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Hunter New England  
Local Health District

# Hyperglycaemia Ketone Monitoring Sick Day Management

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# Learning Outcomes



- Discuss hyperglycaemia causes, signs and symptoms
- Discuss metabolic emergencies – DKA & HHS
- Discuss ketone monitoring and interpretation of results
- Discuss sick day management with Type 1 DM



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# Hyperglycaemia





What blood glucose level is defined as hyperglycaemia?



# Hyperglycaemia



- Hyperglycaemia is defined as a BGL  $\geq 10$  mmol/L due to relative or absolute insulin deficiency
- However, the symptoms of hyperglycemia usually occur when the BGLs are persistently  $>15$  mmol/L
- Above target blood glucose levels can lead to both short and long term complications
  - BGL  $> 10$  - needs review
  - BGL  $> 15$  - may need treatment adjustment
  - BGL  $> 20$  - may need urgent treatment



# Causes of Hyperglycaemia



## Persistently high BGLs over a period of time

- Causes include:
  - insufficient insulin i.e.. new diagnosis or omitting insulin injections
  - medication inertia or compliance issues i.e.. insufficient oral hypoglycaemic agents, injectable therapy or insulin prescribed or omitting to take medications as prescribed
  - excessive carbohydrate intake
  - stress – stress increases the bodies energy demands, which increases the production of glucose and counter-regulating hormones
  - infection and illnesses – exacerbation of respiratory conditions, gastroenteritis, myocardial infarction, urinary tract infection, wound infection, cellulitis surgery
  - medications - steroids such as prednisolone, steroid injections into joints.

# Early Signs and Symptoms



- Excessive thirst
- Frequently passing large volumes of urine
- Fatigue
- Blurred vision
- Headache



# Later Signs and Symptoms



- Nausea and vomiting
- Abdominal pain
- Shortness of breath
- Weakness
- Fruity-smelling breath (sign of ketosis)
- Confusion
- Coma



# Diabetic Ketoacidosis (DKA)



Metabolic emergency that occurs in patients with Type 1 Diabetes.

If a person does not have enough insulin, their body is unable to convert blood sugar to glucose, which the body uses as fuel. Because the cells cannot receive sugar for energy, the body begins to break down fat and muscle for energy. When this happens, ketones, are produced causing chemical imbalance (metabolic acidosis).

Fruity breath is a common sign of DKA.

# Hyperglycaemic Hyperosmolar Syndrome (HHS)



Metabolic emergency that occurs in patients with Type 2 Diabetes. It can occur at initial diagnosis of diabetes and is usually seen in the older population >60yrs.

Significant hyperglycaemia leads to severe dehydration and impaired renal function, leading to decreased excretion of glucose. The dehydration can lead to electrolyte imbalance, seizures, coma and even death.

Usually a precipitating factor such as infection, other illness i.e.. heart attack/stroke, medications or conditions that increase fluid loss, omitting diabetes medications.

# Key Points



- Occasional BGLs  $>10\text{mmol/L}$  acceptable if cause known i.e.. dietary choice
- 80% of the time BGLs in range, 20% 'life a little'
- Persistent BGLs  $>15\text{mmol/L}$ 
  - What is the cause
  - Solution for cause
- Are there concerns of DKA or HHS? Is the patient at risk of severe dehydration & deterioration? Check BGL, check blood ketones and escalate.



# QUESTIONS





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# Ketone Monitoring





If a person does not have enough insulin, their body is unable to convert blood sugar to glucose, which the body uses as fuel. Because the cells cannot receive sugar for energy, the body begins to break down fat and muscle for energy. When this happens, ketones, are produced.

Being able to measure ketone levels is a **very important** part of a sick day management plan for people who have type 1 diabetes.

# When to test ketones?



- If BGL is higher than 15mmol/L (even if feeling well)
  - for longer than 6hrs if on MDI
  - 2-3hrs if using an insulin pump
  - 1-2hrs if pregnant (Type 1)
- If patient feeling unwell, nausea/vomiting, flu/COVID, gastroenteritis or changed eating habits
- Repeat ketone monitoring every 2-4hrs to ensure not increasing

# How to test for ketones - Urine



**Using a urinary ketone stick** – Dip the test strip into urine collected in a small container. The stick then changes colour. The chart on the bottle shows how high ketone levels are.

Not as accurate & easy to interpret as blood ketones.





# How to test for ketones - Blood



**Using a blood ketone strip** – Test like using a normal glucose strip. Blood ketone strips are available from the Chemist.

It is recommended that all Type 1 Diabetes patients keep a ketone meter and strips in their sick day kit. Check expiry date every change of day light savings or season.

Not all meters are able to check ketones. Current options in Australia;

- **Freestyle Neo** which can measure blood glucose (blue strip) and blood ketones (purple strip).
- **LifeSmart 2 Plus blood glucose and ketone meter**
- **CareSens Dual blood glucose and ketone monitor**
- **Freestyle Libre**



# How to interpret results



Blood Ketone Level	Urine Ketone Level	What does it mean?
Less than 0.6mmol/L	Negative	Normal
0.6 to 1.5mmol/L	Trace or small	<p>Ketones are building up</p> <p>Action is needed to reduce them</p> <p>Follow sick day plan and contact health professional if ketones do not reduce by following the plan</p> <p>OR if no sick day plan</p>

# How to interpret results



Blood Ketone Level	Urine Ketone Level	What does it mean?
1.5 to 3.0mmol/L	Moderate/Large	Ketones are high  Increasing risk of DKA  Follow sick day plan and contact health professional urgently if ketones do not reduce by following sick day plan  OR no sick day plan
Over 3.0mmol/L	Large	DKA Likely – Urgent medical attention required

# Key Points



- All patients with Type 1 Diabetes should have a blood ketone meter and strips in their sick day kit. Ask at each care plan or diabetes review and remind them to check their ketone strips are in date.
- Check blood ketones if any patient presents with a BGL over 15mmol/L or a patient with Type 1 Diabetes presents unwell.
- Ensure your surgery has access to a blood ketone meter and strips. Ensure checking ketone strip expiry dates is part of your regular checks. Place a ketone interpretation chart with meter to prompt correct management.
- If blood ketone meter required, Contact local rep to obtain.



# QUESTIONS





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# Sick Day Management



# Sick Days



- Like everyone, people with diabetes can get sick with the flu, a cold or other common infections or illnesses.
- When patients have diabetes, everyday illnesses or infections can affect their blood glucose levels. It is important they are prepared and know what to do if they get sick.
- It is important you educate all patients with diabetes about what to do when they are sick and prepare them a personalised sick day action plan. You should also suggest they create a sick day management kit ready to use at the earliest sign of illness.





- Patients should start following their sick day management plan if they feel unwell, have any signs of sickness or an infection  
OR
- If their BGL has been  $>15\text{mmol/L}$  longer than 6hrs (even if they feel well)
- The patient should notify a family member or friend they are unwell & to check in with them regularly
- Check BGL every 2-4hrs until BGLs are back into target range & check blood ketones every 2-4hrs (Type 1 Diabetes).



# Oral & Non-Insulin Injectable Diabetes Medications & Sick Days



- Metformin - If significant vomiting and/or diarrhoea or not able to tolerate fluids - Metformin should be ceased to prevent lactic acidosis
- SGLT-2 Inhibitors - If significant vomiting and/or diarrhoea or not able to tolerate fluids – SGLT-2 Inhibitors should be ceased to prevent dehydration and potential ketosis.
- GLP-1 Injectables - If significant vomiting and/or diarrhoea or not able to tolerate fluids – These should be ceased as can increase nausea and vomiting due to their gastrointestinal action.
- Sulfonylureas - If significant vomiting and/or diarrhoea or not able to tolerate fluids – These medications should be ceased to prevent hypoglycaemia.



- Patients should NOT STOP TAKING INSULIN (unless advised)
- If unwell, patients may need a change to their insulin dose/s. This should be discussed with their GP as it is outside Practice Nurse scope of practice. However, the following is as per the RACGP Guidelines and can be included in a patients individual sick day management plan.
- **If blood glucose levels are falling below 4 mmol/L**
  - Ensure patient is appropriately treating hypoglycemia
  - Consider 20% reduction in basal insulin



- **If blood glucose levels rise above 15 mmol/L** and patient is taking basal insulin;
  - temporarily increase dose by 10%
  - If blood glucose levels go back to normal, patient to start taking usual dose again
- **If blood glucose level is still above 15 mmol/L after 4 hours**, do the following:
  - Patient may also need to take extra, rapid-acting insulin, such as Novorapid
  - Start with a single injection of **2–4 units only**
  - Keep monitoring blood glucose every 2 hours
  - After 4 hours – if blood glucose level is still above 15 mmol/L, take another extra dose, following steps above.
  - After another 4 hours – if there is still no effect on lowering glucose, **Patient should be advised to contact their GP, present to ED or dial 000.**

# Prevent dehydration



## MAINTAIN HYDRATION AND CARBOHYDRATE INTAKE

- To reduce risk of hypoglycaemia
- Anti-emetic may be required to ensure adequate intake
- Maintain fluid intake - 125-250 mls/hour

## IF UNABLE TO CONSUME FOOD:

- Consume carbohydrate containing fluids if BGL  $\leq$  15 mmol/L every hr  
i.e.. regular cordial, soft drinks, juice, sports drinks, weak tea with sugar/honey, jelly or sweet ice blocks.

- Carbohydrate free fluids if BGL  $>$  15 mmol/L

i.e.. water, diet cordial, diet soft drinks, weak tea with no sugar/honey, diet jelly or broth.

# Seek support / medical attention early



See or speak to GP/Practice Nurse if;

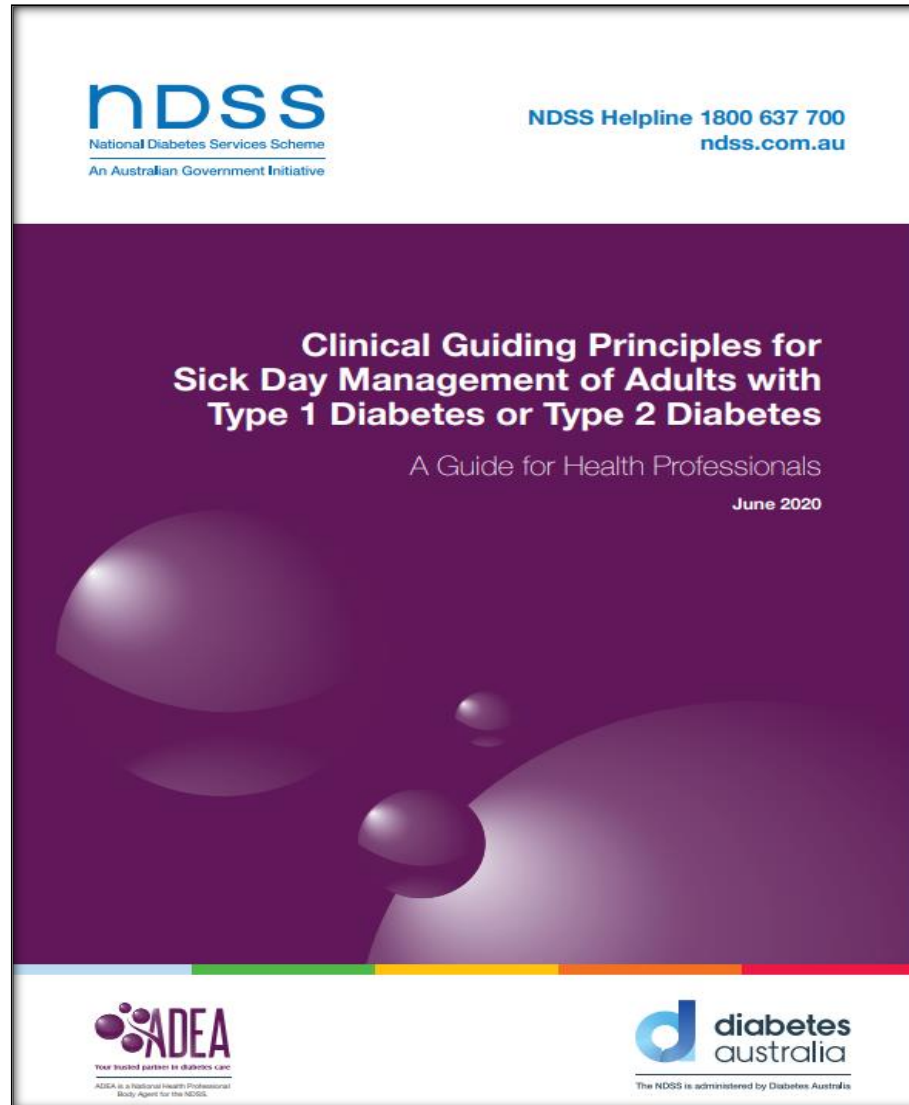
- Cannot keep food or fluids down and experiencing persistent vomiting, diarrhoea and / or stomach pain
- Blood glucose levels that continue to rise even though following sick day management plan

Call for an ambulance or attend local hospital if;

- Drowsy or confused
- Deep rapid breathing or shortness of breath
- Showing signs of dehydration (such as extreme thirst, weakness, confusion, lack of urination)
- Difficulty keeping blood glucose levels above 4mmol/L
- Not well enough to follow sick day action plan or no one to support / help.



# Resources



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# Key Points



- Have a sick day plan completed for your patient BEFORE they get sick and save a copy on their medical record for reference if they call when unwell
- When completing a patients diabetes review or care plan, note if they are on any oral or injectable therapy required to be ceased if significant vomiting or diarrhoea and remind the patient
- Encourage patients to keep a list of contact numbers by the phone including their support person, chemist, GP, diabetes team, local hospital.



# QUESTIONS



## ***References:***

*NDSS Factsheets via [www.ndss.com.au](http://www.ndss.com.au)*

*ADEA: Clinical Guiding Principles for Sick Day Management of Adults with Type 1 or Type 2 Diabetes, 2020*

*Diabetes management in general practice: Guidelines for type 2 diabetes – RACGP Guidelines*