Summary

Diabetic ketoacidosis (DKA) is a complex disordered metabolic state characterised by hyperglycaemia, acidosis, and ketonaemia. DKA usually occurs as a consequence of absolute or relative insulin deficiency that is accompanied by an increase in counter regulatory hormones. Mortality rates have fallen significantly in the last 20 years from 7.96% to 0.67% due improved understanding and appropriate management.

The main causes of mortality in the adult population include severe hypokalaemia, adult respiratory distress syndrome, and co-morbid states such as pneumonia, acute myocardial infarction and sepsis.

Cerebral oedema remains the most common cause of mortality, particularly in young children and adolescents, therefore intravenous fluids must be given cautiously depending on clinical observations.
1. **Aim/Purpose of this Guideline**

1.1. This guideline is for the management Diabetic Ketoacidosis (DKA) in adults and adolescents admitted under adult medical care only. It has been benchmarked against Joint British Diabetes Societies (JBDS) guidance, to provide guidance on the clinical management of DKA in line with best practice guidelines. However it remains the clinician’s responsibility to use clinical judgment and application of the guidance depending on individual circumstances.

1.2. This version supersedes any previous versions of this document.

1.3. **Data Protection Act 2018 (General Data Protection Regulation – GDPR) Legislation**

The Trust has a duty under the DPA18 to ensure that there is a valid legal basis to process personal and sensitive data. The legal basis for processing must be identified and documented before the processing begins. In many cases we may need consent; this must be explicit, informed and documented. We can’t rely on Opt out, it must be Opt in.

DPA18 is applicable to all staff; this includes those working as contractors and providers of services.

For more information about your obligations under the DPA18 please see the ‘information use framework policy’, or contact the Information Governance Team rch-tr.infogov@nhs.net

2. **The Guidance**

2.1. **Principles of DKA Treatment**

2.1.1. Insulin is given intravenously at a Fixed Rate Intravenous Insulin Infusion (FRIII) which is based on weight (0.1 units/kg/hour).

2.1.2. 0.9% Sodium chloride (0.9%NaCl) should be given for all fluid resuscitation.

2.1.3. Potassium should be replaced and closely monitored.

2.1.4. Continue Long acting insulin at pre-admission dose along with IV insulin.

2.1.5. Response of treatment should be assessed by hourly bed side capillary ketones and glucose and 2 hourly PH.

2.1.6. All patients should be reviewed by diabetes team prior to discharge.

2.2. **Recommended Targets**

2.2.1. Reduction of the blood ketone concentration by 0.5mmol/L/hour.

2.2.2. Increase the venous bicarbonate by 3.0mmol/L/hour.
2.2.3. Reduce capillary blood glucose by 3.0mmol/L/hour.

2.2.4. Maintain potassium between 4.0 and 5.5mmol/L.

2.3. If there is no improvement as above, then the FRIII rate should be increased (see Management of DKA, Appendix 4)

3. Monitoring compliance and effectiveness

<table>
<thead>
<tr>
<th>Element to be monitored</th>
<th>All of It</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>Specialist Adult In-Patient Diabetes Team</td>
</tr>
<tr>
<td>Tool</td>
<td>Patient Documentation using audit and review tool</td>
</tr>
<tr>
<td>Frequency</td>
<td>Adult in-patients with diabetes who are diagnosed with DKA and who are reviewed by the specialist diabetes team</td>
</tr>
<tr>
<td>Reporting arrangements</td>
<td>Non-compliance will be reported to the responsible medical team, ward/area manager. Non-compliance resulting in an adverse patient event will be reported via Datix</td>
</tr>
<tr>
<td>Acting on recommendations and Lead(s)</td>
<td>Medical teams/ward/area managers will undertake subsequent recommendations and action planning for any or all deficiencies and recommendations within reasonable timeframes for their areas. The Specialist Adult In-Patient Diabetes Team will undertake any trust wide recommendations and action planning for any or all deficiencies and recommendations within reasonable timeframes</td>
</tr>
<tr>
<td>Change in practice and lessons to be shared</td>
<td>Lesson learned or changes to practice will be shared with all the relevant stakeholders</td>
</tr>
</tbody>
</table>

4. Equality and Diversity

4.1. This document complies with the Royal Cornwall Hospitals NHS Trust service Equality and Diversity statement which can be found in the ‘Equality, Inclusion & Human Rights Policy’ or the Equality and Diversity website.

4.2. Equality Impact Assessment
The Initial Equality Impact Assessment Screening Form is at Appendix 2.
## Appendix 1. Governance Information

<table>
<thead>
<tr>
<th>Document Title</th>
<th>Management of Diabetic Ketoacidosis in Adults Clinical Guideline V4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Issued/Approved:</td>
<td>15 November 2019</td>
</tr>
<tr>
<td>Date Valid From:</td>
<td>November 2019</td>
</tr>
<tr>
<td>Date Valid To:</td>
<td>November 2022</td>
</tr>
<tr>
<td>Directorate / Department responsible (author/owner):</td>
<td>Amanda Veall, Lead Clinical Nurse Specialist Diabetes</td>
</tr>
<tr>
<td>Contact details:</td>
<td>01872 253014</td>
</tr>
<tr>
<td>Brief summary of contents</td>
<td>To provide guidance on the management of diabetic ketoacidosis in adults</td>
</tr>
<tr>
<td>Suggested Keywords:</td>
<td>Diseases, Endocrine diseases, Diabetes, Measurement, Clinical measurement, Diagnosis, Care, Health care, Medical care, Medical treatment, Diabetic care, Tests, Diagnostic tests</td>
</tr>
<tr>
<td>Target Audience</td>
<td>RCHT</td>
</tr>
<tr>
<td>Executive Director responsible for Policy:</td>
<td>Medical Director</td>
</tr>
<tr>
<td>Date revised:</td>
<td>15 November 2019</td>
</tr>
<tr>
<td>This document replaces (exact title of previous version):</td>
<td>Clinical Guideline for the Management of Diabetic Ketoacidosis (Dka) in Adults V3.0</td>
</tr>
<tr>
<td>Approval route (names of committees)/consultation:</td>
<td>Consultant Endocrinologists, Diabetes In-Patient Specialist Nurses, Consultant Biochemist</td>
</tr>
<tr>
<td>Care Group General Manager confirming approval processes</td>
<td>Sidwell Lawler</td>
</tr>
<tr>
<td>Name and Post Title of additional signatories</td>
<td>Not Required</td>
</tr>
<tr>
<td>Name and Signature of Care Group/Directorate Governance Lead confirming approval by specialty and care group management meetings</td>
<td>{Original Copy Signed}</td>
</tr>
<tr>
<td>Name: Becky Osborne</td>
<td></td>
</tr>
<tr>
<td>Signature of Executive Director giving approval</td>
<td>{Original Copy Signed}</td>
</tr>
</tbody>
</table>
### Publication Location (refer to Policy on Policies – Approvals and Ratification):
| Internet & Intranet | ✓ Intranet Only |

### Document Library Folder/Sub Folder
Clinical / Endocrine and Diabetes

### Links to key external standards
NSF for Diabetes 2001

### Related Documents:
- NHS DIABETES 2013 2e
- Joint British Diabetes Societies Inpatient Care Group
- The Management of Diabetic Ketoacidosis in Adults

### Training Need Identified?
No

### Version Control Table

<table>
<thead>
<tr>
<th>Date</th>
<th>Version No</th>
<th>Summary of Changes</th>
<th>Changes Made by (Name and Job Title)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 2012</td>
<td>V1</td>
<td>Initial Issue</td>
<td>Amanda Veall Clinical Nurse Specialist Diabetes</td>
</tr>
<tr>
<td>Jan 2013</td>
<td>V2</td>
<td>Updated to reflect the National Guidance, including venous PH</td>
<td>Amanda Veall Clinical Nurse Specialist Diabetes</td>
</tr>
<tr>
<td>April 2016</td>
<td>V3</td>
<td>Review date. Guideline updated to reflect the National Guidance including Ketones and Prescription and Monitoring Chart</td>
<td>Amanda Veall Clinical Nurse Specialist Diabetes</td>
</tr>
<tr>
<td>November 2019</td>
<td>V4.0</td>
<td>Updated to latest Trust template and guidance moved to appendixes</td>
<td>Amanda Veall Clinical Nurse Specialist Diabetes</td>
</tr>
</tbody>
</table>

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**All or part of this document can be released under the Freedom of Information Act 2000**

**This document is to be retained for 10 years from the date of expiry.**

**This document is only valid on the day of printing.**

**Controlled Document**
This document has been created following the Royal Cornwall Hospitals NHS Trust Policy for the Development and Management of Knowledge, Procedural and Web Documents (The Policy on Policies). It should not be altered in any way without the express permission of the author or their Line Manager.
## Appendix 2. Initial Equality Impact Assessment Form

<table>
<thead>
<tr>
<th>Name of the strategy / policy / proposal / service function to be assessed</th>
<th>Management of Diabetic Ketoacidosis in Adults Clinical Guideline V4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directorate and service area:</td>
<td>Endocrine and Diabetes</td>
</tr>
<tr>
<td>New or existing document:</td>
<td>Existing</td>
</tr>
<tr>
<td>Name of individual completing assessment:</td>
<td>Amanda Veall</td>
</tr>
<tr>
<td>Telephone:</td>
<td>01872 253104</td>
</tr>
</tbody>
</table>

### 1. Policy Aim*

**Who is the strategy / policy / proposal / service function aimed at?**

To provide detailed guidance on the clinical management of Adults with Diabetes diagnosed with Diabetic Ketoacidosis

### 2. Policy Objectives*

- To provide a consistent approach to the management of Diabetes within RCH sites.
- To maintain patient safety and improve outcomes for adult patients with diagnosed with Diabetic Ketoacidosis in RCH sites

### 3. Policy – intended Outcomes*

- Consistent management of Diabetes at RCH sites.
- Prompt and safe management of Diabetic Ketoacidosis

### 4. *How will you measure the outcome?*

Audit
Datix Reporting
Review of medical / nursing documentation as required

### 5. Who is intended to benefit from the policy?

All adult patients with Diabetic Ketoacidosis within all RCH sites

### 6a Who did you consult with?

Workforce
Patients
Local groups
External organisations
Other

x

#### b). Please identify the groups who have been consulted about this procedure.

Consultant Endocrinologists, Diabetes In-Patient Specialist Nurses, Consultant Anaesthetist, Emergency Medicine Consultant, Medical Admission Consultant

#### What was the outcome of the consultation?

Agreed

### 7. The Impact

Please complete the following table. If you are unsure/don't know if there is a negative impact you need to repeat the consultation step.
Are there concerns that the policy could have differential impact on:

<table>
<thead>
<tr>
<th>Equality Strands:</th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>Rationale for Assessment / Existing Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex (male, female, trans-gender / gender reassignment)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race / Ethnic communities /groups</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disability - Learning disability, physical impairment, sensory impairment, mental health conditions and some long term health conditions.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religion / other beliefs</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marriage and Civil partnership</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnancy and maternity</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sexual Orientation, Bisexual, Gay, heterosexual, Lesbian</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

You will need to continue to a full Equality Impact Assessment if the following have been highlighted:

- You have ticked “Yes” in any column above and
- No consultation or evidence of there being consultation- this excludes any policies which have been identified as not requiring consultation. or
- Major this relates to service redesign or development

8. Please indicate if a full equality analysis is recommended. 
   Yes | No | X

9. If you are not recommending a Full Impact assessment please explain why.

Not indicated

Date of completion and submission 15 November 2019  Members approving screening assessment  Policy Review Group (PRG) ‘APPROVED’

This EIA will not be uploaded to the Trust website without the approval of the Policy Review Group.

A summary of the results will be published on the Trust’s web site.
## Appendix 3. Management of Diabetic Ketoacidosis in patients under adult medical care

### Management of Diabetic Ketoacidosis in patients under adult medical care

(Please print and keep a copy in the medical notes)

<table>
<thead>
<tr>
<th>Doctor Name</th>
<th>Grade</th>
<th>Consultant</th>
<th>Date &amp; Time</th>
<th>--</th>
<th>Location</th>
</tr>
</thead>
</table>

### Diagnostic Criteria:
All three of the following must be present:

- Capillary blood glucose above 11 mmol/L or known diabetes
- Capillary ketones above 3 mmol/L or urine ketones ++ or more
- Venous pH less than 7.3 and/or bicarbonate less than 15 mmol/L

### Urgent Critical Care/HDU Review if any of the following present:

- Severe DKA by following criteria
  - Blood ketones above 6 mmol/L
  - Venous bicarbonate below 5 mmol/L
  - Venous pH below 7.0
  - Hypokalaemia on admission (below 3.5 mmol/L)
- GCS less than 13
- Pregnant
- History of CCF or CKD stage 3 or above
- Systolic BP below 90 mmHg
- Pulse over 100 or below 60 bpm
- Anion gap above 16 \( \text{Anion Gap} = (\text{Na}^+ + \text{K}^+) - (\text{Cl}^- + \text{HCO}_3^-) \)

### Initial Investigations

- Secure two large bore IV lines
- FBC, U&Es, LFTs, CRP, HbA1c
- Capillary ketones
- Venous pH
- Blood Cultures
- ECG
- Chest X-Ray
- ABG if O2 saturation below 94% on air
- Pregnancy test in women of childbearing age
- Examine Feet for diabetic foot disease and Document in notes
- Refer to Diabetes team via Maxims

### Time 0 to 60 Minutes - Immediate Management: Diagnosis, Resuscitation

- **1 - Intravenous Fluids** (use large bore cannula) via infusion pump
  - If BP < 90mmHg Systolic:
    - 500ml 0.9% sodium chloride solution (0.9%NaCl) as bolus STAT and reassess
  - If BP > 90 mmHg Systolic:
    - 1 Litre of 0.9% NaCl over 60 minutes
- **2 - Insulin**
  - Commence Fixed Rate Intravenous Insulin Infusion (FRIII) based on weight (0.1unit/kg/hr)
  - If next planned dose is due more than 6 hours, give half of the long acting insulin as stat dose.

### Monitoring

- Observations (NEWS2)
- Hourly capillary blood glucose
- Hourly capillary ketone measurement
- Venous pH and potassium at 60 minutes, and 2 hourly
- 4 hourly plasma electrolytes
- Continuous cardiac monitoring
- Prophylactic LMWH if no contraindications
- Fluid balance chart

NB: More cautious fluid replacement in young people aged 18-25 years, elderly, pregnant, heart failure or with BMI 19 or less (Critical Care team review if there is pulmonary oedema or low GCS)
2) **60 MINUTES to 6 HOURS**

Aim: Monitors response of treatment

Rate of fall of ketones of at least 0.5 mmol/L/hr OR bicarbonate rise 3 mmol/L/hr and blood glucose fall 3 mmol/L/hr. Consider increasing insulin infusion rate by 1 unit/hour increments if ketones not falling at this rate.

Continue fluid replacement via infusion pump as follows: (Please Tick)
- 0.9% NaCl 1L +/- KCL over next 2 hours
- 0.9% NaCl 1L +/- KCL over next 4 hours
- 0.9% NaCl 1L +/- KCL over next 4 hours

**Potassium Replacement**

<table>
<thead>
<tr>
<th>Potassium level (mmol/L)</th>
<th>Potassium replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;5.5</td>
<td>Nil</td>
</tr>
<tr>
<td>3.5-5.5</td>
<td>40 mmol/L</td>
</tr>
<tr>
<td>&lt;3.5</td>
<td>Senior/ITU Review</td>
</tr>
</tbody>
</table>

- **Continue Fixed rate Intravenous Insulin Infusion**
- Add 10% Dextrose IV @125ml/hr if blood glucose falls below 14 mmol/L along with 0.9%NaCl infusion

3) **06 to 12 HOURS**

Aim: Ensure clinical and biochemical parameters improving

Continue fluid replacement via infusion pump as follows:
- 0.9% NaCl 1L +/- KCL over next 4 hours
- 0.9% NaCl 1L +/- KCL over next 6 hours

- **Continue fixed rate intravenous insulin infusion**
- Add/Continue 10% Dextrose IV @125ml/hr if blood glucose falls below 14 mmol/L along with 0.9%NaCl infusion

**BIOCHEMICAL and CLINICAL MONITORING**

(Please Tick)

<table>
<thead>
<tr>
<th>Hourly Capillary Glucose and Capillary ketones</th>
<th>60 mins</th>
<th>2 Hour</th>
<th>3 Hour</th>
<th>4 Hour</th>
<th>5 Hour</th>
<th>6 Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>U&amp;Es / VBG / bicarb</th>
<th>60 mins</th>
<th>2 Hour</th>
<th>4 Hour</th>
<th>6 Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Document GCS</th>
<th>60 mins</th>
<th>2 Hour</th>
<th>4 Hour</th>
<th>6 Hour</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Re-assess for complications of treatment e.g. fluid overload, cerebral Oedema
- At 12 hours check venous pH, bicarbonate, potassium, capillary ketones and glucose

4) **12 to 24 HOURS**

Aim: Asses for resolution of DKA; by 24 hours the Ketonaemia and acidosis should have resolved

**Resolution of DKA:** Defined as “Capillary Ketones less than 0.6 mmol/L and pH over 7.3”
- If DKA not resolved identify and treat the reasons for failure to respond; Seek senior and specialist input
- If DKA resolved but patient NOT eating and drinking, switch to Variable rate insulin infusion (Sliding Scale)
- If DKA resolved and patient is able to eat and drink restart usual sub cut (Rapid acting meal time) insulin and refer to diabetes team for advice on dose titration. Do not discontinue intravenous insulin infusion until 30 minutes after subcutaneous short acting insulin has been given
- If the patient is newly diagnosed with diabetes, conversion to subcutaneous insulin should be managed by the Specialist Diabetes Team.

**DISCHARGE PLAN/SPECIALIST REVIEW**
- To determine cause of episode and review diabetes education

**DISCHARGE ONLY WHEN**
- Biochemically stable
- Eating and drinking
- Established on subcutaneous insulin regimen

**FOLLOW UP**
- Diabetes Specialist Nurse
- Outpatient Endocrinologist appointment through Maxims

Management of Diabetic Ketoacidosis in Adults Clinical Guideline V4.0
Page 10 of 11
Appendix 4. Fixed Rate Intravenous Insulin Infusion Prescription and monitoring

Section B: Fixed Rate Intravenous Insulin Infusion Prescription and monitoring

- Fixed rate Insulin infusion should be prescribed on this insulin prescription page
- Fluids, and potassium must be prescribed on the supplementary paper prescription chart
- Long acting background insulin must be prescribed on JAC

Insulin may be infused in the same line as the intravenous replacement fluid provided that a Y connector with a one way anti-syphon valve is used and a large-bore cannula has been placed.

### INSULIN INFUSION PREPARATION

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Dose</th>
<th>Volume</th>
<th>Doctor Signature</th>
<th>Date and Time</th>
<th>Syringe Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actrapid</td>
<td>50 Units</td>
<td>Made up to 50ml with 0.9%NaCl (1 unit per/ml)</td>
<td></td>
<td></td>
<td>BN and expiry Normal Saline BN and expiry Insulin signature witness</td>
</tr>
</tbody>
</table>

### INSULIN INFUSION RATE CALCULATION

Start all patients on a dose of 0.1 units/kg/hr (Maximum rate 15 units/hour)
If necessary increase in increments of 1 unit / hour as per step 2 of guideline and use separate prescription sheet
(For example a 60kg patient on 0.1 units/kg/hour should be started on 6 units/ hour)

**Body weight:**

**Fixed rate Insulin infusion dose (units/hour):**

<table>
<thead>
<tr>
<th>Start Date Time</th>
<th>Prescriber Name and sign Bleep no</th>
<th>Stop Date and Time</th>
<th>Doctor Name and sign</th>
</tr>
</thead>
</table>

### INSULIN INFUSION RATE AND CAPILLARY GLUCOSE, KETONES, ELECTROLYTE MONITORING

<table>
<thead>
<tr>
<th>Date And Time</th>
<th>Capillary Blood Glucose ONE Hourly</th>
<th>Insulin Infusion rate (ml/hour)</th>
<th>Capillary Ketones ONE Hourly</th>
<th>Serum K+ 2hourly</th>
<th>PH(VBG) 2Hourly</th>
</tr>
</thead>
</table>