

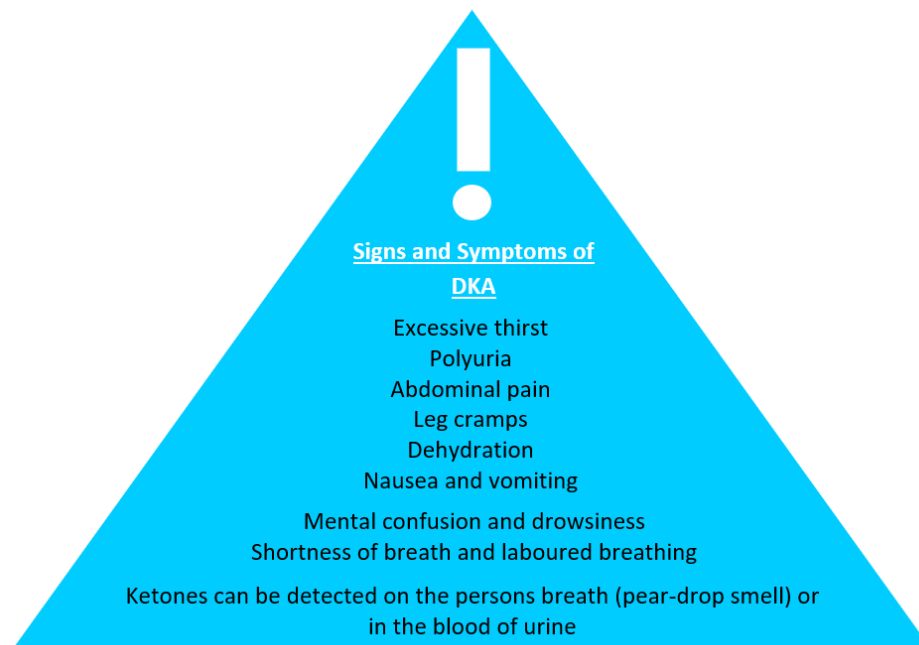


## **GUIDANCE FOR THE PRESCRIBING OF KETONE TEST STRIPS**

**The following guidance is applicable to type 1 and type 2 adult and paediatric diabetic patients. The guideline will provide information relating to diabetic ketoacidosis (DKA), prevention of DKA, ketone testing and responsibility for primary and secondary care clinicians to provide ketone testing.**

### **DKA**

- DKA is due to a profound reduction of circulating insulin relative to the body's requirements.
- DKA develops due to an absolute lack of insulin in type 1 diabetes. DKA in type 2 diabetes is due to severe relative insulin deficiency.
- DKA develops when there is not enough glucose entering the cells because there is not enough circulating insulin in the body. The body then begins to use its fat stores as an alternative source of energy. This results in acidic ketones being produced.
- Ketones are toxic and disrupt the normal functioning of the body's process. DKA is a medical emergency with a significant morbidity and mortality.



- DKA is characterised by hyperglycaemia, acidosis and ketonaemia. Precipitating factors include infection/acute illness, dehydration, prolonged or vigorous exercise, inadequate insulin, or non-compliance.
- People with diabetes who are treated with insulin are at higher risk than the general population of having higher ketone levels –particularly during times of illness.

### **PREVENTION**

Education programmes are key for people with diabetes, especially in case of illness. There is the Dose Adjustment For Normal Eating (DAFNE) programme aimed at helping adults with type 1 diabetes, to lead as normal life as possible and maintaining blood glucose levels within healthy levels. The programme also includes sick day rules and in particular concerning what to do in cases of illness with education on action to be taken. This can be accessed via referral to community or secondary care diabetes services.

## KETONE TESTING

Testing for ketones is indicated to differentiate ketoacidosis from simple hyperglycaemia or in monitoring response to treatment of DKA.

Patients in the at-risk group for DKA who become unwell will need to test both capillary glucose and blood ketone levels every two hours, depending on levels, until blood ketones return to a satisfactory level.

Blood ketone strips are more effective at detecting ketonaemia than urine ketone strips since they provide 'real time' results and test for the main types of ketones. Urine strips should only be used if there is no option of blood ketone testing e.g. type 1 diabetes patient is unable to use a blood ketone machine. There are two urine test strip options available:

Manufacturer	Product name	Number of strips	Cost per 50 strips
Gluco Rx	KetoRx	50	£2.25
Bayer	Ketostix	50	£3.06

\*(Prices based on Drug Tariff – October 2022)

### Type 1 diabetes: Blood Ketone Monitoring

We advise as per NICE guidelines that all patients with type 1 diabetes including children, young people and adults should have access to blood ketone testing strips and a meter to monitor ketones as part of 'sick-day rules' and, to facilitate self-management of an episode of hyperglycaemia. Patients must understand when to test ketones and how to respond to high levels.

### Type 2 diabetes (T2DM): Blood Ketone Monitoring

Specialist care teams will be able to identify groups of patients through admissions and out-patient appointments. Primary care prescribers can use the following table to identify higher risk groups of patients with type 2 diabetes that may require ketone testing strips for monitoring.

Groups	Ketone monitoring	Counselling for patients and additional information
People with T2DM taking sodium-glucose co-transporter-2 inhibitors (SGLT2i) with an elevated risk of DKA: <ul style="list-style-type: none"><li>• Increased insulin requirements due to acute illness, surgery, alcohol abuse or heavy consumption.</li><li>• Conditions leading to restricted food intake (particularly carbohydrate intake) or severe dehydration</li></ul>	Yes	Follow MHRA advice to health professionals for SGLT2i and DKA. Advise patients to withhold their SGLT2i if at risk of dehydration and seek medical help if feeling any symptoms of DKA. Specialist care to restart SGLT2i only if another cause for DKA has been identified and resolved when feeling well again. Refer to specialist for further review and investigation for diabetes diagnoses classification. Offer patients Trend Diabetes leaflet: <a href="#">type-2-diabetes-and-diabetic-ketoacidosis</a> Offer patients sick day rules advice leaflet: <a href="#">type-2-diabetes-what-to-do-when-you-are-ill</a> See below for more information on sick day rules.

<ul style="list-style-type: none"> <li>• Concurrent and history of alcohol overuse/abuse</li> <li>• Insulin deficient states (poor compliance to insulin regimen; a sudden insulin dose reduction; refusal of insulin initiation)</li> <li>• History of previous DKA admission</li> <li>• Ketone prone diabetes</li> <li>• Marked <math>\beta</math>-cell insufficiency often reflected in high/rapidly increasing insulin requirements</li> </ul>		
<p>People with T2DM taking SGLT2i (+/- other antidiabetic drugs and insulin) with no prior history of ketosis and no elevated risk DKA.</p>	No	<p>Follow MHRA advice to health professionals on the risk of DKA with SGLT2i. Advise patients to withhold their SGLT2i if at risk of dehydration and seek medical help if feeling any symptoms of DKA.  Offer patients Trend Diabetes leaflet:  <a href="#">type-2-diabetes-and-diabetic-ketoacidosis</a>  Offer patients sick day rules advice leaflet:  <a href="#">type-2-diabetes-what-to-do-when-you-are-ill</a>  See below for more information on sick day rules.</p>
<p>People with T2DM not taking SGLT2i (+/- other antidiabetic drugs and insulin)</p>	No	<p>Nil</p>

## GLUCOSE AND KETONE METERS

If a single meter is required for patients to monitor blood glucose and ketones, then the blood ketone test strips costing < £10 for 10 and blood glucose strips < £10 for 50 are considered as a first line option. The following meters are formulary first line choices as they provide both ketone and glucose testing (see below for more information):

- GlucoMen Areo 2K (GlucoMen Areo Ketone Sensor)
- CareSens Dual meter (KetoSens test strips)

The cost-effective choice of meters with strips that cost <£10 should be recommended.

**FreeStyle Optium strips (compatible with the Freestyle Libre meter) should not be offered as these strips are expensive and offer no clinical or technological advantage. If a patient requires a new meter that is compatible with the recommended test strips, then all primary and specialist care prescribers can contact the manufacturer (details in the table below) to provide a meter free of charge.**

Patients using ketone strips for urine should be invited for review to discuss switching to blood ketone monitoring. If this is agreed and appropriate for the patient, then they should be prescribed formulary ketone testing strips with the appropriate meter. The purpose and frequency of testing should form part of each individualised care plan using a patient-centred approach.



## KETONE TEST RESULTS

The following table shows how to interpret blood ketone levels:

Less than 0.6mmol/L	Normal
0.6 to 1.5mmol/L	Risk of developing DKA. Retest in 2 hours.
1.6 to 2.9mmol/L	High risk of developing DKA. Increase in insulin required.
3mmol/L or higher	Very high risk of DKA. Needs urgent medical attention and may need admission to accident and emergency department.

- If the patient is vomiting, unable to keep fluids down, or is unable to control their blood glucose or ketone levels they must seek urgent medical advice.
- In pregnancy – if ketotic and/or vomiting or unable to keep fluids down, they must seek urgent medical advice.

## Formulary Choice Combined Ketone and Glucose Meters

Name of meter	<b>GlucoMen Areo 2K (GlucoMen Areo Ketone Sensor)</b>	<b>CareSens Dual meter (KetoSens test strips)</b>
Meter image		
Compatible strips-glucose	GlucoMen Areo Sensor £8.25 for 1x50* Expiry: 12 months after first opening vial	CareSens PRO blood glucose test strips £9.95 for 1x50* Expiry: 12 months from first opening vial
Compatible strips-ketone	GlucoMen areo Ketone Sensors £9.95 for 10* Expiry: up to expiry date on foil packet	KetoSens £9.95 for 10* Expiry: up to expiry date on foil packet
Memory (no. of tests)	730 Glucose + 100 Ketone	1000
Replacement batteries	2 x 3v CR2032 (Replaced free of charge by company)	2 x 3.0V lithium (CR2032) (replaced free of charge by company)
External output (e.g., to phone, PC)	USB cable to PC. Smartphone via Bluetooth adapter	Bluetooth or PC via free cable supplied on request
Software and compatibility	Diasend Uploader GlucoLog software on PC or GlucoLog App on smartphone	Diasend Uploader SmartLog app
Insulin bolus advisor app on smartphone	RapidCalc	N/A
Company contact	myglucomen@menarinidiag.co.uk Freephone 0800 243667	info@spirit-healthcare.co.uk 0116 2865000
Training video	<a href="https://www.glucomen.co.uk/areo">https://www.glucomen.co.uk/areo</a>	<a href="https://www.spirit-health.co.uk/support-and-downloads">https://www.spirit-health.co.uk/support-and-downloads</a>

\*(Prices based on Drug Tariff – October 2022)

-Glucomen Areo 2K– for people with dexterity issues as larger strip size and Includes strip eject function. Has a Carbohydrate counting facility (via Rapidcalc® app)

## SICK DAY RULES

All diabetes patients should be educated on how to manage their condition when they are ill. To complement the education and reinforce the sick day rules advice, the appropriate TREND Sick Day Rules leaflet should be printed and handed to the patient.

[type-1-diabetes-what-to-do-when-you-are-ill](#)

[type-2-diabetes-what-to-do-when-you-are-ill](#)

[type-2-diabetes-and-diabetic-ketoacidosis](#)

### When unwell (acute illness):

Fever, sweats,  
shaking,  
vomiting/diarrhoea,  
unable to eat or drink

### Miss out/ omit/ pause:

S- SGLT2i  
A- Ace Inhibitors  
D- Diuretics  
M- Metformin  
A- Angiotensin  
Receptor Blockers  
N- Non-steroidal anti-  
inflammatory drugs

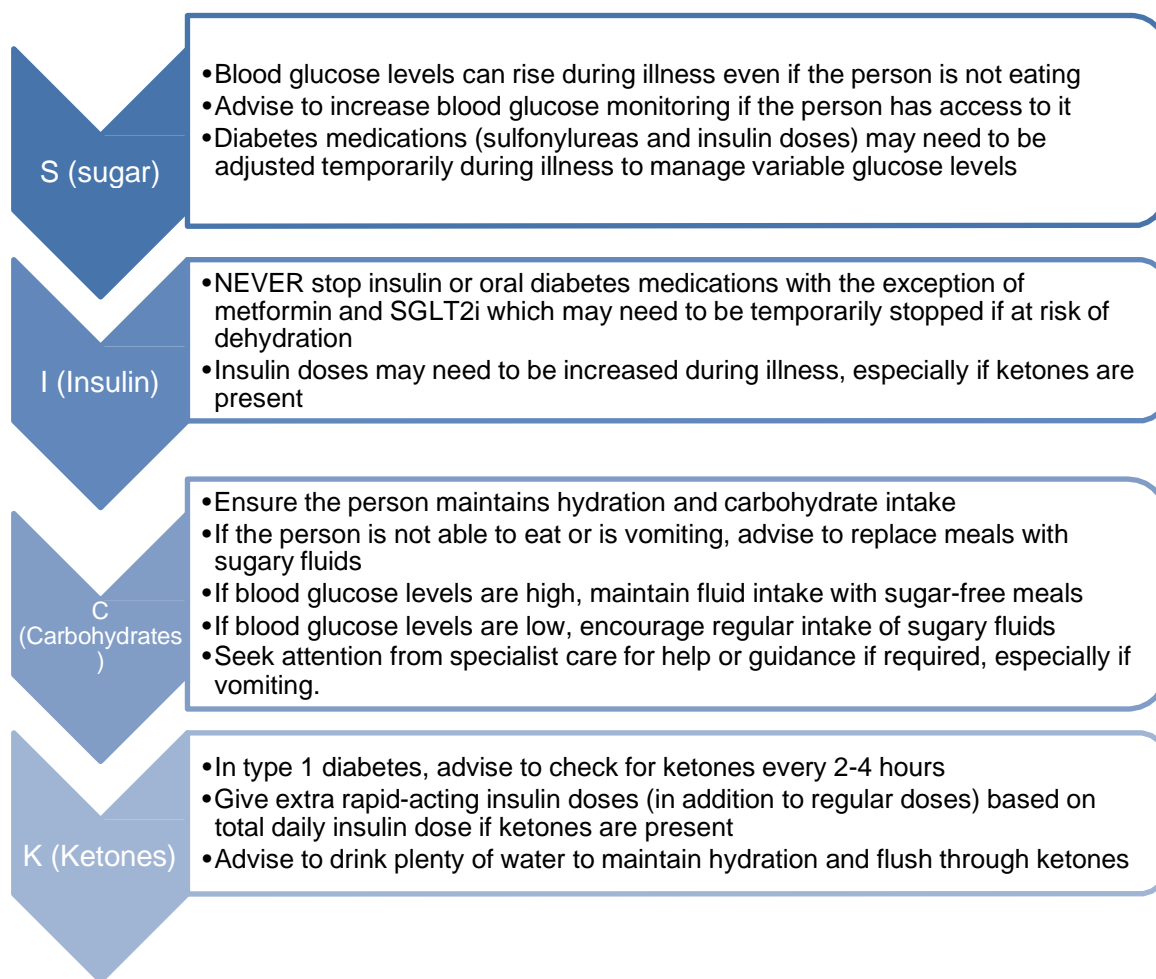
### After 2-3 days:

Feeling better: restart  
paused medicines

Not better= seek  
medical attention

Increase blood glucose monitoring during acute illness and check for ketones. Ensure fluid intake to minimise dehydration.

## General Advice for Managing Diabetes During Incurrent Illness



Practices and Out of Hours services should ensure they have the ability to test for blood ketones for those patients on SGLT2i who may present with normoglycaemic DKA, as per MHRA advice.

### MHRA Warnings

- 1) MHRA Drug Safety update April 2016: SGLT-2 inhibitors: updated advice on the management of the risk of diabetic ketoacidosis.

<https://www.gov.uk/drug-safety-update/sqgt2-inhibitors-updated-advice-on-the-risk-of-diabetic-ketoacidosis>

Discontinue treatment immediately with the SGLT2 inhibitor if DKA is suspected or diagnosed. Treatment is not restarted in patients who experienced DKA during use unless another cause for DKA was identified and resolved.

- 2) MHRA Drug Safety update March 2020: SGLT2 inhibitors patients need ketone levels monitored in blood during treatment interruption for surgical procedures or acute serious medical illness.

<https://www.gov.uk/drug-safety-update/sqgt2-inhibitors-monitor-ketones-in-blood-during-treatment-interruption-for-surgical-procedures-or-acute-serious-medical-illness> Interrupt treatment with SGLT2 inhibitor in patients who are hospitalised for major surgery or acute illnesses. Monitor ketone levels during this period and blood ketone levels are preferred as opposed to urine.

## REFERENCES

- NICE. Type 1 diabetes in adults: diagnosis and management. August 2015. Accessed on August 15<sup>th</sup> 21. <https://www.nice.org.uk/guidance/ng17>
- NICE. Diabetes (type 1 and type 2) in children and young people: diagnosis and management. August 2015. Accessed in August 2021. <https://www.nice.org.uk/guidance/ng18>
- North Central London Joint Formulary Committee- Guideline for glucose & ketone monitoring for adults with diabetes v2.0: [https://www.ncl-mon.nhs.uk/wp-content/uploads/Guidelines/6\\_Blood\\_glucose\\_ketone\\_monitoring.pdf](https://www.ncl-mon.nhs.uk/wp-content/uploads/Guidelines/6_Blood_glucose_ketone_monitoring.pdf)
- Sussex community NHS foundation trust. Diabetes care for you ketone testing guidelines. For healthcare professionals in Brighton and Hove CCG and High Weald Lewes and Havens CCG. Accessed on 15<sup>th</sup> August 21. <https://www.sussexcommunity.nhs.uk/downloads/services/diabetes/Ketone%20testing%20guidelines%20for%20healthcare%20professionals.pdf>
- Ketone testing in people with type 1 diabetes: advice for prescribers in primary care. Accessed on 20<sup>th</sup> August 21. <https://www.england.nhs.uk/london/wp-content/uploads/sites/8/2019/07/NHSLPP-ketone-testing-type-1-px-advice-for-primary-care-Oct18-v1.0.pdf>
- Oxfordshire Clinical commissioning group. Ketone testing and sick day rules guideline (2017). Accessed December 2021. <https://www.oxfordshireccg.nhs.uk/professional-resources/documents/clinical-guidelines/diabetes/ketone-testing-and-sick-day-rules-guidance.pdf>
- West Essex Clinical commissioning group and Essex Partnership University NHS foundation trust. West Essex blood glucose & ketone meter guidance (Including lancets, insulin pen needles and disposable of sharps) 2016. Accessed December 2021. <https://westessexccg.nhs.uk/your-health/medicines-optimisation-and-pharmacy/clinical-guidelines-and-prescribing-formularies/06-endocrine-system/84-blood-glucose-meter-guidance/file>
- Northwest London health and care partnership. North West London Diabetes guidelines 2020. Accessed December 2021. <https://www.hounslowccg.nhs.uk/media/116668/diabetes-north-west-london-diabetes-clinical-guidelines.pdf>
- Buckinghamshire Clinical commissioning group and Buckinghamshire Healthcare NHS Trust. Preferred blood glucose meters for adults with type 2 diabetes (2019). Accessed December 2021. [http://www.bucksformulary.nhs.uk/docs/Guideline\\_212FM.pdf?UNLID=424662987202\\_11210114244](http://www.bucksformulary.nhs.uk/docs/Guideline_212FM.pdf?UNLID=424662987202_11210114244)
- PBenmoussa, J.A., Clarke, M., Penmetsa, A., Leykina, L., Diaz, K. and Otterbeck, P., 2016. Euglycemic diabetic ketoacidosis: The clinical concern of SGLT2 inhibitors. Journal of Clinical and Translational Endocrinology: Case Reports, 2, pp.17-19.
- Diabetes UK. Dealing with illness. Accessed July 2021. <https://www.diabetes.org.uk/guide-to-diabetes/life-with-diabetes/illness>.
- TREND diabetes. Managing diabetes during intercurrent illness. Accessed October 2021. <https://trenddiabetes.online/portfolio/managing-diabetes-during-intercurrent-illness/>
- TREND diabetes. Monitoring in adult diabetes: Glucose and ketones. Accessed October 2021. <https://trenddiabetes.online/portfolio/monitoring-in-adult-diabetes-glucose-and-ketones/>
- MHRA Drug Safety update April 2016: SGLT-2 inhibitors: updated advice on the management of the risk of diabetic ketoacidosis. <https://www.gov.uk/drug-safety-update/sglt2-inhibitors-updated-advice-on-the-risk-of-diabetic-ketoacidosis>
- MHRA 2020: SGLT2 inhibitors: monitor ketones in blood during treatment interruption for surgical procedures or acute serious medical illness. <https://www.gov.uk/drug-safety-update/sglt2-inhibitors-monitor-ketones-in-blood-during-treatment-interruption-for-surgical-procedures-or-acute-serious-medical-illness>
- Sick day rules – Rotherham CCG <http://www.rotherhamccg.nhs.uk/Sick%20Day%20Rules%20Diabetes%20Primary%20Care%202018.pdf>

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