1. **Introduction**

Diabetic ketoacidosis (DKA) is defined as all of the following:
- Blood glucose above 11 mmol/L or known history of diabetes
- Blood ketones above 3mmol/L
- Venous pH less than 7.3 and/or venous bicarbonate less than 15mmol/L

**DKA is a medical emergency and is treated by fluid therapy, electrolyte replacement and correction of blood glucose and ketones with insulin.**

The WUTH diabetic ketoacidosis care pathway (intended for use in ED and general wards) is **NOT** entirely appropriate for critical care patients where invasive monitoring allows more patient specific fluid management. Compound sodium lactate may also be a more appropriate fluid to use instead of 0.9% sodium chloride due to the risks associated with hyperchloraemic acidosis.

Blood ketone meters for measuring at the bedside are available. **Management should focus on clearing ketones alongside normalising blood glucose.** Intravenous infusions of glucose 10% or 20% may be required to prevent hypoglycaemia and allow continued insulin infusion to clear blood ketones.

2. **Management**

2.1 **Insulin**

Consider starting an intravenous insulin infusion **1 unit/ml at 0.1 units/kg/hour**, e.g. the starting rate in a 90kg patient would be 9ml/hour. Pre prepared insulin syringes 50units in 50ml sodium chloride 0.9% available from pharmacy should always be used.

Long acting insulin (Levemir® or Lantus®) MUST BE CONTINUED in addition to intravenous insulin during DKA treatment.

2.2 **Intravenous fluids**

In severe DKA (pH <7.0), patients are commonly dehydrated by 10% or more (>6 litres for most adults). Initial fluid challenges to correct hypotension are followed by steady deficit replacement. Fluid therapy to be managed on a case-by-case basis by ITU registrar/consultant according to clinical judgement. Sepsis can trigger DKA, which may need concurrent vasopressor therapy.

2.3 **Electrolyte replacement**

Aim to maintain potassium between 4 and 5 mmol/L. Replace phosphate according to critical care guideline. Routine use of bicarbonate is not recommended in DKA.

3. **Monitoring**

3.1 **Ketones**

Blood ketones should be **checked every hour**.

Aim to reduce blood ketones by 0.5mmol/L/hour. Increase insulin by 1 unit/hour until ketones begin to fall, even if this leads to blood glucose falling. If blood glucose falls then
maintain blood glucose levels between 5 and 10 mmol/L by an appropriate glucose infusion. DO NOT REDUCE INSULIN unless blood glucose drops below 4 mmol/L.

Consider reducing the rate of insulin infusion if the ketones are dropping rapidly and the blood glucose is in range (i.e. less than 10 mmol/L). For example if the ketones are falling by:

- 2 mmol/L/hour: reduce insulin rate by half (50%)
- 1 mmol/L/hour: reduce insulin rate by a quarter (25%)

When blood ketones are stable at less than 1 mmol/L and pH is above 7.3, consider either:

- Continuing intravenous insulin infusion, following the blood glucose control in critical care guidelines. Use the patient’s normal daily insulin dosage as a guide to estimate requirements (see below point 4). Note a significant reduction in the rate of the insulin infusion may be required at this point.
- Transfer to usual subcutaneous insulin. Note intravenous insulin infusion should be continued for 1 hour following the first dose of subcutaneous insulin.
- Transfer to GK1 infusion, particularly if not tolerating oral diet.

3.2 Glucose
Blood glucose must be monitored every hour, aiming for a reduction of 3 mmol/L/hour. A rapid reduction in blood glucose e.g. more than 5 mmol/L/hour may precipitate cerebral oedema.

When blood glucose falls below 14 mmol/L, a 10% glucose infusion should be started at 125 mL/hour. The infusion should be titrated to maintain blood glucose between 5 and 10 mmol/L. Continue the insulin infusion until ketones are in range (<1 mmol/L). If volume overload is a concern, a glucose 20% infusion may be substituted.

In cases of hypoglycaemia (blood glucose below 4 mmol/L), consider giving glucose 50% bolus rather than stopping insulin. CASES OF HYPOGLYCAEMIA MUST be discussed with a doctor.

3.3 Electrolytes
In DKA there is a risk of hypoglycaemia, hypokalaemia and hyperkalaemia. Potassium should be monitored at least four times daily. Aim to maintain potassium between 4 and 5 mmol/L. Sodium levels should not increase by more than 0.5 to 1.0 mmol/L per hour or by more than 12 mmol/L in a 24-hour period.

3.4 Arterial or venous blood gases
Should be monitored until sustained improvement in pH and blood ketones. Values of interest include bicarbonate, chloride, PCO2 and pH.

3.5 CNS observations
Should be repeated 4 hourly.

4. Additional Notes
- Patients should be referred to the diabetes team or diabetes specialist nurses, available on bleep 2705. Bleeps for diabetes specialist nurses: Jane Leach 2706, Chrissie Bigg-Wither 2707, Kay Hannon 2381.
- Patient’s usual dose of insulin: example; Novorapid® 8 units tds & Lantus® 24 units nocte, equals a total dose of 24 units short acting & 24 units long acting insulin in 24 hours. Provided the long acting insulin is being continued, the hourly requirement...
will be 1 unit/hour. Usual doses may be found on Millennium (clinic letter / Diabetes M page).

5. References
WUTH guideline Management of Diabetic Ketoacidosis: