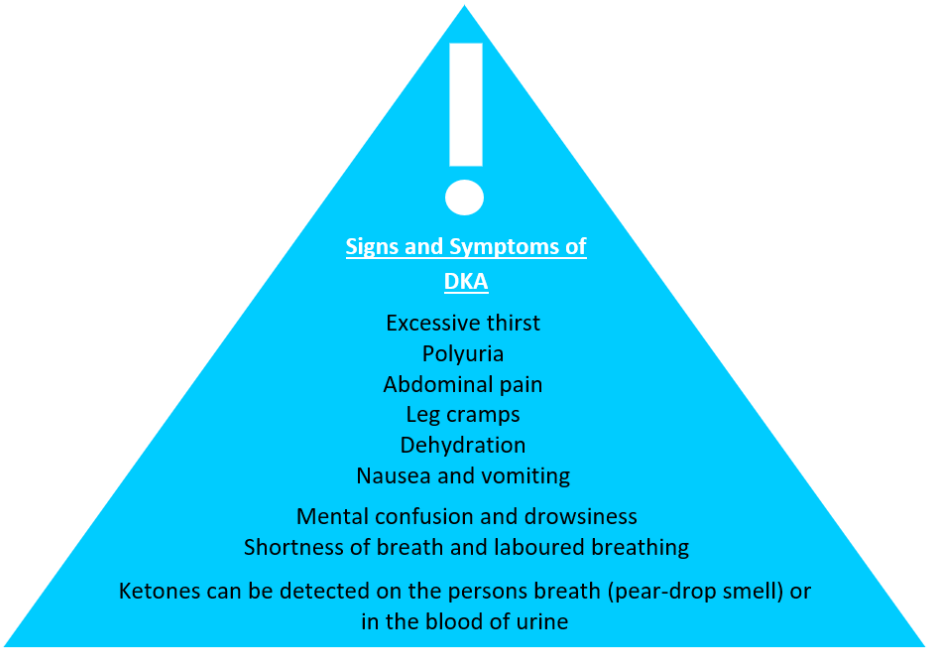
GUIDELINE FOR THE PRESCRIBING OF KETONE TEST STRIPS

The following guideline 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	£3.11

*(Prices based on Drug Tariff – September 2023)

Patients using ketone strips for urine should be invited for review to discuss switching to blood ketone monitoring, follow the flow diagram below. 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.

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: • Increased insulin requirements due to acute illness, surgery, alcohol	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.

abuse or heavy consumption. • Conditions leading to restricted food intake (particularly carbohydrate intake) or severe dehydration • Concurrent and history of alcohol overuse/abuse • Insulin deficient states (poor compliance to insulin regimen; a sudden insulin dose reduction; refusal of insulin initiation) • History of previous DKA admission • Ketone prone diabetes • Marked β-cell insufficiency often reflected in high/rapidly increasing insulin requirements		Offer patients Trend Diabetes leaflet: 'Type 2 diabetes and diabetic ketoacidosis'. Type 2 diabetes and diabetic ketoacidosis – Trend Diabetes Offer patients sick day rules advice leaflet: 'Type 2 diabetes: what to do when you are ill'. Type 2 diabetes: What to do when you are ill – Trend Diabetes See below for more information on sick day rules.
People with T2DM taking SGLT2i (+/- other antidiabetic drugs and insulin) with no prior history of ketosis and no elevated risk DKA.	No	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: 'Type 2 diabetes and diabetic ketoacidosis'. Type 2 diabetes and diabetic ketoacidosis – Trend Diabetes Offer patients sick day rules advice leaflet: 'Type 2 diabetes: what to do when you are ill'. Type 2 diabetes: What to do when you are ill – Trend Diabetes See below for more information on sick day rules.
People with T2DM not taking SGLT2i (+/- other antidiabetic drugs and insulin)	No	Nil

PRIMARY CARE AND SPECIALIST CARE RESPONSIBILITY FOR KETONE TESTING STRIPS FOR ADULTS

Specialist diabetes services and primary care prescribers will identify type 2 diabetic high-risk patients. For those identified from type 2 diabetics and all type 1 diabetic patients as needing testing strips:

Prescriber responsibilities are to:

- Initiate ketone monitoring → how to use strips
- Provide training and education → when to use strips
- Provide meter and initial strips → what to do with result
- Specialist care to communicate the above to primary care if not being initiated in primary care.

Primary care prescribers in general practice responsibilities are to

- Provide on-going strips to patients
- Reinforce training on meter use
- Reinforce education on dealing with high ketone levels so that patients know what to do if reading is high

GLUCOSE AND KETONE METERS

Formulary choices of glucose and ketone meters can be found at **[link]**

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.

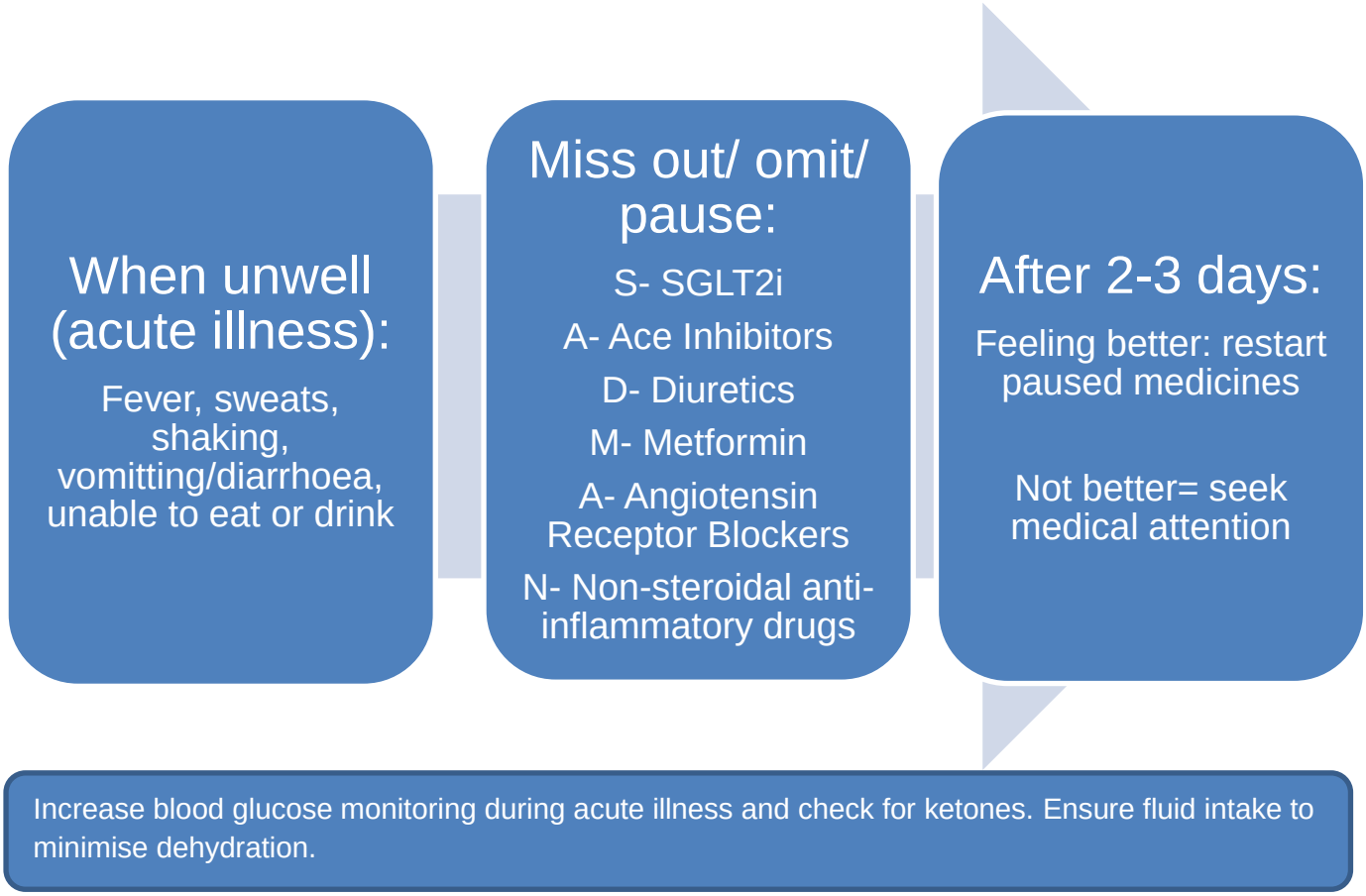
SICK DAY RULES

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 1 diabetes: What to do when you are ill – Trend Diabetes

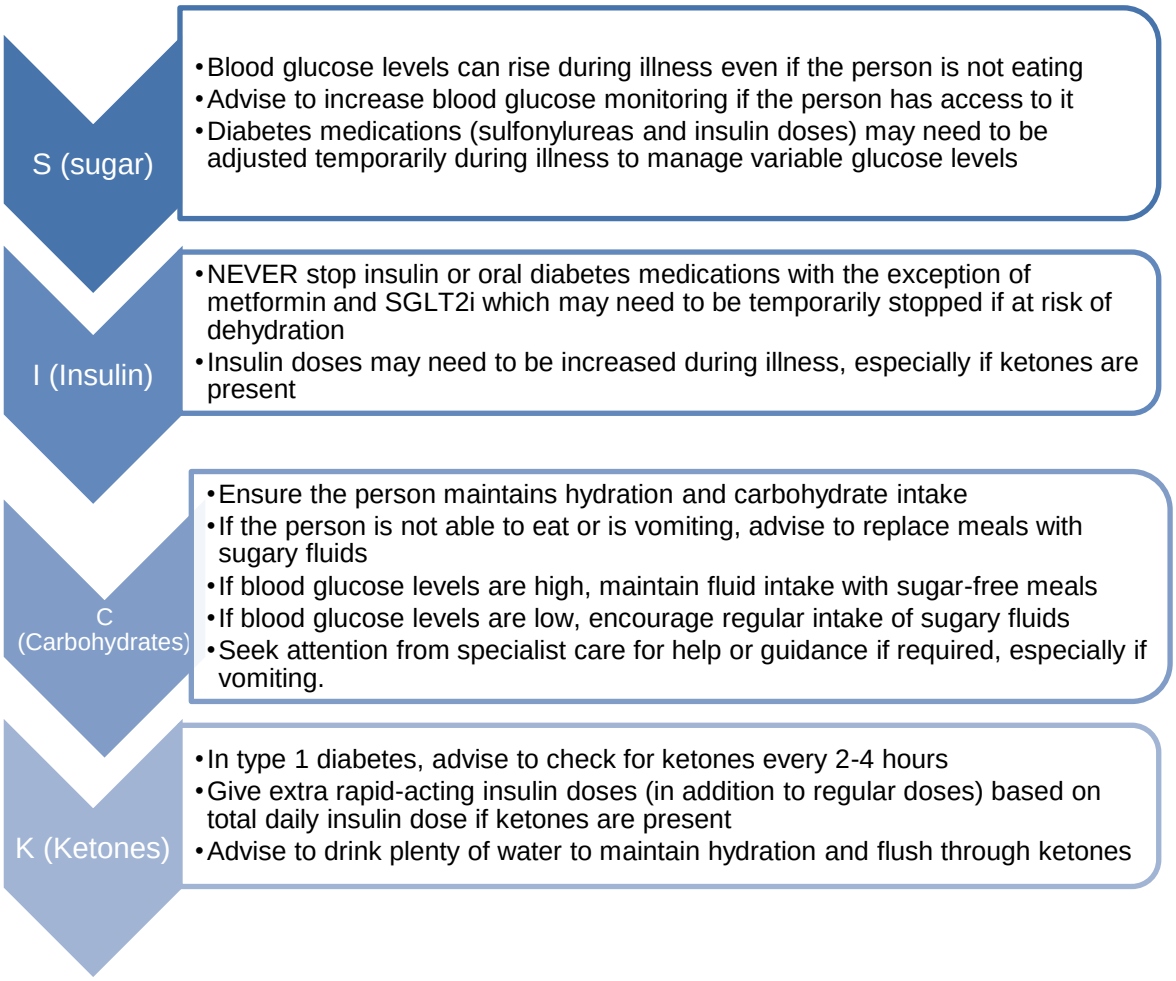
Type 2 diabetes: what to do when you are ill'.
Type 2 diabetes: What to do when you are ill – Trend Diabetes

'Type 2 diabetes and diabetic ketoacidosis'.
Type 2 diabetes and diabetic ketoacidosis – Trend Diabetes



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

General advice for managing diabetes during intercurrent 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/sglt2-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/sglt2-inhibitors-monitor-ketones-in-blood-during-treatment-interruption-for-surgical-procedures-or-acute-serious-medical-illnessInterrupt treatment with SGTL2 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.

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Version	0.2 Harmonisation of Hertfordshire Medicines Management Committee (HMMC) guidance and West Essex Medicines Optimisation Programme Board (WEMOPB) guidance updates include: • Rebadging with HWE ICB and removal of ENHCCG and HVCCG headers • Review date removed and replaced with standard statement
Approved by	HMMC and WEMOPB
Developed by:	Developed by pharmacy and medicines optimisation team Hertfordshire and West Essex (HWE) ICB with relevant HWE ICS stakeholders.
Date approved /updated	HMMC June 2022 and WEMOPB June 2022
Review date	This HWE APC recommendation is based upon the evidence at the time of publication. This recommendation will be reviewed upon request in the light of new evidence becoming available.
Superseded version	0.1