Guidelines for Management of Diabetic Ketoacidosis in Adults

**DIAGNOSIS:**
Immediate capillary glucose (BM) & Venous Blood Gas
- Acidosis: pH < 7.35, Bicarbonate (HCO₃⁻) < 18 mmol/L
- Ketosis: Blood Ketones > 0.6 mmol/L
- Urinary Ketones > 1+ (>0.5 mmol/L)
- Raised blood glucose: Capillary measurement

**IMMEDIATE MANAGEMENT**

**START IN EMERGENCY DEPT**
- Insert 2 iv cannulae
- Administer 6 units Actrapid iv
- Administer 1L 0.9% NaCl Stat
- Draw blood: (1 Gold Capped, 1 Grey Capped, 1 Purple Capped)
  - Venous Bicarbonate
  - Total Venous Bicarbonate
  - Full Blood Count (FBC)
- Commence fixed rate IV Insulin Infusion @ 6 units / hour (or 0.6 units/kg/hour in patients <60kg)
- Inform Diabetes / Endocrinology Registrar (09.00 - 17.00) or Medical Registrar (17.00 and weekends)

**SEVERITY ASSESSMENT & TRANSFER**

**Baseline severity assessment & appropriate transfer on Clinical Parameters & Venous Bicarbonate (HCO₃⁻)**

- **Severe Diabetic Ketoacidosis:**
  - Venous Bicarbonate (HCO₃⁻) < 10mmol/L and/or pH < 7.1
  - Patient drowsy or unable to speak (GCS <12)
  - Myocardial Infarction (CCU)
  - Hypotension (systolic < 90 mm/Hg) unresponsive to initial fluid resuscitation
  - Consider transfer of care to ITU, HDU or CCU
- **Less Severe Diabetic Ketoacidosis**
  - Venous Bicarbonate (HCO₃⁻) > 10mmol/L
  - Patient able to give history and clinically stable
  - **Manage on Medical Ward**

**INTRAVENTOUS (IV) INSULIN INFUSION:**

- Draw up 50 Units (0.5mL) Actrapid Insulin using an insulin syringe and make up to 50 mL in 0.9% NaCl
- Administer via syringe driver pump
- Note: 1 unit / hour = 1 mL / hour

**MONITORING**

**Glucose:**
- Check Capillary Glucose every 30mins for the first hour and hourly thereafter until intravenous sliding scale started (See below)

**Venous Sampling:**
- Blood should be drawn after 1 hour and 4 hourly thereafter for the first 24 hours and sent for:
  - Electrolytes (U/E), Venous Glucose
  - Total Venous Bicarbonate
  - Ketones

**FLUID REPLACEMENT VIA INFUSOMAT**

**While glucose > 14.0 mmol/L administer 0.9% NaCl**
- **When glucose < 14.0 mmol/L administer 5% dextrose at 125mL/h and balance rate with 0.9% NaCl**
- **Aim for glucose to drop by 3 mmol/L per hour**
- **Bicarbonate should rise by > 3.0 mmol/L per hour until > 19.0**
- **Blood ketones should fall by > 0.5 mmol/L per hour**

**TARGETS:**

- **BICARBONATE, KETONES & GLUCOSE**
  - Blood ketones should fall by > 0.5 mmol/L per hour
  - Bicarbonate should rise by > 3.0 mmol/L per hour until > 19.0
  - Aim for glucose to drop by 3 mmol/L per hour

**ONGOING MANAGEMENT**

**POTASSIUM (K) REPLACEMENT**

- Give K replacement from the **second** litre of fluids onwards
- Use bags of fluid with **pre-added** potassium
- Do not give potassium if patient is anuric
- Administered K based on venous electrolytes (U/E)

<table>
<thead>
<tr>
<th>Venous Potassium (mmol/L)</th>
<th>Fluid Potassium Supplementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 5.0</td>
<td>No Supplement</td>
</tr>
<tr>
<td>3.5 - 5.0</td>
<td>20 mmol/L</td>
</tr>
<tr>
<td>&lt; 3.5</td>
<td>40 mmol/L*</td>
</tr>
</tbody>
</table>

If fluids running at 500 mL / hour only give 20 mmol/L potassium unless patient is on a cardiac monitor

**INSULIN INFUSION**

- **When capillary glucose < 14.0 mmol/L switch to variable rate intravenous insulin sliding scale on page 2**
- Leave patient on their subcutaneous long-acting insulin i.e. Lantus®, Levemir®, Humulin III, in addition to the iv insulin infusion

**ADDITIONAL ACTIONS**

- Use attached monitoring sheet (Page 3)
- Ensure insulin prescription is recorded in the iv section of the hospital drug chart
- Ensure all intravenous fluids are prescribed in the hospital drug chart
## Insulin Prescription for Diabetic Ketoacidosis in Adults

### Intravenous (IV) Insulin Infusion:
Draw up 50 Units (0.5mL) Actrapid Insulin using an insulin syringe and make up to 50 mL in 0.9% NaCl. Administer via syringe driver pump.

**Note:** 1 unit / hour = 1 mL / hour

### Targets:
**Bicarbonate, Ketones & Glucose**
- Blood ketones should fall by > 0.5 mmol/L per hour
- Bicarbonate should rise by > 3.0 mmol/L per hour until > 19.0
- Glucose should fall by 3 mmol/L per hour until within normal range i.e. (4.0 - 8.0 mmol/L)

### Additional Actions
- **Insulin Infusion**
- **Insulin Infusion**
- **Insulin Infusion**

**Target Glucose Ranges:**

<table>
<thead>
<tr>
<th>Glucose (mmol/L)</th>
<th>Glucose Monitoring</th>
<th>Insulin Infusion (Units/Hour)</th>
<th>Additional Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 3.0</td>
<td>15 mins until glucose &gt; 3.0</td>
<td>0.25</td>
<td>Continue 5% dextrose as prescribed. Give 10mL 50% dextrose or oral Lucozade (if tolerated). Repeat if necessary.</td>
</tr>
<tr>
<td>3.1 - 3.5</td>
<td>30 mins until glucose &gt; 3.5</td>
<td>0.5</td>
<td>Continue 5% dextrose as prescribed</td>
</tr>
<tr>
<td>3.6 - 5.0</td>
<td>1 hourly</td>
<td>1</td>
<td>If glucose stable for 2 hours in succession monitor 2 hourly</td>
</tr>
<tr>
<td>5.1 - 7.0</td>
<td>1 hourly</td>
<td>1.5</td>
<td>If glucose stable for 2 hours in succession monitor 2 hourly</td>
</tr>
<tr>
<td>7.1 - 9.0</td>
<td>1 hourly</td>
<td>2.0</td>
<td>If glucose stable for 2 hours in succession monitor 2 hourly</td>
</tr>
<tr>
<td>9.1 - 11.0</td>
<td>1 hourly</td>
<td>2.5</td>
<td>If glucose stable for 2 hours in succession monitor 2 hourly</td>
</tr>
<tr>
<td>11.1 - 13.0</td>
<td>1 hourly</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>13.1 - 16.0</td>
<td>1 hourly</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>16.1 - 18.0</td>
<td>1 hourly</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>&gt; 18.0</td>
<td>30 mins until glucose &lt; 18.0</td>
<td>6.0</td>
<td>Check Cannula, Stop 5% Dextrose, Check Ketones, Call Diabetes (or medical) Registrar</td>
</tr>
</tbody>
</table>

Please refer to back page of document for further guidance.

**Continue Intravenous Fluids According to Prescription Guidance on Page 1**

**Please refer to back page of document for further guidance.**

**Date:** / / **Time:**

**Name:** ___________________________

**Board Number:** _______________________

**Address:** _______________________

**Date of Birth:** _______________________

**Signature:**

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**Convert back to appropriate subcutaneous regimen when biochemically stable**
(Ketones <0.3, HCO3 > 17.0, pH > 7.3) and the patient is ready to eat.

Please refer to back page of document.
### Monitoring Sheet for Diabetic Ketoacidosis in Adults

**Glucose:**
Check Capillary Glucose every 30mins for the first hour and hourly thereafter until intravenous sliding scale started (See page 2)

**Insulin Infusion Rate:**
units / hour = mL / hour

**Venous Sampling:**
Blood should be drawn after 1 hour and 4 hourly thereafter for the first 24 hours and sent for: Electrolytes (U/E), Venous Glucose, Total Venous Bicarbonate, Ketones
The result must be recorded by the doctor on call and the medical registrar must be notified

<table>
<thead>
<tr>
<th>Time</th>
<th>Capillary Glucose (BM) (mmol/L)</th>
<th>Insulin Infusion Rate (units / hour)</th>
<th>Intravenous Fluids (Refer to prescription on hospital drug chart)</th>
<th>Admin by</th>
<th>Monitoring (To be Completed by Doctor)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P1</td>
<td>Venous Glucose (mmol/L)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P2</td>
<td>Venous Bicarbonate (mmol/L)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sodium (mmol/L)</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>Potassium (mmol/L)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Blood Ketones (mmol/L)</td>
</tr>
</tbody>
</table>

**Insulin Administration & Glucose Monitoring (Refer to page 2)**

- **IV Fluids (0.9% NaCl)** (mL/hour)
- **IV Fluids (5% Dextrose)** (mL/hour)
- **Potassium Supplement** (mmol/L)

**Targets:**
- Blood ketones should fall by > 0.5 mmol/L per hour
- Ketones < 10mmol/L and/or pH < 7.1
- Ketones > 10mmol/L
- Venous Bicarbonate (HCO₃⁻) < 18 mmol/L
- Venous Bicarbonate (HCO₃⁻) > 19.0 mmol/L
- Bicarbonate should rise by > 3.0 mmol/L per hour until > 19.0 mmol/L
- Sodium (mmol/L)

**Regimen:**
- **Hypotension (systolic < 90 mm/Hg)** unresponsive to initial fluid replacement
- **Severe Diabetic Ketoacidosis:**
  - Administer 1L 0.9% NaCl Stat
  - Administer 6 units Actrapid iv
  - Insert 2 iv cannulae
  - Variable rate intravenous insulin sliding scale on infusion

**Less Severe Diabetic Ketoacidosis:**
- **Full Blood Count (FBC)** (To be Completed by Doctor)
- **Urine Ketones** (To be Completed by Doctor)
- **Venous Potassium** (mmol/L)

**Do not give intravenous bicarbonate** on Glucose Measurement

**DIAGNOSIS:**
- Urinary Ketones > 1+ (>0.5 mmol/L)
- Blood Ketones > 0.6 mmol/L
- pH <7.35; Bicarbonate (HCO₃⁻) < 10mmol/L

**Supplementation:**
- Potassium should rise by > 2.0 mmol/L per hour until > 3.5 mmol/L
- Give K replacement from the potassium replacement solution

**Biological Monitoring:**
- Urine Ketones
- Venous Bicarbonate, Glucose

**Intravenous Fluids**

- **5% Dextrose** (500 mL / hour)
- **0.9% NaCl** (500 mL / hour)
- **6 units Actrapid iv** (or 0.1units/kg/hour in patients <60kg)
- **5% Dextrose** and **0.9% NaCl** (or 0.2 units/kg/hour in patients <60kg)

**Blood should be drawn after 1 hour and 4 hourly thereafter for the Venous Sampling:**
- **Electrolytes (U/E)**, **Venous Glucose**, **Total Venous Bicarbonate**, **Ketones**

**Patient Addressograph**

**Date: / / Time: ____________________________
Name: ____________________________
Board Number: ____________________________
Address: ____________________________
Date of Birth: ____________________________

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**Version 1.1 February 2011: Q Pulse CLN-DIAB-005**
General Information

**PRACTICAL POINTS**

**INFUSIONS & CANNULAE**
Insulin and replacement fluids are **EQUALY important in the management of DKA**
2 wide-bore (green topped) cannulae should be maintained at all times
If only one cannula is available for use, insulin may be infused through the same line as replacement fluids providing that a Y connector with a one-way, anti-syphon valve is used through a wide bore cannula

**NG TUBE / URINARY CATHETER / ANTIBIOTICS**
Nasogastric tube and/or urinary catheter insertion is **not usually necessary in patients with DKA**
In patients who are vomiting persistently, it may be necessary to insert an NG tube for patient comfort and to assess ongoing fluid losses
Urinary catheter insertion is necessary in patients who are anuric
Avoid commencing antibiotics unless there are objective clinical signs of infection even when initial white cell count is high

**TARGETS & AIMS**
Blood ketones should fall by > 0.5 mmol/L per hour
Bicarbonate should rise by > 3.0 mmol/L per hour until > 19.0
Glucose should fall by 3 mmol/L per hour until within normal range i.e. (4.0 - 8.0 mmol/L)
Ketones should be cleared within 24 hours of starting treatment
If these treatment targets are not met, please check all lines, connectors and infusions and contact the Diabetes Consult Registrar or Medical Registrar “on-call”

**PRACTICAL POINTS**

**TRANSITION TO SC INSULIN**
Transitioning to subcutaneous insulin should only be done under the guidance of the Diabetes Team

There should always be an overlap of 60 minutes between administration of subcutaneous and intravenous insulin

**MULTIPLE DAILY INJECTION REGIMEN**
When receiving the first meal after admission, inject subcutaneous quick-acting (QA) insulin (Novorapid®, Apidra®, Humalog®, Humulin S®).

The correct dose of QA insulin will have been calculated by the diabetes team in newly diagnosed patients. In already diagnosed patients give the usual, pre-admission, pre-meal dose of QA insulin.

Patients should have remained on their normal pre-admission dose of long-acting insulin (Lantus®, Levemir®, Humulin L®) throughout management with iv insulin. If not, administer this with QA insulin at the time of the first meal.

Do not stop the intravenous insulin infusion until 60 minutes following the administration of QA insulin.

**PRE-MIXED INSULIN**
Patients on pre-mixed insulin (Novomix 30®, Humalog Mix®) will NOT have remained on their usual subcutaneous insulin while receiving intravenous insulin.

When transitioning these patients, administer the usual pre-admission dose of pre-mixed insulin with the morning or evening meal.

Do not stop the intravenous insulin infusion until 60 minutes following the administration of pre-mixed insulin.

**PRACTICAL POINTS**

**TRANSITION TO SC INSULIN**
**CONTINUOUS SUBCUTANEOUS INSULIN INFUSION**

Recommend insulin at normal basal rate when patient is biochemically stable.

Do not recommence the basal rate at bedtime.

At first meal give the normal mealtime bolus of insulin using the pump function.

Continue intravenous insulin infusion until 60 minutes after the mealtime bolus given.

**PLEASE ENSURE THAT ALL SUBCUTANEOUS INSULIN IS PRESCRIBED ON THE INSULIN PRESCRIPTION CHART PRIOR TO ADMINISTRATION**

**CONTACT DETAILS**

**BLEEP / PHONE**

| Diabetes Registrar | 707 |
| Medical Registrar ‘On-Call” | 230 |
| Diabetes Nurse Specialist | 591 |
| Intensive Care Physician | 111 |
| Diabetes Centre | 2148 |

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This document is located on Q Pulse