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# **CLINICAL GUIDING PRINCIPLES FOR SICK DAY MANAGEMENT OF ADULTS WITH TYPE 1 AND TYPE 2 DIABETES**

**Technical Document**

**May 2014**

The ADEA Clinical Guiding Principles for Sick Day Management of Adults with Type 1 and Type 2 Diabetes has been developed and revised with the support from Abbott Diabetes Care.



Disclaimer: The medical information provided in this document is of a general nature and cannot substitute for professional medical advice, diagnosis, or treatment. Please seek medical advice from your healthcare professionals with any questions you may have regarding a medical condition.

## Definition of Terms

### Sick Day

“Sick days” refer to periods of minor intercurrent illness, usually of up to 1 to 4 days’ duration, that require changes to the person’s usual diabetes self-management practices.

### Diabetic Ketoacidosis (DKA)

Diabetic ketoacidosis (DKA) is precipitated by an absolute or relative insulin deficiency and an increase in levels of counter-regulatory hormones such as glucagon, catecholamines, cortisol and growth hormone leading to hepatic overproduction of glucose and ketone bodies and usually occurs in people with type 1 diabetes mellitus.

DKA is characterised by severe disturbances in carbohydrate, fat and protein metabolism, Metabolic derangements in DKA include hyperglycaemia, osmotic diuresis, metabolic acidosis, dehydration, hyperlipidaemia and an increase in ketone bodies and lactate. The biochemical criteria for the diagnosis of DKA include (APEG, ADS 2011):

- Blood glucose level >11.0mmol/L,
- pH <7.3,
- Bicarbonate <15.0mmol/L,
- Ketonaemia >3.0mmol/L.

### Ketosis

The presence of ketones is usually associated with elevated blood glucose and an indication of insulin deficiency, but ketones can occur in the presence of normal or low blood glucose levels, particularly in the presence of gastrointestinal illnesses, starvation, following hypoglycaemia or in pregnancy (with or without diabetes being present).

### Hyperosmolar Hyperglycaemic State (HHS)

Hyperglycaemic Hyperosmolar State (HHS) is a metabolic derangement that occurs principally in people with type 2 diabetes. The condition is characterised by hyperglycaemia, hyperosmolarity and an absence of significant ketosis.

HHS is clinically defined by the presence of relative insulin deficiency and hyperglycaemia. The blood glucose is usually >30.0mmol/L, with associated elevated serum osmolarity >320 mosmol/kg, dehydration and without significant hyperketonaemia (<3.0 mmol/L) or acidosis (pH>7.3, bicarbonate>15.0mmol/L) (Joint British Diabetes Societies, 2012). There may be stupor progressing to coma if uncorrected.

## Glossary of Acronyms

|      |   |
|------|---|
| ADA  | American Diabetes Association             |
| ADEA | Australian Diabetes Educators Association |
| ADS  | Australian Diabetes Society               |
| BGL  | Blood Glucose Level                       |
| BKL  | Blood Ketone Level                        |
| CAM  | Complementary and Alternative Medicines   |
| DKA  | Diabetic Ketoacidosis                     |
| HHS  | Hyperosmolar Hyperglycaemic State         |
| IPT  | Insulin Pump Therapy                      |
| MDI  | Multiple Daily Injections                 |
| ORS  | Oral Rehydration Solutions                |
| SMBG | Self-Monitoring of Blood Glucose          |
| SSI  | Sliding Scale Insulin                     |
| TDD  | Total Daily Dose                          |

## **Acknowledgements**

In 2006 the ADEA released *Guidelines for Sick Day Management for People with Diabetes*. In 2011 Baker IDI, following a formal request by the ADEA Board, undertook a revision of the original 2006 document and updated the literature review. The development of the new ADEA *Clinical Guiding Principles for Sick Day Management of Adults with Diabetes* has been undertaken by the Australian Diabetes Educators Association Clinical Practice Committee.

## **Committee**

Michelle Robins (Chair)

Melissa Armstrong

Wendy Bryant

Mark Coles

Carol De Groot

Lyndon Homeming

Denise Smith

## **Australian Diabetes Society**

Dr Glynis Ross (Seconded)

## **Additional acknowledgement**

Professor Trisha Dunning (Complementary and Alternative Medicines)

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## 1 Background

In 2006 the ADEA released Guidelines for *Sick Day Management for People with Diabetes*. In addition to the technical document, a six page summarised version for health professionals and consumer brochures for people with type 1 and type 2 diabetes were also produced. The newly revised document is deliberate in its description 'clinical guiding principles' due to the very limited level I and II published evidence and scant international guidelines. The previous guidelines assigned nearly all recommendations to either 'C' – expert committee reports or clinical experience/consensus statements or reports from professional organisations, or 'GPP' – good practice point based on the judgment of the then established Guidelines Reference Group as well as on work and literature in the field. Unfortunately this situation has not altered in terms of the number of trials and studies available for critical review. Therefore, these clinical guiding principles are designed to promote reflective practice and best practice of diabetes educators. Sound clinical judgment should always be exercised.

In 2011 Baker IDI, following a formal request by the ADEA Board, undertook a revision of the original 2006 document and updated the literature review. A number of issues were identified by the ADEA Clinical Practice Committee (CPC), in terms of content, practical application and format. Publications including the recently released *National evidence-based clinical care guidelines for type 1 diabetes in children, adolescents and adults* (2011) and the *Guidelines for Managing Diabetes at the End of Life* (2010) have influenced this process of revision. The ADEA Board formally requested assistance from a member of the Australian Diabetes Society (ADS) to assist with the development of the clinical guiding principles. Just as the development of a sick day management plan should be undertaken by a multidisciplinary team, so has this been reflected in the progression and revision of this document.

This technical background document is designed for use by all health professionals involved in the diabetes multidisciplinary team including endocrinologists, diabetes educators, dietitians and pharmacists.

## 2 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. However, this important part of diabetes self-management is often not comprehensively taught by diabetes health professionals to people with diabetes (and their support team), not reviewed or updated at regular intervals, not helpful or not completely relevant to the changing needs of the individual or it is confusing to the client and their support team. Empowering people with diabetes to recognise the signs and symptoms of illness, the impact illness can have on blood glucose (and blood ketone) levels, the self-management interventions that can minimise the effects of illness on glycaemic control and the ability to recognise when medical assistance is required, is one of the most important activities diabetes educators can undertake.

### **3 Purpose of the ADEA Clinical Guiding Principles for Sick Day Management of Adults with Type 1 and Type 2 Diabetes**

The purpose of these clinical guiding principles is to:

- Provide information, guidance and direction to health care professionals to provide best practice self-management advice and support for adults with type 1 and type 2 diabetes when they experience an intercurrent illness.
- Articulate the roles and responsibilities of health care professionals and people with diabetes and their carers.
- Reduce risk of further acute deterioration of glycaemic control resulting from either insufficient or ineffective sick day management intervention strategies.

## 4 Scope of the ADEA Clinical Guiding Principles for Sick Day Management of Adults with Type 1 and Type 2 Diabetes

The guidelines apply to non-inpatient (including home, residential care and correctional facilities), management of adults with type 1 or type 2 diabetes experiencing “sick days”.

“Sick days” refer to periods of minor intercurrent illness usually of only 1-4 days’ duration, that require changes to the person’s usual diabetes self-management practices.

These clinical guiding principles:

- Do not discuss management of diabetic emergencies that require hospitalisation ie. ketoacidosis (DKA), hyperglycaemic hyperosmolar state (HHS) and lactic acidosis.
- Do not discuss management of blood glucose in the presence of prolonged intercurrent infection or illness (more than 3 to 4 days’ duration), as escalation of direct medical intervention is instead recommended.
- Do not discuss diabetes management for hospital inpatients.
- Do not discuss the sick day management of children or adolescents (ie. those  $\leq$  16 years of age).
- Discuss sick day management for pregnant women with pre-gestational diabetes, but not gestational diabetes.
- Discuss hyperglycaemia in people with pre-existing diabetes requiring corticosteroid therapy, but do not discuss the management of elevated blood glucose levels in people not already known to have diabetes prior to commencing steroid therapy.
- Reinforce that appropriate individualisation of management is essential and that further modification for groups such as the Aboriginal and Torres Strait Islander community, older people, people with a disability, from culturally and linguistically diverse communities and people residing in remote areas may be required.
- Acknowledge that ketoacidosis is uncommon in individuals with type 2 diabetes, however caution should be exercised in people with type 2 diabetes who are lean, or pregnant or in individuals who have previously developed ketones when unwell.

## 5 Target Audience

The target audience is health care professionals with knowledge about diabetes and involved in the care of people with diabetes.

The two companion documents, *Sick day management in type 1 diabetes* and *Sick day management in type 2 diabetes*, will be available for people with diabetes.

There is an assumption that health professionals utilising these clinical guiding principles have an understanding of:

- Normal blood glucose levels and abnormal variations such as hyperglycaemia and hypoglycaemia.
- Pathophysiology of diabetes including differentiation between type 1 and type 2 diabetes.
- Mechanisms of action of currently available insulins.
- Pharmacodynamic and pharmacokinetic principles of other glucose lowering medicines.
- Methods of monitoring blood glucose as well as urine and blood ketone levels.

In addition, background knowledge of the person with diabetes such as medical history, self-care potential and access to support is essential.

## 6 Diabetes and Intercurrent Illness

People with well controlled diabetes generally do not experience more infections or illness than the wider community (Brink et al, 2009). Acute intercurrent illness may affect diabetes control in a number of ways. Illness may cause hyperglycaemia, hypoglycaemia or may have no significant effect on blood glucose levels. Individuals with consistently poor metabolic control may however have reduced immunity resulting in:

- Increased risk of acquiring infection.
- Increased chance of infections spreading quickly.
- Increased risk of unusual infections.
- Increased risk of infections from organisms that are not normally pathogenic.
- Poor response to antibiotic therapy.

Hyperglycaemia refers to an elevated blood glucose level (>10.0mmol/L) due to relative or absolute insulin deficiency. The symptoms of hyperglycaemia usually occur when the blood glucose levels are persistently >15.0mmol/L (Dunning, 2009). Intercurrent illness can raise the blood glucose level due to higher levels of stress hormones, gluconeogenesis and insulin resistance. The most common illness for precipitating hyperglycaemia, and subsequent DKA and HHS, is infection. Typical infections likely to be associated with increased insulin resistance include:

- Viral illnesses associated with fever and systemic features, especially if associated with vomiting.
- Bacterial infections, especially if associated with fever.

Additional triggers that may contribute to hyperglycaemia, ketosis, and increase the risk of DKA and HHS include:

- Emotional stress.
- Psychosis.
- Substance abuse.
- Omission of insulin and/or other diabetes medicines.
- Insulin delivery system failure in insulin pump therapy (IPT).
- Medications that increase blood glucose levels e.g. corticosteroids.

The majority of hospital admissions for acute illness and poor diabetes control are related to hyperglycaemia and ketoacidosis, rather than hypoglycaemia. The impact of hyperglycaemic emergencies cannot be understated with DKA being a prominent cause of morbidity and mortality in people with type 1 diabetes. There is a lack of data from Australia, but data from the United States suggests hyperglycaemic emergencies lead to significant financial costs to the individual and to the health care system. In England between 2004 and 2010, the prevalence rate of people with type 1 diabetes experiencing an episode of DKA was just over 12% (NHS Information Centre, 2011). DKA was most commonly seen in people with type 1 diabetes aged 0 to 24 years. There was a prevalence rate of 14% in people aged 25 – 39 years but it was only 5% in over 85 year olds. Interestingly the prevalence rate of DKA in people with type 2 diabetes was recorded around 1%. The majority of patients admitted

with DKA have been previously diagnosed with diabetes. This, coupled with the fact that the common precipitating cause for DKA is infection, highlights the potential for prevention by using education and early access to sound medical advice.

Some individuals with diabetes will be at greater risk for being unwell and have subsequent adverse glycaemic outcomes. Wright et al (2009) reviewed 278 DKA admissions over a decade and identified a number of factors contributing towards hospital presentation (See Table 1).

**Table 1 - Factors contributing to DKA (Wright, 2009)**

| Factors contributing to DKA         | Number of admissions | Percentage of admissions (%) |
|-------------------------------------|----------------------|------------------------------|
| <b>Poor control and compliance</b>  | 160                  | <b>57.6</b>                  |
| <b>Infective illness</b>            | 65                   | <b>23.4</b>                  |
| <b>Psychological problems</b>       | 57                   | <b>20.5</b>                  |
| <b>Missed insulin dose</b>          | 52                   | <b>18.7</b>                  |
| <b>New diagnosis</b>                | 28                   | <b>10.1</b>                  |
| <b>Alcohol abuse</b>                | 25                   | <b>9.0</b>                   |
| <b>Vomiting or diarrhoea</b>        | 19                   | <b>6.8</b>                   |
| <b>Family problems</b>              | 11                   | <b>4.0</b>                   |
| <b>Cough/cold/flu-like symptoms</b> | 5                    | <b>1.8</b>                   |
| <b>Other</b>                        | 3                    | <b>1.1</b>                   |

In addition, clinic non-attendance was identified by Kipps et al (2002) as a contributing risk factor for mortality following DKA in young people with type 1 diabetes transitioning to adult services. Randall et al (2011) found that financial issues, losing or reporting diabetes supplies/equipment as being stolen or simply ‘did not know how to handle insulin on sick days’ as common precipitating causes of DKA among 164 inner city monitored adults in the US. When young adults are better supported in an Australian adult service and clinic attendance is maintained, rates of DKA admissions are reduced by one third (Holmes-Walker. D, Llewellyn. A, Farrell. K, 2007).

The incidence of HHS is also difficult to determine due to the lack of population-based studies, but it is thought to be less than 1% of all primary diabetes-related admissions. HHS usually affects middle aged or older people. Infection is a common precipitating factor for the development of HHS with symptoms usually evolving over days to weeks. This provides diabetes health professionals with an opportunity for early detection and highlights the role of education to empower the person with type 2 diabetes of intervention strategies to prevent the escalation towards HHS. However, as two thirds of episodes of HHS occur in people who have not previously been diagnosed as having diabetes, there will be a limit to which this condition can be prevented in the community.

No exact cost of DKA, HHS and hypoglycaemia can be found, though in the US ‘metabolic complications’ contribute to 13% (US\$7 billion) of the overall cost of diabetes-related complications (ADA, 2008).

## 7 The Role and Function of a Sick Day Management Plan

Sick day management plans should be developed for every person with type 1 and type 2 diabetes so that they are then available should any illness occur. The initial plan should be developed as soon after first presentation with diabetes as appears appropriate for the individual and the circumstances of presentation. The plans also should be reviewed and revised at least every 1-2 years. Indeed this should be done as part of an annual cycle of care and/or complications assessment

The plans need to be individualised taking 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 following acute illness, physical and cognitive capacity.

Sick day management plans need to identify and clearly articulate the role of the person with diabetes and of each member of their multidisciplinary management team. This will potentially include their support person(s), their diabetes care team (any/all of endocrinologist/diabetologist, diabetes educator, general practitioner, dietitian) and other relevant team members (eg indigenous health worker, mental health case worker, residential staff). All members of this team should be offered the opportunity of being involved in developing and/or reviewing the sick day management plan.

Individual sick day management plans need to be developed for people with diabetes in the supportive residential care environment and correctional institutions. Organisations caring for people with diabetes also need to develop clear policies and procedures to support these people with diabetes during times of illness (ADA, 2014). Sinclair (2011) argues that residents with diabetes within institutional settings appear to be highly vulnerable with respect to susceptibility to infections and increased hospitalisation rates. The Task and Finish Group of Diabetes UK (2010) recommended that each resident with diabetes should:

- Have an individual care plan agreed between the person with diabetes (or relative/carer), general practitioner and residential care staff.
- Identify a designated doctor (usually GP) who accepts overall medical responsibility for the diabetes management of the resident and ensures that diabetes care follow-up takes place.
- Identify a designated person to contact when a resident becomes unwell and professional advice/direction is needed quickly (a Diabetes Specialist Nurse is suggested within the guidelines).
- Identify when presentation to acute care services such as an emergency department is required.

## 8 Key Concepts of Sick Day Management Plans

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

### Key concepts

- Sick day management plans need to be developed with the person and where relevant, their carer(s) eg. parents, partner, children, residential care, correctional institutions prior to the occurrence of illness.
- The person with diabetes as well as members of their support team require appropriate, timely and ongoing education to correctly and confidently manage their diabetes when unwell.
- Diabetes sick day management plans should be regularly reviewed with the person with diabetes and their carer(s), to determine whether they need to be changed or updated, based upon the patient's current circumstances.
- 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 than for those with type 2 diabetes. They will also differ within the population of people with type 2 diabetes depending on whether they are insulin treated or not.
- Sick day management concepts and strategies will also vary with different types and severity of intercurrent illness, with the presence or absence of vomiting being of particular importance.
- All aspects of education related to sick day management plans and their development must be documented in the patient's medical record as well as a copy given to the person with diabetes for safekeeping and future reference.
- The intercurrent illness should be treated as it would be for a person without diabetes.
- People with diabetes and their carer(s) should be familiar with the signs and symptoms of illness that warrant immediate emergency care and should act accordingly.
- A sick day management plan should be initiated at the first signs of the person with diabetes feeling unwell.
- 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.
- Following an episode of illness, the sick day management plan should be reviewed and evaluated by the person with diabetes and their carer(s) with the health care team.
- Health professionals need to keep in mind that diabetes-related complications, in particular gastroparesis, can mimic illness by producing symptoms such as nausea, vomiting, anorexia and abdominal pain.
- An individual's life changes could potentially/actually affect their (or support team's) ability to manage illness and revision of the plan should be considered. Examples

may include changes in diabetes treatment, the development of diabetes-related complications or other co-morbidities, transition from paediatric to adult services, changes in employment, geographical relocation, pregnancy, or travel.

Following an episode of illness, an evaluation process of the sick day management plan should occur to determine:

- Was the plan implemented?
- Were the steps in the plan followed?
- Were the objectives of the plan achieved?
- What components of the plan worked successfully?
- What components of the plan were not implemented?
- What components of the plan did not achieve desired outcomes and why?
- What components of the plan need to be changed or reviewed?

Appropriate modifications to the sick day management plan should then be made.

## 9 Components of a Sick Day Management Plan

### Key concepts

A sick day management plan should include:

- Recommended frequency and amount of fluids to reduce the risk of dehydration and carbohydrate containing food and fluids to reduce risk of hypoglycaemia.
- The frequency of blood glucose monitoring and, if appropriate, blood or urine ketone testing.
- Diabetes medication dose adjustment.
- Recommended additional medication useful to address clinical symptoms of illness eg antiemetic and antidiarrhoea 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 if the sick day management plan is not effective or if the person's condition further deteriorates or usual health care team is not contactable.
- Regular checking of sick day management kit eg. expiry dates
- A sick day management kit which is modifiable to other situations such as travel.

People with diabetes have better outcomes when they have timely interactions with health care professionals (Laffel, 2000). Kitabchi et al (2009) stresses that effective communication with healthcare providers, proper client education and better access to medication can prevent many cases of DKA and HHS. Development of an individualised sick day management plan should take into consideration accessibility to 24 hour specialist advice which may be achieved using a variety of strategies including:

- Telephone on-call diabetes services provided by the person with diabetes' own acute service team, for example, their diabetes educator, endocrinology registrar.
- Telephone advice provided by informed medical staff employed in hospital accident and emergency services.
- Nurse on Call telephone services.
- Home visiting GP locum services.

Farrell and Holmes-Walker (2011) found that after establishing a 24 hour mobile phone support service in an Australian diabetes clinic, there was a significant reduction in the number of patients progressing from ketosis to DKA. Of the 31 patients who accessed the phone support service on 83 occasions, only 2 required admission for a diagnosis of DKA.

## 10 Type 1 Diabetes – Key concepts for sick day management

### 10.1 Key concepts

- 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 illness.
- Sick day management education must be provided soon after initial diagnosis as an integral part of survival skills information for people with type 1 diabetes.
- More frequent blood glucose is needed during episodes of illness.
- People with type 1 diabetes should be reminded to never discontinue taking their insulin, especially basal insulin.
- Pre-meal short/rapid-acting insulin may need to be reduced if dietary carbohydrate intake is poor and blood glucose levels are not elevated.
- Supplemental doses of rapid-acting insulin should be administered according to Table 2.
- Ketone levels should be measured during times of illness, even if blood glucose is not high.
- Blood ketone testing is the preferred method of measuring ketosis.
- Ketones may occur in the setting of low/'normal' blood glucose levels in the presence of poor oral intake.
- DKA is a life-threatening condition in people with type 1 diabetes.

Enacting a sick day management plan earlier, that is, at a lower blood glucose or urine/blood ketone level  $\geq 0.6$  mmol/L is needed if people with diabetes:

**Note:** The guidelines have been modified to take into consideration people with type 1 diabetes with complex or challenging needs where by escalation of ketosis management should be instigated at the lower level of 0.6 mmol/L.

- Have a history of recurrent diabetic ketoacidosis.
- Have very poor glycaemic control.
- Have an eating disorder.
- Are known to frequently and/or inappropriately omit insulin.
- Are pregnant.
- Have multiple co-morbidities which may include end-stage organ failure.
- Are elderly.
- Live in a remote/isolated area some distance from medical support.

## 10.2 Ketone testing

Within the literature there is much debate as to the precise level at which the presence of ketone bodies is considered to be abnormal. However the American Diabetes Association (ADA) has provided a consensus statement stating that blood ketone levels of  $>3.0\text{mmol/L}$  require medical intervention but that the presence of ketones alone is not sufficient for the diagnosis of DKA.

Two methods exist to measure ketone bodies. First is the long established semi-quantitative estimation of acetoacetate and acetone levels in urine (Weber et al, 2009). The second method for testing ketone levels is using a capillary blood sample that measures  $\beta$ -hydroxybutyrate ( $\beta$ -OHB) based on a specific enzyme reaction. It is important that the person with type 1 diabetes has access to ketone measuring equipment when unwell (even if it involves using a meter different to their preferred day to day blood glucose meter). If blood ketone testing is not available, urine testing is recommended. Weber et al (2009) found both methods of self-monitoring ketone bodies were safe and clinically reliable.

However blood ketone testing offers some advantages over urine ketone testing including:

- Assessment of blood ketones in real time.
- Potential convenience of use.
- Minimal delay in identifying the presence of ketones if unable to pass urine.
- Demonstrated greater compliance in measuring ketone levels during illness (Laffel et al, 2005).
- Specificity of blood  $\beta$ -OHB aiding the recognition of impending ketosis or DKA.
- Identification of euglycaemic DKA which tends to occur when there has been excessive vomiting and it has been reported in up to 10% of cases of DKA presentations during pregnancy (Wallace and Matthews, 2004).
- Fewer false positives and negatives than urine testing.
- Cost saving in normalising blood  $\beta$ -OHB when managing ketosis and DKA.
- Accurate indicator of the adequacy of treatment and intervention (Wallace et al, 2001).
- Similar methodology to blood glucose monitoring and less reliance on renal function.
- Possible reduction in emergency and hospital admissions with earlier detection of ketosis and DKA (Laffel et al, 2006).
- Preferred option of ketone measurement in people using IPT (APEG, ADS 2011).
- The integrity of urine ketone strips cannot be assured despite a valid batch/lot expiry date, if the canister has been opened 3 months previously.

### 10.3 Supplemental insulin

Supplemental doses of rapid or fast-acting insulin should be administered to manage hyperglycaemia and ketosis. Supplemental insulin should not be confused with sliding scale insulin (SSI). SSI has been described as the administration of insulin when BGLs are within a specified range, with insulin often being withheld when BGLs are within a 'normal range' (ADS, 2012).

Supplemental insulin is described by Cheung and Chipps (2010) as 'the administration of variable dose insulin to correct hyperglycaemia, given in conjunction with appropriate adjustments to the person with diabetes' scheduled anti-diabetic therapy". This proactive adjustment is more effective and safer than the reactive approach used in SSI as sole therapy.

A supplemental insulin dose should be:

- Calculated as a percentage of the usual total daily dose (TDD).
- Given **in addition** to the usual prescribed insulin doses.

Supplemental insulin doses can be given 2-4 hourly (ie a supplemental insulin dose may be given midway between main meals if necessary), if rapid acting insulin (ie aspart, lispro, glulisine) is used. Medical care should be sought if there is no improvement (or indeed if there is deterioration) in blood glucose or ketones after 2 supplemental doses have been given.

Individuals with insulin pumps can develop ketosis and DKA more quickly (ie within 2-3 hours of interruption to insulin pump delivery), because there is no background reservoir of long acting insulin. They should promptly check for technical problems with the pump and then appropriately use an insulin pen or syringe to deliver supplemental insulin doses rather than rely on pump correction boluses that may not actually get delivered in the setting of a faulty pump/tubing.

Table 2 - Supplemental Insulin Guidelines for type 1 diabetes (modified from the National evidence-based clinical care guidelines for type 1 diabetes in children adolescents and adults 2011)

| If the blood or urine ketone level is:  | And the blood glucose level is:  |  |  |   |
|---|--|--|--|---|
|   | Below 4.0 mmol/L   | 4.1-8.0 mmol/L   | 8.1-15.0 mmol/L  | >15.0mmol/L   |
| <p><b>Urine: negative</b></p> <p><b>AND/OR</b></p> <p><b>Blood: 1.0mmol/L</b><br/>Or<br/><b>&gt;/= 0.6mmol/L for at risk individuals*</b></p> | <ul style="list-style-type: none"> <li>• Increase blood glucose level with carbohydrate – hypo treatment</li> <li>• If unable to eat or drink #</li> <li>• May need to reduce insulin dose</li> <li>• Hourly monitoring until glucose level normalized</li> <li>• If glucose levels do not rise seek urgent medical assistance</li> </ul>    | <ul style="list-style-type: none"> <li>• No change to insulin</li> <li>• Recheck glucose and ketones in 2 hours</li> <li>• Consume carbohydrate containing fluids<sup>^</sup></li> </ul> | <ul style="list-style-type: none"> <li>• May fall without extra insulin</li> <li>• If persistently elevated consider 5% supplemental insulin+</li> <li>• Recheck glucose and ketones in 2 hours</li> <li>• Consume carbohydrate containing fluids<sup>^</sup></li> </ul> | <ul style="list-style-type: none"> <li>• 5-10% supplemental insulin dose+</li> <li>• Recheck glucose and ketones in 1 hour</li> <li>• Consume carbohydrate free fluids</li> <li>• If unable to reduce glucose levels after 2 supplemental doses of insulin seek urgent medical assistance</li> </ul>  |
| <p><b>Urine: small</b></p> <p><b>AND/OR</b></p> <p><b>Blood: 1.0-1.4mmol/L</b><br/>Or<br/><b>&gt; 0.6mmol/L for at risk individuals*</b></p>  | <ul style="list-style-type: none"> <li>• Increase blood glucose level with carbohydrate</li> <li>• If unable to eat or drink#</li> <li>• Hourly monitoring of glucose and 2 hourly monitoring ketone level until normalized</li> <li>• If unable to raise glucose levels or ketones remain present seek urgent medical assistance</li> </ul> | <ul style="list-style-type: none"> <li>• No change to insulin</li> <li>• Recheck glucose and ketones in 2 hours</li> <li>• Consume carbohydrate containing fluids<sup>^</sup></li> </ul> | <ul style="list-style-type: none"> <li>• If persistently elevated ketones consider 5-10% supplemental insulin+</li> <li>• Recheck glucose and ketones in 2 hours</li> <li>• Consume carbohydrate containing fluids<sup>^</sup></li> </ul>                                | <ul style="list-style-type: none"> <li>• 10-15% supplemental insulin dose+</li> <li>• Recheck glucose and ketones in 1 hour</li> <li>• Consume carbohydrate free fluids</li> <li>• If unable to reduce glucose levels after 2 supplemental doses of insulin seek urgent medical assistance</li> </ul> |

| If the blood or urine ketone level is:   | And the blood glucose level is:  |   |  |  |
|--|--|---|--|--|
|  | Below 4.0 mmol/L   | 4.1-8.0 mmol/L  | 8.1-15.0 mmol/L  | >15.0mmol/L  |
| <p><b>Urine:</b><br/>moderate/large</p> <p><b>AND/OR</b></p> <p><b>Blood:</b> &gt;/= 1.5mmol/L</p> | <ul style="list-style-type: none"> <li>• Increase blood glucose level with carbohydrate</li> <li>• If unable to eat or drink#</li> <li>• Hourly monitoring until glucose and ketone levels normalise</li> <li>• If unable to raise glucose or ketones remain present seek urgent medical assistance</li> </ul> | <ul style="list-style-type: none"> <li>• 5% supplemental insulin may be required+</li> <li>• Recheck blood glucose and ketones in 2 hours</li> <li>• Consume carbohydrate containing fluids^</li> </ul> | <ul style="list-style-type: none"> <li>• If persistently elevated ketones consider 10% supplemental insulin+</li> <li>• Recheck glucose and ketones in 2 hours</li> <li>• If ketones remain present seek urgent medical assistance</li> <li>• Consume carbohydrate containing fluids^</li> </ul> | <ul style="list-style-type: none"> <li>• 15-20% supplemental insulin+</li> <li>• Recheck glucose and ketones in 1 hour</li> <li>• Consume carbohydrate free fluids</li> <li>• If unable to reduce glucose levels after 2 supplemental doses of insulin seek urgent medical assistance</li> </ul> |

\* At risk individuals are people with type 1 diabetes who:

- Have a history of recurrent diabetic ketoacidosis.
- Have very poor glycaemic control.
- Have an eating disorder.
- Are known to frequently and/or inappropriately omit insulin.
- Are pregnant.
- Have multiple co-morbidities which may include end-stage organ failure.
- Are elderly.
- Live in a remote/isolated area some distance from medical support.

+ Refers to the percentage of total daily insulin dosage given as rapid or fast-acting dose

# Implement individual hypo emergency plan ie. Dial 000 or intramuscular glucagon. May also be relevant to people with gastroparesis (APEG, ADS 2011).

^ Refer to Table Five

Supplemental doses of insulin are defined as:

- Rapid-acting insulin doses to be given in addition to usual insulin dose(s)
- Currently available rapid-acting insulins are aspart, lispro, glulisine
- Insulin to be given straight away (but not closer than 2 hours to the previous dose of rapid-acting insulin) and not just delayed until the time that the next prescribed usual insulin dose is due.
- Being calculated as a percentage of the total daily dose ie. % of the total of short and intermediate/long acting in a day.

Example of how to calculate extra insulin dose:

| Usual daily dose:        | Morning  | Lunch   | Dinner   | Bedtime  |
|--------------------------|----------|---------|----------|----------|
| Rapid acting             | 4 units  | 6 units | 10 units |          |
| Intermediate/Long acting |          |         |          | 20 units |
| Total daily dose         | 40 units |         |          |          |
| 5% of daily dose         | 2 units  |         |          |          |
| 10% of daily dose        | 4 units  |         |          |          |

**Important: if glucose continues to rise despite 2 extra supplemental doses of insulin, seek urgent medical assistance**

Urgent medical assistance eg presentation to hospital emergency department should occur if the person becomes, drowsy or confused, has fast or unusual breathing or abdominal pain. If carers are unsure how to provide sick day management and support, or themselves are exhausted as an outcomes of providing ongoing assistance, urgent medical assistance should be sought (Queensland Health).

## 11 Specific Management Issues for People using Insulin Pump Therapy (IPT)

### Key concepts

- People using IPT, require additional education and instruction regarding the management of intercurrent illness. This should be undertaken both prior to and at the time of commencement of IPT as well as periodically reviewed.
- People using IPT can be at greater risk for developing ketosis and DKA.
- More frequent blood glucose testing is recommended during episodes of illness.
- The ability to identify and manage pump malfunctions is essential for all people using IPT, and all should have an emergency plan in case of pump failure.
- The emergency plan should include a subcutaneous insulin regimen and/or education on calculation of insulin doses should there be an urgent need to switch from IPT back to multiple daily injections (MDI) in the setting of pump failure.

The concepts for sick day management for patients on IPT are the same for those on multiple daily injections (MDI). Individuals using IPT can develop ketosis and DKA more quickly than those using MDI, as there is no background reservoir of long acting insulin. Therefore, hyperglycaemia must be taken very seriously. The basal rate and/or correction boluses may need to be increased during the period of illness. If a patient on IPT is unwell and the BGL is 15mmol/L or above the following steps should be taken:

- Check for problems with the pump, line and connections and change the cannula, tubing and reservoir if required.
- Check for ketones in blood/urine. If ketones are positive OR hyperglycaemia cannot be corrected, suspect a problem with the pump.

Follow the table below.

Table 3 - Sick day management for people using Insulin Pump Therapy

| Category according to:<br>clinical status,<br>blood/urine ketone<br>level, blood glucose<br>level   |  |   |   |  |
|---|--|---|---|--|
|   | Basal Insulin  | Correction Bolus  | Food Bolus  | Extra fluids   |
| <p><b><u>Unwell (no vomiting or diarrhoea):</u></b><br/> <b><u>KETONES:</u></b><br/> <b><u>Urine: negative</u></b><br/> <b><u>Blood: &lt;1.0mmol/L</u></b><br/>                     Or<br/> <b>0.6 – 1.0mmol/L for at risk individuals</b><br/> <b>AND</b><br/> <b>BGL &lt; 15.0 mmol/L</b></p> | <p>Maintain basal rate</p>   | <p>If blood glucose above target, correct blood glucose level using the pump with ‘usual’ settings</p>  | <p>If blood glucose above target cover all carbohydrate intake<br/>If blood glucose level below target do not cover carbohydrates</p> | <p>If glucose levels low or in range have fluids containing carbohydrate</p>   |
| <p><b><u>Unwell ( no vomiting or diarrhoea):</u></b><br/> <b><u>KETONES:</u></b><br/> <b><u>Urine: small</u></b><br/> <b><u>Blood: 1.0-1.4mmol/L</u></b><br/>                     Or<br/> <b>0.6 – 1.4mmol/L for at risk individuals*</b><br/> <b>AND</b><br/> <b>BGL &gt; 15.0 mmol/L</b></p>  | <p>Maintain basal.<br/>If blood glucose level is over target range after giving a correction dose via injection use a temporary basal rate: Increase basal rate by 10-20% for the next 2 hours<br/>Repeat until blood glucose returns to normal.<br/>Sometimes the basal rate may need to be increased by as much as 50-100%</p> | <p>Give first correction with an injection. This is 10% of the Pump Total Daily Dose (found in pump memory)<br/>Change pump site including cannula, tubing and reservoir<br/>Re-check blood glucose in 2 hours and if blood glucose is greater than 15.0mmol/L give another correction by injection.<br/>Re-check blood glucose again in 2 hours and if blood glucose is still greater than 15.0mmol/L, call for medical advice</p> | <p>Cover all carbohydrates</p>  | <p>Consume non-carbohydrate containing fluids<br/>Change to non-carbohydrate containing fluids once BGL less than 15.0mmol/L</p> |

| Category according to:<br>clinical status,<br>blood/urine ketone<br>level, blood glucose<br>level  |  |  |  |  |
|--|--|--|--|--|
|  | Basal Insulin  | Correction Bolus   | Food Bolus   | Extra fluids   |
| <p><b><u>Vomiting and/or diarrhea:</u></b><br/><b>AND/OR</b><br/><b><u>KETONES:</u></b><br/><b><u>Urine: moderate/large</u></b><br/><b>AND/OR</b><br/><b><u>Blood: 1.5mmol/L or more</u></b><br/><br/><b>REGARDLESS OF BGL</b></p> | <p>Maintain basal rate unless blood glucose level is less than 5.5 mmol/L<br/>If blood glucose less than 5.5 mmol/L, use a temporary basal: Decrease basal rate by 10-20% for duration of 4 hours then review<br/>If unable to raise glucose or ketones remain present seek urgent medical assistance/ present to emergency department</p> | <p>Correct blood glucose to target every 2 hours as needed</p> | <p>Don't cover carbohydrate until vomiting/diarrhea slows. Wait 30 minutes after eating to bolus for carbohydrate (to make sure food is kept down)</p> | <p>Consume carbohydrate containing fluids<br/>Likely to need intravenous fluids so seek urgent medical assistance/present to emergency department unless clear improvement occurs within a few hours</p> |

\* At risk individuals are people with type 1 diabetes who:

- Have a history of recurrent diabetic ketoacidosis.
- Have very poor glycaemic control.
- Have an eating disorder.
- Are known to frequently and/or inappropriately omit insulin.
- Are pregnant.
- Have multiple co-morbidities which may include end-stage organ failure.
- Are elderly.
- Live in a remote/isolated area some distance from medical support.

## 12 Type 2 Diabetes – Key Concepts For Sick Day Management

Adverse drug reactions to diabetes medications may mimic illness either soon after commencement of a medication or after the dosage has been increased. As part of the Quality Use of Medicines, all people with diabetes and their carers should be informed of potential side effects arising from medications or changes to dosage. Complementary and alternative medicines (CAM) are often used by people with diabetes. Just as prescribed medications can produce adverse reactions that can mimic illness, so too can CAM. A sudden change in a previously stable medical condition can indicate a CAM-conventional medicine interaction (Dunning, 2009).

The sick day plan should be commenced immediately if the person with diabetes is feeling unwell or has any signs of illness, even if the blood glucose levels are still normal. Glucose levels should be monitored second hourly if blood glucose levels are greater than 15mmol/L for more than 8-12 hours.

Most patients should be advised to continue taking their usual medications even if they are eating little or have vomiting and/or diarrhoea. However as vomiting and/or diarrhoea can cause rapid dehydration, those patients with known impaired renal function should omit metformin. Glucagon-like peptide-1 mimetics can cause nausea if administered without eating and their use during an episode of illness that produces nausea and vomiting again may require medical intervention and direction in terms of its continuation during acute illness.

Individuals taking insulin may require extra insulin when unwell. If the person with diabetes is currently administering a basal/bolus insulin regimen, they can be advised to use the supplemental insulin advice (see Table 2) as prescribed for those with type 1 diabetes. People with diabetes taking a basal only or premixed insulin regimen, should be advised to contact their diabetes care team for advice on insulin adjustment.

## Key concepts

- A sick day management plan should be tailored to the individual needs of the person with diabetes and be initiated when the first signs of illness occur.
- People with diabetes should be reminded to never discontinue taking their insulin or glucose lowering medicines unless otherwise advised by their diabetes specialist team.
- Assistance from the individual's doctor or diabetes team should be sought early in a period of illness as prompt medical assistance may be required to advise the patient on appropriate adjustment or oral and/or injectable diabetes medications.
- As many people with insulin-treated type 2 diabetes are prescribed basal or premixed insulin, they do not have access to rapid-acting insulin to use as a supplemental insulin dose, therefore medical assistance must be sought in the early stages of illness in these patients to facilitate access to appropriate insulin.
- More frequent blood glucose testing is recommended during episodes of illness.
- The presence of co-morbidities and/or end-stage organ failure will require the individual to seek prompt medical attention regardless of blood glucose levels.
- People with renal impairment should be advised to cease metformin promptly if an intercurrent illness is leading to dehydration.
- Ketoacidosis is considered uncommon in individuals with type 2 diabetes, however it may occur in with people with type 2 diabetes who are lean, pregnant women or known to have previously shown ketones.

Intercurrent illness that is not managed appropriately and expediently can result in very high blood glucose levels, and in rare occasions may lead to hyperosmolar hyperglycaemic state (HHS). HHS is associated with relatively high rates of mortality. Diabetes health professionals, people with type 2 diabetes and their carer(s) should be familiar with the symptoms of illness that warrant immediate emergency care and should act accordingly.

Diabetes educators should be cognisant that some symptoms associated with adverse drug reactions could mimic illness such as nausea, vomiting, diarrhoea and sinusitis and need to be distinguished from illness (see Appendix 1).

**Table 4 - Management of glucose lowering medicines during illness**

| Medication                                | Specific concerns or considerations   | Action  |
|---|---|---|
| <b>Metformin</b>                          | <p>Rapid dehydration resulting from acute illness may impact on renal function, further reducing creatinine clearance in people with known renal impairment and in the frail elderly.</p> <p>Is contraindicated in severe liver, cardiac and respiratory disease.</p> <p>Requires awareness of the clinical signs and symptoms of lactic acidosis*.</p> | <p>Prompt medical direction should be sought to confirm continuation of metformin in people at high risk of acute renal failure in the presence of rapid dehydration.</p> <p>Metformin should never be commenced during an episode of acute illness. Presentation to hospital required if lactic acidosis is suspected and metformin is ceased.</p> |
| <b>GLP -1 mimetics</b>                    | <p>Illness that results in sudden nausea, vomiting or anorexia (not as an adverse drug effect) may be exacerbated by continued short term use of exenatide, liraglutide</p> <p>Sudden abdominal pain.</p>   | <p>Medical direction should be sought to confirm continuation of GLP-1 mimetics.</p> <p>Cease GLP-1 mimetics with full medical and pathology assessment to look for possible development of pancreatitis.</p>   |
| <b>Sulfonylureas</b>                      | <p>Illness that results in sudden nausea, vomiting or anorexia may increase risk of hypoglycaemia, especially with long-acting preparations.</p>  | <p>Frequent self-monitoring blood glucose levels to identify falls in blood glucose.</p> <p>Medical direction should be sought to confirm continuation of sulfonylureas.</p>  |
| <b>Thiazolidinediones</b>                 | <p>Can contribute to fluid retention.</p>   | <p>Should be reviewed if marked fluid retention is occurring or if symptoms are suggestive of cardiac failure develop.</p>  |
| <b>Dipeptidyl peptidase-4 inhibitors</b>  | <p>Sudden abdominal pain.</p>   | <p>Cease DPP4 inhibitors with full medical and pathology assessment to look for possible development of pancreatitis.</p>   |
| <b>Alpha-glucosidase enzyme inhibitor</b> | <p>Development of an ileus.</p>   | <p>Medical direction should be sought to confirm continuation.</p>  |

| Medication                                 | Specific concerns or considerations                          | Action   |
|--|--|--|
| <b>Sodium-glucose linked transporter 2</b> | Illness that results in sudden dehydration/volume depletion. | Cease.   |
|  | Urinary tract infection or genital yeast infection           | Medical direction should be sought to confirm continuation of SGLT2. |

\*According to Dunning (2010), lactic acidosis should be considered during an episode of acute illness when vasoconstriction and hypotension occur in the presence of:

- Recent myocardial infarction.
- Cardiac failure and cardiogenic shock.
- Pulmonary disease.
- Cirrhosis.
- Sepsis.
- Renal impairment.
- Medicines and toxins such as isoniazid, salicylates, beta-adrenergic agents, alcohol and metformin especially in older people with conditions causing hypoxia and/or dehydration.
- Surgery.
- Inborn errors of metabolism such as fructose 1,6-diphosphatase deficiency.

Symptoms of lactic acidosis include nausea, vomiting, hyperventilation, abdominal pain, lethargy, anxiety, hypotension, irregularly heart rate and tachycardia.

Urgent medical assistance should be sought if:

- Blood glucose is greater than 15.0mmol/L for more than 24 hours or if blood glucose continues to rise despite additional oral medications or 2 increases to insulin doses.
- Symptoms include drowsiness, confusion, breathing difficulties or have severe abdominal pain.
- Vomiting is persistent and especially if frequent for more than 4 hours.
- The person with diabetes experiences hypoglycaemia which is severe or if the blood glucose cannot be kept above 4.0mmol/L.
- The person with diabetes is too unwell to carry out their own monitoring.

## 13 Type 1 and Type 2 diabetes

### Maintenance of Hydration and Carbohydrate Intake

The person with diabetes should be encouraged to maintain oral carbohydrate intake during illness to reduce the risk of hypoglycaemia and maintain energy requirements. Antiemetic therapy may be required to ensure adequate hydration and carbohydrate intake. Unless otherwise stated by a medical officer, 125 – 250 mls of fluid (1/2 to 1 cup) per hour is suggested during acute illness.

In the event that food is unable to be consumed, it is recommended that:

- Carbohydrate containing fluids be consumed if blood glucose levels < 15.0mmol/L.
- Carbohydrate-free fluids be consumed if blood glucose levels  $\geq$  15.0mmol/L.

Table 5. Carbohydrate containing fluids

Table 5 - Carbohydrate containing fluids

| Type of fluid                            | Carbohydrate load per 100mls |
|--|------------------------------|
| <b>Fruit juice</b>                       | 10g                          |
| <b>Cordial 1 teaspoon of concentrate</b> | 10g/20ml                     |
| <b>Soft drink</b>                        | 10g                          |
| <b>Jelly</b>                             | 13g or 16 per half cup       |
| <b>Milk</b>                              | 5g                           |
| <b>Oral rehydration solution</b>         | 1.5g                         |
| <b>Sports drink</b>                      | 6g                           |
| <b>Icy pole</b>                          | 12g per stick                |
| <b>Calippo®</b>                          | 21g per tube                 |
| <b>Frosty fruit®</b>                     | 21g per stick                |

Carbohydrate free fluids include:

- Sugar-free/diet jelly.
- Sugar-free/diet/zero soft drink.
- Sugar-free/low-joule cordial.
- Water.
- Broth.

In addition, consideration should be given to the use of oral re-hydration solutions (ORS) such as Gastrolyte® that can help replenish fluid and electrolytes which have been lost through vomiting, diarrhoea or dehydration. Re-hydration solutions have a relatively low concentration of carbohydrate (~1.6g/100ml of made up solution) and therefore additional carbohydrate maybe be required to avoid hypoglycaemia. Some solutions also contain artificial sweeteners (Gastrolyte®, Hydralyte®, Repalyte®). ORS are also available in sachets to be added to water.

Precooked rice sachets and ice blocks are also available and contain sufficient glucose and salts to improve hydration (Australian Medicines Handbook, 2014). Consumption of the rice sachets may also be beneficial in those with diarrhoea as the additional starch in these products may improve stool consistency. Any powdered versions of ORS should only ever be mixed with clean water.

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. Sweetened fluids may require dilution of up to 1 – 5 times for optimum tolerance and absorption. This should be taken into account when calculating carbohydrate intake. Fluids should be sipped slowly over a period of time – indeed up to an hour. Too rapid consumption of fluids when unwell can result in increased vomiting and/or diarrhoea. Fizzy fluids, for example, soft drink, should be left to go flat prior to consumption as effervescence can result in increased nausea and/or vomiting. Sports drinks e.g. Gatorade® or Powerade® can be a good alternative to ORS, however they are slightly higher in carbohydrate (see Appendix 4). Avoidance of an excessive intake of caffeinated drinks should be encouraged as these may make dehydration worse as caffeine is a gastric irritant thus has the potential to exacerbate nausea and vomiting.

## 14 Pregnant Women with Pre-Gestational Diabetes – Key Concepts For Sick Day Management

Sick day management plans are an integral part of pregnancy planning for women with type 1 and type 2 diabetes (McElduff. A et al, 2005).

### Key concepts

- DKA during pregnancy occurs more often in women with type 1 diabetes than in women with type 2 diabetes or gestational diabetes mellitus. However, pregnancy increases the risk of DKA in pregnant women compared to non-pregnant women with diabetes.
- Pregnant women with type 2 diabetes are more prone to ketosis than non-pregnant women with type 2 diabetes.
- DKA is more likely in the second and third trimesters when there is an increase in insulin resistance, relative insulin deficiency and accelerated starvation leading to increased free fatty acids from which they are converted to ketones in the liver.
- The patient's usual sick day management plan will require modification during pregnancy.
- More frequent blood glucose testing is recommended during episodes of illness.
- Episodes of nausea and vomiting eg. 'morning sickness' are common during pregnancy and may require adjustment to insulin therapy.
- Ketosis and the development of DKA tend to occur at lower blood glucose levels in pregnancy and can occur with euglycaemia or only mild hyperglycaemia.
- Ketone production may worsen nausea and vomiting.
- Medical intervention and hospitalisation should occur promptly when there is hyperglycaemia, and/or ketosis, and/or emesis, and/or other concurrent illness in pregnant women.

### 14.1 Type 1 diabetes

Maternal precipitating factors (see listed below), dehydration or a relative/absolute lack of insulin may increase counter-regulatory hormones such as glucagon, growth hormone, cortisol and catecholamines which will promote gluconeogenesis, lipolysis and the formation of ketones.

Factors that may increase the risk for the development of DKA during pregnancy include: (Yogev, Ben-Haroush, Hod 2008):

- Infection.
- Acute illness.
- Emesis.
- Endocrine disorders such as hyperthyroidism, pheochromocytoma.
- Poor compliance with insulin administration.
- Insulin pump therapy failure.
- Medications such as corticosteroids, beta-sympathomimetic agents.
- Medical management errors.
- Smoking.

Pregnant women with type 1 diabetes should begin to enact their sick day management plan if their blood ketone levels are  $\geq 0.6$ mmol/L. They should seek further medical assistance if two supplemental insulin doses have not reduced their BGLs.

### 14.2 Type 2 diabetes

Women with type 2 diabetes who are pregnant should be assessed for ketones and follow the type 1 sick day guidelines.

## 15 Management Of Hypoglycaemia During Illness

Hypoglycaemia can occur during illness especially when a person treated with insulin or an insulin secretagogue has gastrointestinal manifestations. The ADA recommends the ingestion of 15-30 grams of glucose as the preferred treatment for the conscious individual experiencing hypoglycaemia (ADA, 2014).

### Key concepts

- Illnesses associated with nausea, vomiting or diarrhoea may cause hypoglycaemia.
- Pregnant women with type 1 and type 2 diabetes are at increased risk of hypoglycaemia if emesis occurs.
- If able to tolerate fluids, routine hypoglycaemia management is recommended.
- In addition, some people may require a reduction to their insulin dose.
- All people with type 1 diabetes should have a readily available glucagon kit and their support team should be aware of how and when to administer glucagon in response to severe hypoglycaemia.

## 16 Discontinuation of Sick Day Management Plan and Presentation to Acute Medical Service

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

- Blood glucose levels >15.0mmol/L despite 2 supplemental insulin doses.
- Blood ketone levels >1.5mmol/L/ or urine ketone levels moderate/large and not decreasing following 2 doses of supplemental insulin.
- Blood ketone levels >0.6mmol/L in people with type 1 diabetes who have a history of recurrent DKA, very poor glycaemic control, eating disorders, known history of frequent inappropriate omission of insulin, who are pregnant, have multiple co-morbidities which may include end-stage organ failure, who are elderly or live in a remote/isolated area some distance from medical support.
- 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 4 hours, or becomes blood or bile stained.
- Severe dehydration (symptoms may include increased thirst, dry mouth and swollen tongue, weakness, dizziness/fainting, palpitations, headache, confusion/delirium, inability to sweat, decreased or no urine output).
- Persistent hypoglycaemia.
- If the individual or support person(s) are unable to carry out the monitoring and surveillance required.
- 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 elderly.
- Last time voided, for example more than 6 hours ago (to assist in identifying the presence of oliguria).
- If physical or cognitive impairment occurs making the implementation of the sick day management plan impossible.

## 17 Type 1 and Type 2 Diabetes – Key Concepts to Consider when Travelling

### Key concepts

- Sick day management plans should be prepared for all people with diabetes planning to travel, particularly to remote areas or overseas.
- Preparation and maintenance of a sick day management kit is vital and will require modification when travelling.
- People intending to travel with their IPT must also carry syringes or insulin pens/needles with them in case of pump malfunction.
- People intending to travel with their IPT may wish to carry an additional pump where possible. This may be available from the relevant IPT company.
- People intending to travel with their IPT must carry spare pump batteries.
- People using IPT must receive additional education related to the issues of dosing accuracy with ascent and descent.
- Contact details should be sought for overseas support for people using IPT.
- IPT and continuous glucose monitors will need to be removed prior to entering the new full body scanners found in some airports. Discussion with airport security staff in seeking an alternative security screening process may be required.
- Vaccinations should be undertaken as per medical recommendation.
- People with diabetes and their travelling companions should be updated on basic food safety issues prior to departure to minimise the risk of developing food-borne illnesses
- It is strongly recommended that people travelling overseas purchase comprehensive travel insurance prior to departure. As diabetes is a pre-existing condition it will need to be listed as such with the insurance company. This process may take several weeks and should be undertaken early in the process of travelling planning.
- Consider having any health-related documents translated into the language(s) of the countries to be visited.
- People requiring insulin should be encouraged to obtain and wear a medical ID bracelet.
- A document listing all of the individual's current medications (including doses), together with information about the person with diabetes or their carer carrying insulin devices, needles and syringes is required when travelling overseas.
- Documentation explaining the necessity of carrying needles/syringes, insulin pumps, blood glucose meters, continuous glucose monitor and sharps containers are required when travelling by plane, whether domestically (NDSS card) or internationally (letter provided and signed by health professional).
- CGMS should not be used during flying as it is considered a transmitter.

When travelling, whether by road, rail, boat or air, all diabetes supplies and equipment should be at hand, packed as carry-on luggage. Cool packs for GLP-1 mimetic agents and insulin should be taken to store these medications. Check with the travel carrier whether medicines can be stored in their fridge for the duration of the journey or whether additional ice can be obtained (the latter will require extra insulation to avoid direct contact so that freezing of medication does not occur).

Additional equipment to pack includes:

- Spare insulin pens and needles.
- Spare IPT consumables.
- Spare insulin pens, including basal insulin if currently on IPT.
- Additional lancets.
- Additional lancet device and batteries for blood glucose meter and pump if travelling to remote areas.
- Blood or urine ketone testing strips.
- Travel size sharps container.
- Glucagon.
- Carbohydrate containing snacks.
- Hypo treatment.
- Emergency medical kit.

The person with diabetes should be advised to visit their doctor at least 6 weeks prior to departure to discuss their planned destinations and what medications and vaccinations may be required before departure. In addition, seeking out specific recommendations with regard to air travel and security is useful.

People travelling should be aware of the relevant immunisations required. These include:

- Measles.
- Tetanus.
- hepatitis B (hepatitis A may also be useful).
- Influenza.
- Pneumococcus.

It is also appropriate to take anti-malarial medications prior to and during an overseas trip to active malarial areas. Detailed information can be found on the Travel Doctor website [www.traveldoctor.com.au](http://www.traveldoctor.com.au)

## 17.1 Emergency Medical Kit

To enable timely management of any intercurrent illness, people with diabetes should be encouraged to take an emergency medical kit with them when travelling overseas. This should be discussed with their Endocrinologist or General Practitioner as prescriptions for certain medications will be required.

The Emergency Medical Kit should contain:

- Antiemetics (for some individual this may mean considering suppository formulary).
- Antidiarrhoea agents.
- Paracetamol.
- Broad spectrum antibiotics.
- Oral Rehydration Solution (ORS).
- Betadine™.
- Basic wound dressing product.

## 17.2 Food Safety/Hygiene Principles for Travel

Diarrhoea and/or vomiting can be common health problems experienced by travellers. Other illnesses including cholera, hepatitis and typhoid are also spread by food and water contaminated by human waste. It is recommended that patients:

- Always wash hands before preparing food or eating. Bactericidal hand wash gels that do not require the use of water are suitable if clean water is not available for hand washing.
- Avoid drinking tap water in developing countries. This includes avoiding ice in drinks or water-grown vegetables such as watercress, salads washed in tap water.
- Boil water for at least a minute and leave to cool before drinking. Use water purification tablets (available from camping and outdoor stores) if unable to boil water.
- Only drink bottled water where the seal of the bottle is intact. Avoid any product that may have been tampered with.
- Food that is meant to be served cold should only be eaten at this temperature eg. Avoid melting ice-cream or warm salads.
- Food that is meant to be served hot should only be eaten at this temperature eg. Avoid lukewarm cooked foods like casseroles, meat pies, etc.
- Fruit should be peeled before consuming or if this is not possible the fruit should be thoroughly washed in safe drinking water.
- Teeth should be cleaned in safe drinking water.
- Do not assume that food served in expensive hotels or restaurants is safe. Try to eat freshly prepared foods which have been thoroughly cooked and served piping hot, or chilled.
- At risk foods include:
  - Salads.
  - Raw fruit and vegetables, unless washed and peeled freshly.
  - Food exposed to flies or vermin.
  - Food shared with many others eg. buffets.
  - Unpasteurised products eg. dairy food and fruit juices.
  - Undercooked or raw fish, meat or shellfish.
  - Reheated food – especially fish, meat or rice.
  - Takeaways and street food – unless thoroughly and freshly cooked.
  - Food left to stand at room temperature.

## 17.3 Reciprocal Health Care Agreements

Australia does have 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 and patients should be advised to be fully insured prior to departure.

Further advice on travelling can be obtained from the Smart Traveller website:

[www.smarttraveller.gov.au](http://www.smarttraveller.gov.au)

## 18 Recommended Tick List for Sick Day Management Kit

People with diabetes should be advised to check their kit at least every 6 months to ensure all kit is fully stocked and items are within their expiry date

- Copy of the sick day guidelines
- Telephone numbers to call eg. Support people, general practitioner, local hospital/diabetes clinic, diabetes educator, endocrinologist
- Food and fluid for sick days (sweet and unsweetened)
- Pain relief such as paracetamol or ibuprofen
- Rapid-acting insulin (if prescribed)
- Insulin syringes or insulin pen (if prescribed/recommended by medical team)
- In-date blood glucose testing strips
- Thermometer
- In-date ketone blood testing strips and OptiumR meter or in date urine ketone testing strips (KetodiastixR) for those with type 1 diabetes
- Glucagon (in those with type 1 diabetes and if recommended by medical team)

Expiry dates currently for blood ketone electrode strips and urine ketone strips need to be regularly reviewed. Out of date blood ketone electrode strips will not be operational in the meter and urine ketone strips need to be discarded 3 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.

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## 20 APPENDICES

### 20.1 Appendix 1: Type 1 and Type 2 Diabetes

#### Issues to Consider when Diabetogenic Medicines are Prescribed

##### Key concepts

- A number of medicines are known to increase blood glucose levels and are commonly prescribed.
- Modification to existing diabetes medications may need to occur when diabetogenic medicines are prescribed.
- Commencement of insulin therapy may be required.
- Increased self-monitoring of blood glucose levels will be required to identify the effect of diabetogenic medicines on glycaemic control and determine the correct course of action.
- People with diabetes being treated with atypical antipsychotic medicines for their schizophrenia are at risk of sudden severe hyperglycaemia and DKA (even with a diagnosis of type 2 diabetes) and require additional support with the development of their sick day management plan.

##### 20.1.1 Corticosteroids

The hyperglycaemic effects of corticosteroids have long been established. Steroids can be prescribed for short term acute use as well as prolonged, even lifelong, treatment. The effect of corticosteroids on blood glucose levels is variable and dependent on multiple factors that may include:

- Drug dosage – e.g. higher doses for exacerbations of COPD/asthma, rejection of transplanted organs, during chemotherapy or in palliative care, and moderate to lower doses as part of a maintenance regimen in rheumatoid arthritis, polymyalgia rheumatica.
- Dose structure - may be in a stable dose for chronic treatment or may be prescribed at a moderate-high starting dose with a structured dose reduction scale over a number of days, weeks or months, or may be cyclical as in chemotherapy regimens.
- Treatment duration - may range from a few days to years.
- Individual characteristics such as age, bodyweight, percentage of fat content of total body weight (affecting the volume of drug distribution).

Steroids are often prescribed in the morning and the phenomenon of a 'steroid curve' has been described where fasting BGLs are often on target (or lower compared to the rest of the day), but start to rise by lunchtime. BGLs generally peak by late afternoon, and may induce symptoms of hyperglycaemia at this time. By the evening, BGLs start to stabilise, and then tend to drop overnight. This is the usual pattern with prednisolone, but other steroids eg dexamethasone lead to a different pattern of hyperglycaemia. There are limited numbers of prospective trials on glucose lowering therapy during steroid treatment; however insulin is considered the agent of choice for steroid-induced hyperglycaemia (ADS, 2012).

Intra-articular corticosteroid injection may increase blood glucose levels for several days.

Due to the variability of steroid regimens that may be used, the changing requirements of glucose lowering medicines and, in particular of insulin need to be anticipated and individualised. Aside from hyperglycaemia, longer term steroid use can also lead to suppression of the hypothalamic-pituitary-adrenal axis.

In palliative care settings, if the person with diabetes is experiencing hyperglycaemic symptoms, adjustment to existing insulin regimens and/or oral agents should be made. The use of home visiting nursing services may need to be considered to assist with insulin administration for the person requiring palliative care. (Dunning et al, 2010).

The insulin type and dose prescribed for those requiring insulin instead of, or in addition to, their oral agents should be determined by observation of the blood glucose pattern, and by knowledge of the pattern of hyperglycaemia that will occur with different steroid regimens. The following regimens are often used in patients with steroid-induced hyperglycaemia to address the afternoon glucose rises:

- Pre-breakfast and pre-lunch intermediate acting NPH insulin OR
- Pre-breakfast and/or lunchtime short-acting insulin OR
- Pre-mixed insulin before breakfast or lunch.

Short-acting insulins such as Actrapid/Humulin R are preferable to rapid-acting insulins (Novorapid, Humalog, Apidra) when pre-meal insulin is needed in the setting of steroids. Short-acting insulins are mostly needed at lunchtime, but sometimes to also cover the evening meal.

Sliding scale insulin should not be used as the sole treatment for afternoon/evening steroid-induced hyperglycaemia.

### **20.1.2 Other medicines known to increase blood glucose levels (NPS, 2008)**

- $\beta$ -blockers
- Thiazide and thiazide-like diuretics
- Oral contraceptives
- Phenytoin
- Quinolone antibiotics
- Sympathomimetic agents
- Nicotinic acid
- Lithium
- SSRIs
- Others; danazol, protease inhibitors, megestrol, l-asparaginase, diazoxide, pentamidine

## 20.2 Appendix 2: Other Causes of Hyperglycaemia

### Key concepts

- Hyperglycaemia can occur in the person with diabetes for a variety of reasons that are not directly related to illness and the causes should be identified.
- A high intake of carbohydrate without appropriate adjustment of insulin dosage for example will impact on blood glucose levels.
- Illicit drugs may be a cause of hyperglycaemia.
- Severe emotional stress and/or possible omission or manipulation of diabetes medications can markedly increase blood glucose levels.

Illicit drugs can generate a number of symptoms which can also mimic clinical signs of illness.

Table 6 - Illicit drugs commonly used include (Diabetes Australia, 2009)

| Uppers                      | Opiates    | Hallucinogens                      |
|-----------------------------|------------|------------------------------------|
| <b>Ecstasy/E/MDMA/eckys</b> | Heroin     | Cannabis/marijuana/pot/weed/yardni |
| <b>Ice/crystal meth</b>     | Morphine   | Magic mushrooms                    |
| <b>Cocaine/coke/snow</b>    | Smack      | LSD/acid/trip/tabs                 |
| <b>Speed/whiz/goey</b>      | Powder     | Solvents/petrol/paint/glue         |
|                             | H          |                                    |
|                             | Joy powder |                                    |
|                             | Codeine    |                                    |

Whilst the effects of illicit drugs can last up to 24 hours, generally their usual effect is from 4-6 hours.

The effects of illicit drugs that may mimic illness include (Diabetes Australia 2009):

- Numbness and weakness.
- Lethargy.
- Nausea/vomiting.
- Increased heart rate.
- Decreased appetite.
- Dehydration.
- Weight loss.
- Skin sores/ulceration.
- Constipation.
- Increased body temperature.

Illicit drugs can mimic severe mental illness such as hallucinations, panic attacks, aggression, confusion, paranoia, sleepiness, impaired judgment, decreased inhibitions and depression. Use of illicit drugs can affect diabetes control due to the increased risk of omitting insulin, inadequate food intake or the ability to recognise the clinical signs of hyper and hypoglycaemia.

## 20.3 Appendix 3: Other Considerations

### 20.3.1 Medical Alert Products:

A variety of medical alert products are available for people with diabetes to purchase. Such products range from rubber bracelets with the word 'diabetic' marked on it, a generic alert tag worn on a bracelet or necklace, stylish jewellery with alert tags, wallet cards, key rings, USB memory sticks inserted into alert bracelets. Many of the products can be individually engraved at no additional cost. Such medical alert products are not only useful in terms of notifying health professionals of diabetes status during a medical emergency, but other medical conditions and drug allergies. They are also of value for people with diabetes when travelling.

### 20.3.2 Vaccinations:

It is recommended that all people with diabetes have an up to date vaccination status for:

- Influenza (unless there is known anaphylaxis to eggs) (Australian Medicines Handbook, 2014).
- Pneumococcus.
- Tetanus.

The influenza vaccine is an annual vaccination (best given in autumn) that is beneficial for all people with diabetes. During influenza outbreaks, mortality in people with diabetes can rise by 5-15%, particularly in those with complications such as cardiac and renal disease (NACA, 2005). It is particularly important to encourage annual vaccination for people with diabetes who are indigenous, elderly (especially in residential care) and those who are immunosuppressed (Australian Medicines Handbook, 2014).

The pneumococcal vaccine (which can be given at the same time as the influenza vaccine), is recommended for all people with chronic illness, especially if they are tobacco smokers or immune-compromised (Australian Medicines Handbook, 2014). People aged over five years with diabetes should receive pneumococcal vaccination (NACA, 2005). A booster can be considered after 5 years.

In addition to routine review of vaccination status, wounds that may be considered tetanus-prone require review of vaccination history (Australian Medicines Handbook, 2014).

People with diabetes who are also health professionals or microbiology staff are considered to be employed in high-risk occupations and should be vaccinated for a wide range conditions. Q fever vaccine is recommended in high-risk groups that include abattoir workers, veterinarians, laboratory personnel, farm workers and those exposed to cattle, goats, sheep or kangaroos (Australian Medicines Handbook, 2014).

People travelling should be aware of the relevant immunisations required that include conditions such as measles, tetanus, hepatitis B (hepatitis A may also be useful), influenza and pneumococcus. Detailed information can be found on the Travel Doctor website [www.traveldoctor.com.au](http://www.traveldoctor.com.au)

### **20.3.3 Therapeutic Good Authority Report of Adverse Reactions**

Suspected adverse reactions to medicines should be reported to the Therapeutic Goods Administration. Health professionals can complete the 'blue card' or notify via an on-line services (<http://www.tga.gov.au/safety/problem-medicine-report-adr.htm>), and consumers can make their reports by phone using the Adverse Medicines Events line.

The Australian Medicines Handbook (2014) classifies the commonality of adverse effects as:

- Common – incidence of 1% or more
- Infrequently – incidence between 0.1 – 1%
- Rare – incidence less than 0.1%

| Medication Class                           | Incidence of adverse effects | Specific adverse drug reactions may mimic illness  |
|--|------------------------------|--|
| <b>Biguanides</b>                          | Common                       | Nausea<br>Vomiting<br>Anorexia<br>Diarrhoea  |
|  | Infrequent                   | Rash   |
| <b>Sulfonylureas</b>                       | Infrequent                   | Nausea<br>Diarrhoea<br>Headache<br>Rash  |
| <b>Thiazolidinediones</b>                  | Common                       | Headache<br>Dizziness<br>Arthralgia  |
| <b>Dipeptidyl peptidase-4 inhibitors</b>   | Common                       | Nausea<br>Vomiting (saxagliptin)<br>Nasopharyngitis<br>Headache<br>Arthralgia (vildagliptin, linagliptin <sup>^</sup> )<br>Dizziness (vildagliptin)<br>Backpain, (linagliptin <sup>^</sup> ) |
|  | Infrequent                   | Constipation (vildagliptin <sup>^</sup> )  |
| <b>Alpha-glucosidase inhibitor</b>         | Common                       | Diarrhoea<br>Abdomen pain and distension   |
|  | Rare                         | Skin reaction  |
| <b>Glucagon-like peptide-1 mimetic</b>     | Common                       | Nausea*<br>Vomiting*<br>Diarrhoea<br>Abdominal pain<br>Headache<br>Dizziness   |
|  | Rare                         | Severe abdominal pain (pancreatitis)   |
| <b>Sodium-glucose linked transporter 2</b> | Common                       | Genital infection  |
|  | Infrequent                   | Urinary tract infection<br>Polyuria<br>Headache (in combination with metformin) <sup>^</sup>   |

\* Occurring in up to 50% of patients, usually improving with continued treatment

<sup>^</sup> MIMS on line

| Complementary and alternative medicine    | Specific adverse drug reactions may mimic illness                             |
|---|---|
| <b>Cinnamon when taken in large doses</b> | Tachycardia<br>Gastric irritation<br>Excessive perspiration (Kouris, 2009)    |
| <b>Hawthorn (Crataegus species)</b>       | Nausea<br>Palpitations<br>Sedative effect (large doses)                       |
| <b>Momordica Charantia</b>                | Epigastric discomfort and pain<br>Diarrhoea<br>Headaches from ingesting seeds |