise that diabetes-related complications, in particular gastroparesis, can mimic illness by producing symptoms such as nausea, vomiting, anorexia and abdominal pain.
- Following an episode of illness, the sick day management plan should be reviewed and evaluated by the person with diabetes and their carers with the health care team to determine whether the plan was implemented, whether it was successful and to determine if any changes need to be made to the plan and/or if further education in needed around sick day management. This can be achieved by asking at each review appointment whether the person has been unwell and has used their sick day plan.

Components of a sick day management plan

A sick day management plan should include:

- Guidance on when to commence and cease a sick day management plan.
- Recommended frequency and amount of fluids to reduce the risk of dehydration, and carbohydrate-containing food and fluids to reduce risk of hypoglycaemia and the development of ketones.
- The frequency of blood glucose monitoring and, if appropriate, blood or urine ketone testing.
- Advice on the cessation/adjustment and recommencement of diabetes medications.
- Recommended additional medication useful to address clinical symptoms of illness e.g. antiemetic and antidiarrhoeal agents.
- Clinical criteria to trigger contact with the diabetes care team.
- Name and phone number for contact with the diabetes health care provider/department including for times outside office hours, weekends and public holidays.
- Medical facility to which to present or phone if the sick day management plan is not effective or if the person's condition further deteriorates or their usual health care team is not contactable and when to call for an ambulance (**000**).
- Contents of a sick day management kit which is adaptable to other situations, such as travel.
- Regular checking of sick day management kit to ensure all items are within their expiry dates.

Key concepts for sick day management – type 1 diabetes

1. A sick day management plan should be tailored to the individual needs of the person with diabetes and be initiated at the first signs of an illness that impacts their metabolic status (i.e. causing hyperglycaemia and/or ketosis) and/or their ability to self-manage their diabetes.
2. People with type 1 diabetes (and/or their carers) should be alert to the signs and symptoms of significant hyperglycaemia and DKA including:
   - nausea, vomiting and/or abdominal pain
   - increased thirst and/or a dry mouth
   - polyuria
   - deep and laboured breathing (Kussmaul breathing)
   - a fruity-smelling breath
   - feeling drowsy, weak or confused.
3. More frequent blood glucose monitoring is needed during episodes of illness:
   - every 1-2 hours if blood glucose levels are elevated (above 15.0 mmol/L) and/or ketones are present
   - every 15 minutes if blood glucose levels are 4.0 mmol/L or below and then hourly for 3-4 hours once levels are back above 4.0 mmol/L.
4. Ketone levels should be measured during episodes of illness:
   - when blood glucose levels have been above 15.0 mmol/L for 6 hours or more (2-4 hours in those on an insulin pump or women who are pregnant)
   - every 2-4 hours while blood glucose levels remain above 15.0 mmol/L
   - every 1-2 hours once ketones have been detected or the person has symptoms suggestive of DKA
   - if the person has persistent vomiting and/or diarrhoea or poor oral intake, regardless of blood glucose levels.
5. Blood ketone levels above 1.0 mmol/L (or 0.6 mmol/L for those on an insulin pump or pregnant women) or positive urine ketones indicate the development of ketosis and the need to take appropriate action to prevent DKA.
6. Blood ketone testing is the preferred method of measuring ketosis (see page 18). Urine ketone monitoring may be used where blood ketone testing is not available.
7. People with type 1 diabetes (and or their carers) should be reminded to never discontinue taking insulin, especially basal insulin. However, adjustments to insulin doses may be required, as follows:
   - those on insulin injections should take supplemental doses (see page 12) of rapid-acting insulin according to the flowchart on page 13.
   - those using an insulin pump should adjust their insulin doses/basal rates according to the flowchart on page 14.
   - pre-meal short/rapid-acting insulin may need to be reduced if dietary carbohydrate intake is poor and blood glucose levels are not elevated.
8. Maintenance of food and fluid intake is important to reduce the risk of dehydration and to prevent hypoglycaemia and the development of ketones.
9. Individuals using an insulin pump should be advised:
   - to change their cannula and infusion set if blood glucose levels are elevated and ketones present
   - that they may need to switch back to manual mode if they are using a hybrid closed loop pump and the pump algorithm is unable to manage the change in insulin requirements for illness.

Supplemental insulin

Supplemental doses of insulin are defined as:

- Doses of rapid or short-acting insulin given in addition to usual insulin dose(s) – usual doses include prescribed correction doses for those managed with flexible insulin therapy using insulin pump therapy (IPT) or multiple daily injections (MDI).
- Insulin to be given immediately (but not closer than two hours to the previous dose of rapid-acting insulin) and not delayed until the time that the next prescribed usual insulin dose is due.

Supplemental insulin doses are calculated as a percentage of the total daily dose i.e. percentage of the total of rapid/short and intermediate/long/ultralong-acting usually taken in a 24-hour period.

Example of how to calculate extra insulin dose:

Usual daily doses	Morning	Lunch	Dinner	Evening
Rapid/short-acting insulin	6	4	8	
Long-intermediate acting insulin	10			12
Total daily dose (TDD)	40U			

10% of TDD	4U
15% of TDD	6U
20% of TDD	8U

Insulin dose adjustment table

Total Daily Dose (TDD) units	Extra 10% rapid or short-acting insulin	Extra 15% rapid or short-acting insulin	Extra 20% rapid or short-acting insulin
1 to 10	0.5-1 units	0.5 -1 units	0.5-1 units
11 to 20	1-2 units	2.3 units	2-4 units
21 to 30	2-3 units	3-4 units	4-6 units
31 to 40	3-4 units	4-6 units	6-8 units
41 to 50	4-5 units	6-7 units	8-10 units
51 to 60	5-6 units	7-9 units	10-12 units
61 to 70	6-7 units	9-10 units	12-14 units
71 to 80	7-8 units	10-12 units	14-16 units
81 to 90	8-9 units	12-13 units	16-18 units
91 to 100	9-10 units	13-15 units	18-20 units

Sick day management flowchart – Insulin injections

Feeling unwell?

Check blood glucose and ketone levels

Always keep taking your basal (long-acting) insulin

Continue to eat and drink if possible

Try to have 125-250 mls fluid per hour to avoid dehydration

If blood glucose levels below 4.0 mmol/L:

Treat hypoglycaemia with fast-acting carbohydrate (food or fluids or both)

Check BGL every 10 - 15 minutes until above 4.0 mmol/L, then monitor more regularly for the next few hours

No ketones

less than 1.0 mmol/L[1] on blood test

negative or trace on urine test

Check blood glucose and ketones every 2-4 hours

If BGLs are above 8.0 mmol/L, give your usual insulin doses when you eat or drink carbohydrate foods or fluids[2]

Use your usual correction doses to correct elevated blood glucose levels, even if you are not eating

If blood glucose levels are persistently above your target range despite giving correction doses, and you are unwell for more than a day you may need to increase your basal insulin by 1-2 units

If you are vomiting or have diarrhoea for more than a day and blood glucose levels are persistently low, you may need to reduce your basal insulin by 10-20%

Ketones present

more than 1.0 mmol/L[1] on blood test

small or above on urine test

Check blood glucose and ketones every 1-2 hours[4]

Ketones 1.0 mmol/L 1 to 1.5 mmol/L on blood test or small in urine

Ketones 1.5 mmol/L or more on blood test or large in urine

Calculate your Total Daily Dose (TDD) to determine supplemental insulin needs

Give 5-10% of TDD as rapid-acting insulin every 2 hours[3]

If BGLs are above 8.0 mmol/L, give your usual insulin doses when you eat or drink carbohydrate foods or fluids[2]

Give 10-20% of TDD as rapid-acting insulin every 2 hours[3]

If BGLs are above 8.0 mmol/L, give your usual insulin doses when you eat or drink carbohydrate foods or fluids[2]

Seek urgent medical care if you have persistent vomiting, can't keep fluids down, if BGLs remain below 4.0 mmol/L after two hypo treatments or if BGLs remain above 15.0 mmol/L and/or ketones remain above 1.5 mmol/L (blood) or moderate to large (urine) after two supplemental insulin doses

1. 0.6 mmol/L if pregnant or elderly
2. If vomiting, wait for 30 minutes after eating to inject insulin for carbohydrate (to make sure food is kept down)
3. Refers to rapid-acting insulins (e.g. Novorapid, Humalog, Fiasp, Apidra) and not short-acting insulins (e.g. Actrapid and Humulin R) which have a longer duration of action
4. Don't correct more often than every 2 hours

Sick day management flowchart – Insulin pump therapy

Feeling unwell?

Check blood glucose levels (BGLs) and ketone levels

Never stop having insulin delivery but your pump rates may need adjusting

↓

Continue to eat and drink if possible

Try to have 125-250 mls fluid per hour to avoid dehydration

↓

If BGL below 4.0 mmol/L:

Treat hypoglycaemia with fast-acting carbohydrate (food or fluids or both)

Check BGL every 10 - 15 minutes until above 4.0 mmol/L, then monitor more regularly for the next few hours

↓

No ketones

less than 0.6 mmol/L on blood test

negative or trace on urine test

↓

Check BGLs and ketones every 2-4 hours

↓

If BGLs are above 8.0 mmol/L, use your usual carb ratio when you eat or drink carbohydrate foods or fluids[1]

Use your usual correction doses to correct elevated BGLs, even if you are not eating

If BGLs are persistently elevated despite giving correction doses, consider increasing basal rates by 10-20% for 2 hours and repeat as needed until BGLs are back in range

If you are vomiting or have diarrhoea and BGLs are persistently low, reduce basal rate by at least 20% for 4 hours and repeat as needed until BGLs have increased

↓

Ketones present

more than 0.6 mmol/L on blood test

more than a trace on urine test

↓

Change pump site, including cannula, tubing and reservior

↓

Check BGLs and ketones every 1-2 hours[2]

↓

Ketones 0.6 mmol/L to 1.5 mmol/L on blood test or small in urine

Ketones 1.5 mmol/L or more on blood test or large in urine

↓

Calculate your Total Daily Dose (TDD) to determine supplemental insulin needs

↓

Give 10%-20% of TDD as a bolus dose every 2 hours and increase basal rate by 20-30%.

If BGLs are above 8.0 mmol/L, use your usual carb ratio when you eat or drink carbohydrate foods or fluids[1]

Give 20%-30% of TDD as a bolus dose every 2 hours and increase basal rate by 30-50%

If BGLs are above 8.0 mmol/L, use your usual carb ratio when you eat or drink carbohydrate foods or fluids[1]

↓

Seek urgent medical care if you have persistent vomiting, can't keep fluids down, if BGLs remain below 4.0 mmol/L after two hypo treatments or if BGLs remain above 15.0 mmol/L and/or ketones remain above 1.5 mmol/L (blood) or moderate to large (urine) after two supplemental insulin doses

1. If vomiting, wait for 30 minutes after eating to bolus for carbohydrate (to make sure food is kept down)
2. Don't correct more often than every 2 hours

Key concepts for sick day management – type 2 diabetes

1. A sick day management plan should be tailored to the individual needs of the person with diabetes and be initiated at the first signs of an illness that impacts their metabolic status (i.e. causing hyperglycaemia and/or ketosis) and/or their ability to manage their diabetes.
2. People with type 2 diabetes (and/or their carers) should be alert to the signs and symptoms of significant hyperglycaemia and HHS including:
   - excessive thirst and/or a dry mouth
   - increased urination
   - feeling drowsy, weak or confused
   - warm, dry skin
   - fever.
3. More frequent blood glucose is needed during episodes of illness:
   - every 2-4 hours if blood glucose levels are above 15.0 mmol/L for 8 hours or more
   - every 10-15 minutes if blood glucose levels are 4.0 mmol/L or below and then hourly for 3-4 hours once levels are back above 4.0 mmol/L (for those at risk of hypoglycaemia).
4. People with type 2 diabetes should continue to take most diabetes medications but may need to cease certain medications if they have persistent vomiting and/or diarrhoea or poor food and fluid intake. See guidelines on page 16.
5. People with type 2 diabetes using insulin should continue to take their insulin but doses may need adjusting. See guidelines on page 16.
6. Maintenance of food and fluid intake is important to reduce the risk of dehydration and to prevent hypoglycaemia and the development of ketones (in those at risk).
7. People who take sodium-glucose co-transporter-2 inhibitors (SGLT2i) are at risk of DKA/euglycaemic DKA if they have significant vomiting and/or diarrhoea, or poor oral intake. DKA can also occur in some individuals with type 2 diabetes managed with insulin. It is not usually necessary for these individuals to check ketone levels at home but they should be made aware of the risks, symptoms (including abdominal pain, nausea, vomiting and fatigue) and when to seek urgent medical care if DKA is suspected. In some cases, education on ketone testing may be appropriate.

Adjustment of diabetes medications – type 2 diabetes

In individuals with type 2 diabetes managed with oral or non-insulin injectable diabetes medications[12–14]:

- In individuals with nausea, vomiting and/or diarrhoea consider temporarily stopping metformin and GLP-1receptor agonists which may aggravate these symptoms, worsening dehydration and hypovolaemia, and may increase the risk of acute renal impairment due to dehydration.
- If there is acute gastrointestinal illness, cease SGLT2 inhibitors, which may further aggravate dehydration and hypovolaemia and increase the risk of DKA.
- If illness is causing loss of appetite and marked reduction of carbohydrate intake, SGLT2 inhibitors should be reviewed and/or ceased to reduce the risk of DKA/euglycaemic DKA.
- DKA/euglycaemic DKA should be suspected and investigated in those who are taking SGLT2 inhibitors if they develop abdominal pain, nausea, vomiting, fatigue or metabolic acidosis.
- If illness is causing loss of appetite and reduction of carbohydrate intake, there is an increased risk of hypoglycaemia from sulphonylureas, which may require dose adjustment or temporary cessation.
- Other diabetes medications should usually be continued.
- Consider the temporary use of insulin for persistent and symptomatic hyperglycaemia (this may require hospital admission).

In individuals with type 2 diabetes managed with insulin[12–14]:

- If blood glucose levels are persistently elevated, an increase in intermediate or long-acting insulin dose by 10–20% may be needed, with further adjustment of subsequent doses of rapid-acting insulin during the day if the glucose levels remain elevated.
- Those taking rapid or short-acting insulin need advice on adjusting doses according to blood glucose levels and carbohydrate intake.
- For those taking ultra-long-acting basal insulins, such as glargine U300 (Toujeo) and degludec (Ryzodeg 70/30) advice may need to be sought from an appropriate clinician regarding dose adjustment, as dose changes may take 4–7 days for effect.
- Those taking basal only or premixed insulin require appropriate medical advice and may need a prescription for additional rapid-acting insulin to use as a supplemental insulin dose – this should be considered as part of their sick day management plan.

For individuals managed with diet alone who have worsening glycaemia, the introduction of medication and management of symptomatic hyperglycaemia may be considered.

Other medications

Many people with diabetes may be taking other medications that may need to be ceased if they have significant vomiting and/or diarrhoea, including diuretics, some blood pressure medications (angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers and anti-inflammatory pain medications (nonsteroidal anti-inflammatory drugs). They should be encouraged to discuss with their general practitioner whether they need to stop taking any of these if they become unwell.

Corticosteroids cause acute hyperglycaemia and increase medication needs in people with diabetes. Risk factors for the development of hyperglycaemia include a previous history of diabetes, a higher prevalence of comorbidities, older age and a higher dose and/or prolonged treatment with steroids[15,16]. While management of steroid-induced hyperglycaemia is beyond the scope of these guidelines, people with diabetes who require treatment with corticosteroids should be made aware of the impact on their blood glucose level profile and the need for appropriate monitoring and adjustment or commencement of medication while undergoing corticosteroid treatment[16,17].

Many people with diabetes choose to take complementary and alternative medicine (CAM), including nutrition and herbal supplements, and may be more likely to take these during times of illness. A small Australian study of adults with diabetes found that almost half the respondents (46.3%) used CAM and 28% used CAM specifically to treat their diabetes[18]. Individuals born overseas were significantly more likely to use CAM than those born in Australia. It is important that health professionals ask about the use of complementary medicines and that people with diabetes are made aware of the potential interactions and adverse effects, particularly when taken in combination with diabetes medications. While most herbal medications are relatively safe, they have the potential to alter the pharmacokinetic and/or pharmacodynamic properties of some diabetes medications and to increase the risk of hypoglycaemia[19].

Monitoring

Ketone monitoring

Ketone bodies (formed naturally in the body) are produced by the liver when glucose is not readily available, providing the body with an alternative source of energy[20].

There are three ketones produced in the body[20]:

- Acetoacetate (AcAc)
- 3-beta-hydroxybutyrate (3HB)
- Acetone.

When glucose is not readily available, fat is broken down by the liver into fatty acid molecules. In the process of ketogenesis, the fatty acids are broken down further into acetoacetate which is then converted into either 3HB or acetone. Acetone is responsible for the sweet odour on the breath of individuals with DKA but is produced in only small amounts[20]. AcAc and 3HB are the main two ketone bodies produced.

There are two methods available to measure ketones. First is the estimation of acetoacetate (AcAc) levels in urine. The second method for monitoring ketone levels is using a capillary blood sample that measures 3-beta-hydroxybutyrate (3HB) based on a specific enzyme reaction[20].

Blood ketone testing is recommended over urine ketone testing for detecting and monitoring ketones in people with diabetes, for the following reasons[20–24]:

- In DKA, the ratio of 3HB:AcAc rises from normal levels (1:1) to 3:1 or higher (as high as 10:1) making blood ketone monitoring a more accurate way of assessing ketone levels during illness in people with diabetes.
- Urine testing is more likely to give false negative and false positive results (than blood ketone monitoring. This can occur in the presence of certain medications, when the test strips have been exposed to air for an extended period of time and following ingestion of large doses of ascorbic acid, or vitamin C. Hydration status can also affect accuracy.
- In response to insulin therapy, 3HB levels usually decrease well before AcAc levels, which makes urine testing less reliable for monitoring recovery due to the fact that ketone bodies may be detected in urine long after blood concentrations have returned to normal levels.
- Urine testing can be unpleasant and more time-consuming, which can be a barrier to ketone testing.
- Urine testing involves reading a colour change on the test strip, which can be a problem for those with poor vision.
- Urine ketone testing is a semi-quantitative test, only indicating if large, moderate, small or trace amounts of ketones are present, and this can introduce user variability in interpretation.
- Blood ketone testing has been shown to facilitate earlier identification and treatment of ketosis than urine ketone testing and to reduce diabetes-related hospitalisations and emergency visits.

The capacity to test for ketones is crucial for all individuals with type 1 diabetes and those with type 2 diabetes who are at risk of ketosis.

There are currently only a few meters available that can be used for blood ketone testing (FreeStyle Optium Neo, FreeStyle Libre Reader, CareSens Dual and LifeSmart Twoplus Blood Glucose & Ketone Meter). It is important that individuals with type 1 diabetes have access to one of these meters, even if it is not their preferred meter for day-to-day blood glucose monitoring. Test strips can be purchased through pharmacies but are not currently subsidised through the NDSS.

If blood ketone testing is not available, urine ketone testing can be used. For those using urine ketone testing, it is important that they are aware that the integrity of the urine ketone strips may be a problem if the canister lid had not been firmly closed after opening and that strips need to be discarded three months after opening the canister, regardless of expiry date.

Interpretation of ketone levels[24,25]

Blood ketone level	Urine ketone level	Interpretation
Less than 0.6 mmol/L	Negative	Normal
0.6-1.5 mmol/L	Trace or small	Increased ketone production
1.5-3.0 mmol/L	Moderate	Impending DKA
Over 3.0 mmol/L	Large	Probable DKA

Continuous and flash glucose monitoring

Individuals using continuous glucose monitoring (CGM) (e.g. Dexcom or Medtronic CGM devices) or flash glucose monitoring (FreeStyle Libre) during periods of intercurrent illness should be made aware:

- of the need to confirm out of range readings with a fingerprick blood glucose check before taking action to correct them, remembering that there is a lag time between the two readings.
- that severe dehydration may affect the accuracy of sensor readings due to their measurement of glucose in the interstitial fluid.
- that pain medications containing acetaminophen (paracetamol) can affect the accuracy of certain continuous glucose monitors (Dexcom G4, Dexcom G5, Medtronic Guardian), falsely raising sensor glucose readings[26–30]. Dexcom G6 is only affected with higher doses of these medications (more than 1000mg every 6 hours)[28,31].
- that ascorbic acid (vitamin C) may affect the accuracy of the FreeStyle Libre flash glucose monitor, falsely raising sensor glucose levels[32].
- that salicylic acid (aspirin) may affect the accuracy of the FreeStyle Libre flash glucose monitor, falsely lowering sensor glucose levels[32].
- that with all interfering substances, the level of inaccuracy depends on the amount of the interfering substance active in the body and varies between individuals[26,30,32].

Maintenance of hydration and carbohydrate intake

People with diabetes should be encouraged to maintain oral carbohydrate intake during illness to reduce the risk of hypoglycaemia, maintain energy requirements and prevent the development of ketones (in those with type 1 diabetes and those with type 2 diabetes who have low insulin production or who are taking SGLT2 inhibitors). Antiemetic therapy may be required to ensure adequate hydration and carbohydrate intake.

Recommendations for food and fluid intake:

- Unless otherwise stated by a medical practitioner, 125–250 mls of fluid (1/2 to 1 cup) per hour is suggested during acute illness.
- If unable to eat regular meals, encourage a regular intake of carbohydrate-containing foods – around 15g of carbohydrate per hour during waking hours. Easy to digest foods include bread or toast, plain cracker biscuits, plain sweet biscuits, plain rice or pasta, mashed potato, and bananas.
- If the person is unable to consume food, it is recommended that:
  - Carbohydrate-containing fluids be consumed if blood glucose levels are below 10.0 mmol/L
  - Carbohydrate-free fluids be consumed if blood glucose levels are 10.0 mmol/L and above unless fluids are replacing their usual carbohydrate-containing meals and/or insulin is given to cover the carbohydrate.
- Oral rehydration solutions (ORS), such as Gastrolyte® and Hydralyte®, should be considered, to help replenish fluid and electrolytes lost through vomiting and/or diarrhoea, particularly in the elderly[33]. They have a relatively low concentration of carbohydrate and therefore additional carbohydrate maybe be required to avoid hypoglycaemia. ORS are available in sachets to be added to water and ice blocks.
- Sports drinks e.g. Gatorade® or Powerade® can be a good alternative to ORS, however they are slightly higher in carbohydrate (see table on following page).
- Hypertonic or sweetened fluids should be taken in small quantities or avoided if diarrhoea is present or develops as these beverages can exacerbate this condition. They may require dilution of up to 1-5 times for optimum tolerance and absorption. This needs to be taken into consideration when calculating carbohydrate intake.
- Fluids should be sipped slowly over a period as rapid consumption when unwell can result in increased vomiting and/or diarrhoea.
- Carbonated fluids should be left to go flat prior to consumption as effervescence can result in increased nausea and/or vomiting.
- Excessive intake of caffeinated drinks should be discouraged as these may make dehydration worse and caffeine is a gastric irritant thus has the potential to exacerbate nausea and vomiting.

Carbohydrate-containing and carbohydrate-free fluids

Carbohydrate-containing fluids*	Carbohydrate-free fluids
Fruit juice (10g/100 mls)	Water
Regular lemonade (9g/100 mls)	Diet lemonade
Regular cordial (10g/20 mls concentrate)	Diet cordial
Gatorade original (6g per 100 mls)	Broth
Tea with sugar (5g per teaspoon sugar)	Tea without milk or sugar
Milk (5g/100 mls)	Herbal tea
Regular jelly (15g per half cup)	Sugar-free jelly
Lemonade ice-block (~11g per 75g serve)	Hydralyte ice-block (~1g per serve)

*approximate carbohydrate values given in brackets – may vary between brands

Management of hypoglycaemia during sick days

While illness often leads to hyperglycaemia, illness associated with nausea, vomiting and diarrhoea (e.g. gastroenteritis) may lower blood glucose levels and result in hypoglycaemia rather than hyperglycaemia[6]. The person with diabetes (and/or their carers or support team) should remain alert to the signs and symptoms of hypoglycaemia during illness.

- People with diabetes who develop hypoglycaemia while unwell should be encouraged to treat their hypoglycaemia according to their usual management guidelines, where possible.
- Some people will also need a reduction in their insulin or medication to reduce the risk of, or to help in managing hypoglycaemia during illness, but it is important that insulin is never ceased, particularly in those with type 1 diabetes, due to the risk of DKA.
- People with diabetes who are at risk of hypoglycaemia should be encouraged to keep a range of rapid-acting carbohydrate foods and fluids in their sick day management kit. This could include glucose tablets, glucose gels, jellybeans and ordinary (sugar-sweetened) soft drink or cordials.
- People with diabetes at risk of severe hypoglycaemia should have an in-date glucagon injection available and their family members/ carers and/or support persons must be provided with education on how and when to administer glucagon in response to severe hypoglycaemia.
- Pregnant women with diabetes are at higher risk of hypoglycaemia if emesis occurs and should be provided with appropriate guidance on managing morning sickness[6].

Discontinuation of a sick day management plan and presentation to acute medical service

The following situations are an indication for seeking immediate medical attention:

- Blood glucose levels have not improved or have deteriorated despite two supplemental insulin doses. In some cases (for example if blood glucose levels are below 20.0 mmol/L and the person does not feel particularly unwell) it may be appropriate to wait until additional supplemental insulin doses are given.
- Blood ketone levels have not improved or have deteriorated following two doses of supplemental insulin. In some cases (for example if blood ketone levels are below 3.0 mmol/L and the person does not feel particularly unwell) it may be appropriate to wait until additional supplemental insulin doses are given.
- Signs of DKA or HHS such as vomiting, drowsiness, confusion, disorientation, hyperventilation, dehydration or severe abdominal pain.
- Vomiting that is persistent, especially if greater than four hours, or becomes blood or bile stained.
- Signs of severe dehydration including increased thirst, dry mouth and swollen tongue, weakness, dizziness/fainting, palpitations, headache, confusion/delirium, reduced sweating and reduced urine output (oliguria or anuria).
- Persistent hypoglycaemia.
- If the individual or support person(s) are unable to carry out the sick day plan and required additional support.
- If the diagnosis of the underlying illness is unclear.
- If the person has a known complex medical history, end-stage organ failure, is frail and/or elderly.
- If physical or cognitive impairment occurs making the implementation of the sick day management plan impossible.

Note: the person with diabetes should not drive in this situation. If they require emergency care and do not have someone to drive them to the hospital, they should call 000 for an ambulance.

Checklist for sick day management kit

People with diabetes are recommended to have a sick day management kit and advised to check their kit at least every three months to ensure it is fully stocked and items are within the expiry date.

Recommended items include:

- [ ] a copy of their individual sick day management action plan
- [ ] telephone numbers to call – e.g. support people, general practitioner, local hospital/diabetes clinic, Credentialled Diabetes Educator, endocrinologist
- [ ] food and fluid for sick days (carbohydrate-containing and carbohydrate-free)
- [ ] a range of rapid-acting carbohydrate foods and fluids for treatment of hypoglycaemia (for those at risk)
- [ ] pain relief medications (taking into account interactions if they are using CGM - **see page 19**)
- [ ] rapid-acting insulin (if prescribed) – this should be stored in the fridge
- [ ] insulin syringes or insulin pen plus an adequate number of pen needles (if insulin is prescribed)
- [ ] a blood glucose meter and in-date (non-expired) blood glucose testing strips (for those with type 2 diabetes who don't usually monitor but have been provided with education and advised to monitor when unwell; for other people with diabetes a blood glucose meter and test strips will be part of their usual diabetes management)
- [ ] thermometer
- [ ] blood ketone testing meter and in-date ketone blood test strips or in-date urine ketone testing strips for those with type 1 diabetes
- [ ] glucagon injection (in those at risk of severe hypoglycaemia) – requires education of family members/carers and/or support person on how and when to administer glucagon in response to severe hypoglycaemia
- [ ] scripts for any medications that may need to be commenced in accordance with the persons sick day plan (e.g. rapid-acting insulin for someone with type 2 diabetes using only basal insulin).

Expiry dates for blood and urine ketone test strips need to be regularly reviewed. Out of date blood ketone test strips will not be operational in the meter and urine ketone strips need to be discarded three months after opening the canister, regardless of expiry date. Integrity of the urine ketone strips may also be a problem if the canister lid had not been firmly closed after opening. Expiry dates for glucagon or any scripts for diabetes medications also need to be checked regularly.

Appendix 1: Considerations for sick day management while travelling

Sick day management plans should be prepared for all people with diabetes planning to travel, particularly to remote areas or overseas.

The following should be considered:

- If travelling overseas, obtain advice on relevant vaccinations at least six weeks prior to departure. These may include measles, tetanus, hepatitis B (hepatitis A may also be required), influenza and pneumococcus. Anti-malarial medications may also be recommended for travel to certain areas. Detailed information can be found on the Travel Doctor website **traveldoctor.com.au**.
- Preparation and maintenance of a sick day management kit (which will require modification from a home sick day kit) suitable for travel. This may include the addition of antiemetics, antidiarrhoeal agents, paracetamol, broad-spectrum antibiotics, oral rehydration solution, antiseptic cream/lotion, and basic wound dressing products. The person will need prescriptions from their general practitioner or endocrinologist for certain medications (e.g. antibiotics).
- Obtaining appropriate travel insurance in advance in case of an emergency. Diabetes is a pre-existing condition that will need to be listed on the policy. Australia has reciprocal arrangement with several countries in Europe and in New Zealand which enables Australian citizens to be eligible for emergency medical treatment overseas. However, this is not a substitute for travel insurance. More information can be found at: **servicesaustralia.gov.au/individuals/services/medicare/reciprocal-health-care-agreements**.
- Carrying a letter/health summary (preferably multiple copies) from their general practitioner or endocrinologist outlining any medical conditions, allergies, medications, medical devices, and diabetes supplies they are travelling with. Where relevant, this should also be translated into the languages of the countries the person will be visiting.
- Carrying scripts for their diabetes medications in case they need to purchase more while travelling.
- Having health-related documents translated into the language(s) of the countries being visited.
- Obtaining and wearing medical ID, particularly for those who require insulin.
- Storing insulin while travelling.
- Understanding potential food safety risks at their travel destination(s) and how to minimise the risk of food-borne illness.

Further advice on travelling can be obtained from the Smart Traveller website: **smartraveller.gov.au**

Appendix 2: Consumer Sick Day Resources

ADEA consumer sick day resources

adea.com.au/resources/standards-position-statements-and-other-resources/adea-clinical-guidelines

NDSS fact sheets:

ndss.com.au/living-with-diabetes/health-management/sick-days

NDSS resources for aged care facilities:

Resident sick day plan

Six minute intensive training

Sick day management poster

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Notes

NDSS Helpline 1800 637 700
ndss.com.au