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Guideline for Ketone Testing for Adult In-patients with Diabetes Mellitus

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DOCUMENT VERSION CONTROL SCHEDULE			
Year and Version Number	**Date Published on Document Library**	**Revisions from previous issue**	**Date of Endorsement**
2016 Version 1	18/10/2016	New guideline	13/10/2016 / Quality Governance Operational Committee

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Key Points

- Ketone testing is crucial in the safe management of patients with diabetes, particularly those who are insulin – treated, to prevent potentially life threatening Diabetic Ketoacidosis (DKA).

- Blood ketones are the recommended method to check ketones. Urinary ketones can be used as a screening measure only, when blood ketone testing is not readily available.

- Ketones should be tested when two consecutive 4-hour blood glucose levels are above 13mmol/L or one reading is above 17mmol/L.

- Alert medical staff & Diabetes Team if ketones present.

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Guideline for Ketone Testing for Adult In-patients with Diabetes Mellitus

1. Introduction

1.1 Appropriate ketone testing for adults with diabetes, especially when ill and under stress, is an essential step to guide therapy and prevent diabetic ketoacidosis, which is a medical emergency with significant morbidity and mortality.

1.2 Ketones are by-products of fatty acid metabolism in the liver. There are 3 types of ketones – Beta-hydroxybutyrate (detected in blood), Acetoacetate (excreted in urine) and acetone (exhaled).

1.3 **What is the significance of ketones in diabetes?**

Insulin is required for glucose utilisation by peripheral tissues and promotes fat storage. Therefore, in states of either:

- Absolute insulin deficiency – lack of exogenous insulin in Type 1 (T1) Diabetes Mellitus (DM).
- Relative insulin deficiency – Type 2 (T2) DM with concurrent stress (infections, intercurrent illness) causing counterregulatory hormone rise.

Peripheral tissues are unable to use glucose as a fuel. Energy production switches to fat breakdown to yield free fatty acids that are converted to ketoacids to be used as fuel by the peripheral tissues. The unrestrained action of the counterregulatory hormones results in massive production of ketoacids that outstrips peripheral clearance and results in a metabolic acidosis.

A very small amount of insulin is sufficient to turn off the ketone production. The presence of ketones therefore indicates severe insulin deficiency and will result in acidosis, unless prompt corrective action is taken.

2. Purpose

The purpose of this document is to act as a guide for testing Ketone in Adult In-patients with Diabetes Mellitus (DM).

3. Scope

This guideline is relevant to all clinical staff who work anywhere in the Trust where patients with DM may be service users.

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4. Ketone Testing for Adult In-patients with Diabetes Mellitus

4.1 Who to test

Any patient with diabetes and hyperglycaemia should be considered at risk of ketosis.

Traditionally only patients with T1 DM were considered at risk of developing DKA. However, any patient with diabetes may have limited beta cell function and decompensate in the presence of sufficient concurrent stresses.

Very high risk	Patients with T1 DM
High risk	Patients with insulin – treated T2 DM and severe intercurrent illness – for e.g. infections, acute coronary syndrome, major organ failure, major surgery
Moderate risk	Patients with T2 DM not usually treated with insulin but with severe intercurrent illness as above
Low risk	Stable patients with T2 DM

Note – Patient with DKA – Ideally hourly monitoring of ketone is necessary to assess the respose to treatment (Achieve a rate of fall of ketones of at least 0.5 mmol/L/hr) for upto 6 hours; Resolution of DKA defined as blood ketone less than 0.6 mmol/l. Do not use urine ketone for resolution as urine ketones do not reflect the blood ketones at same time.

4.2 How to test

Blood ketone monitoring is preferable where available. However, if blood ketones testing is not available then a ***urinalysis*** for ketones is an acceptable initial alternative. If a urinary catheter is insitu, it is essential the urine sample is collected via the port and not the reservoir bag. Please refer to local urinalysis guidelines.

If urinary ketones negative, document the result on patient record and no further action required.
⬇
If urinalysis positive(++) for ketones, a blood ketone test MUST be completed immediately and the result reported as below

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4.3 Result and Treatment

Blood Ketone result	Action Required
Less than 0.6	None
0.6-1.5*	1. Correct high blood glucose as prescribed and make the medical staff aware. 2. Consider contacting the Diabetic team/DSN for advice. 3. Check blood glucose 2 hourly and ketones 4 hourly until <0.6 for 2 consecutive tests 4. PRN quick acting insulin (such as Novorapid) to be given at a maximum of 4 hourly 5. Trace ketones can occur in patients fasted for more than 8 hours. If appropriate, offer a carbohydrate containing food or drink together with diabetes medication as required.
1.6-2.9	1. Correct high blood glucose as prescribed immediately and contact the medical team for an urgent review to assess for features of DKA. 2. Inform Diabetic team/DSN as soon as possible. 3. Check blood glucose and ketones 2 hourly until normalised and consider Variable Rate Intravenous Insulin Infusion (VRIII) if indicated 4. PRN quick acting insulin to be given at a maximum of 4 hourly
Greater than or equal to 3.0	1. Correct high blood glucose as prescribed immediately and ensure an urgent review by a **Senior Doctor** is undertaken for immediate management of the ketones. 2. Inform Diabetic team/DSN urgently. 3. A minimum of hourly blood glucose and ketone monitoring suggested and consider the need for the DKA protocol or VRIII

* If the patient is pregnant, please contact the Consultant Diabetologist urgently for review if ketones above 0.6mmol/L.

Note: A blood ketone result of 3.0 or above or a urinalysis of +++ or above is potentially DKA and a life threatening scenario requiring immediate attention. Ensure a medical review occurs immediately.

4.4 Location of blood Ketone meters

Ketone testing enabled meters and strips can be found in the following main locations:

- Emergency Department Resus.
- Diabetic Specialist Nurses.
- Critical Care Outreach Nurses.
- Ward B6.

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5. Monitoring compliance with and the effectiveness of this document

5.1 The key outcome standard for this document is for all patients with diabetes receive appropriate and timely ketone testing and corrective action if applicable.

5.2 This standard will be monitored by the Diabetic team who collect data on all patients reviewed by them including any episodes of DKA developed as an inpatient and management errors, which includes inappropriate/missed ketone testing.

5.3 A review of reported incidents will also take place.

5.4 The Diabetic Team are responsible for the monitoring of this document and will review its continued efficacy and implement any required changes..

6. Endorsement

This guideline will be approved by the Nursing & Midwifery Advisory Group & endorsed by Quality Governance Operational Committee.

7. Distribution

This guideline will be available on SharePoint.

8. References

- https://www.diabetes.org.uk/Guide-to-diabetes/Complications/Diabetic_Ketoacidosis/ [Accessed 06/07/2016].
- http://clinical.diabetesjournals.org/content/22/4/198.full [Accessed 06/07/2016].
- http://www.ncbi.nlm.nih.gov/pubmed/18644074 [Accessed 06/07/2016].
- Wolfson Diabetic Clinic Guideline, Cambridge University Hospital

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Quality Assurance Checklist - Version Number: 1 Appendix: 1

		Y/N/n/a	COMMENTS (where necessary)
1	**Title of document** Guideline for Ketone Testing for Adult In-patients with Diabetes Mellitus (C1073)		
2	**Type of document (e.g. guidance, code of practice)**	Guideline	
	Is the title clear and unambiguous?	Yes	
	Is it clear whether the document type is (e.g. guideline, procedure)?	Yes	
3	**Introduction**		
	Are reasons for the development of the document clearly stated?	Yes	
4	**Content**		
	Is there a standard front cover?	Yes	
	Are the key points identified?	Yes	
	Is the document in the correct format?	Yes	
	Is the purpose of the document clear?	Yes	
5	**Approval Route**		
	Does the document identify which committee/group will approve it?	Yes	
6	**Review Date**		
	Is the review date identified?	Yes	

If answers to any of the above questions is 'no', then this document is not ready for endorsement, it needs further review.

Compliance Team:		
1.	Date of Compliance Team approval	06/07/2016
2.	Comments to author for any amendments	
3.	Name of compliance lead	Jim Walker, Quality Governance & Policies Assistant

Approval Committee: NMAG

If the committee/group is happy to approve this document would the chair please sign below and send the document and the minutes from the approval committee to the author. To aid distribution all documentation should be sent electronically wherever possible.

Name	Jo Bennis	**Date**	04/08/16
Signature	J. Bennis		

Endorsing Committee: QGOC

If the committee/group is happy to endorse this document would the chair please sign below and send the document and the minutes from the endorsing committee to the author. To aid distribution all documentation should be sent electronically wherever possible.

Name	KANCHAN REGE	**Date**	13.10.16
Signature	Rege		