



Diabetes and Management of DKA

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Clinical Coach 2021

**Hyperosmolar
hyperglycaemic
state (HHS)**

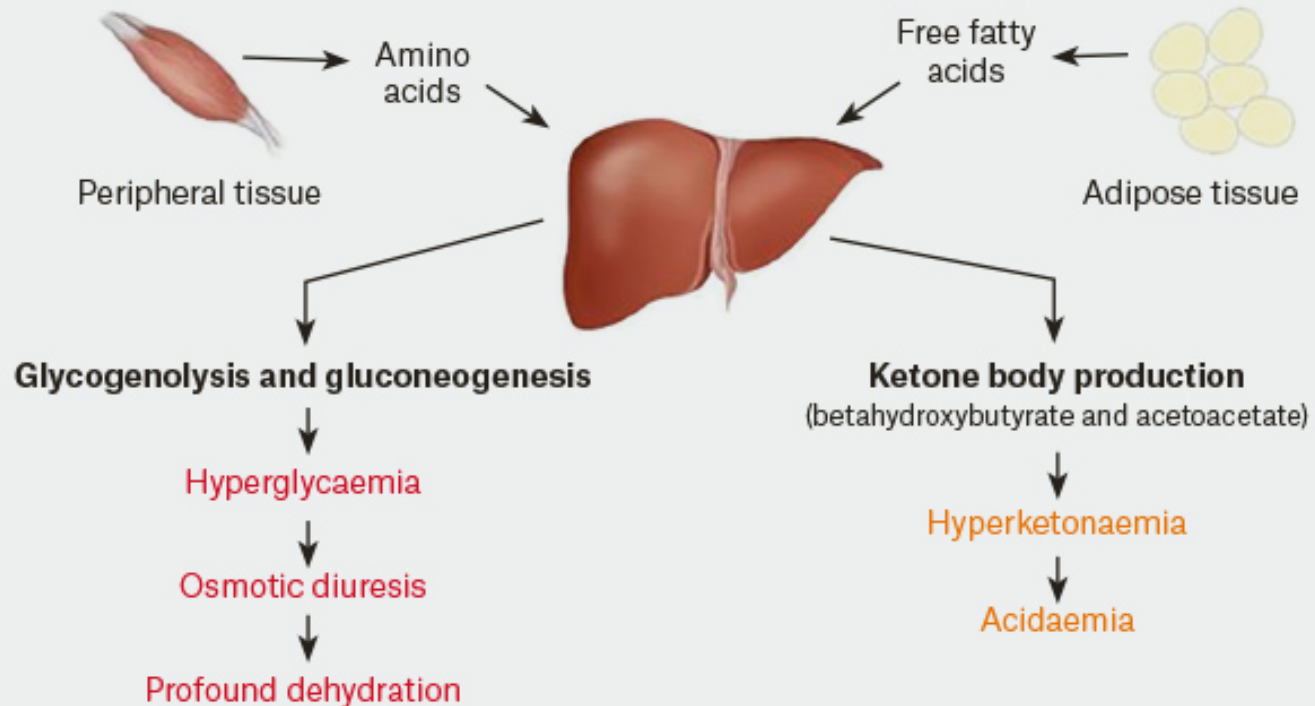
Hyperglycaemia

**Diabetic
ketoacidosis
(DKA)**

Relative

Decreased insulin

Absolute



Diabetes: Overview

- Is a chronic disease caused by:
 - when the pancreas is no longer able to make enough insulin (**insulin deficiency**)
 - when the body cannot make good use of insulin it produces (**insulin resistance**)

What is insulin?

- A hormone made by the pancreas.
- It helps glucose get into the cells where it is used for energy.

Abnormal Blood Glucose Signs and Symptoms

Hypoglycaemia	Hyperglycaemia
Sweaty	Excessive thirst
Dizzy	Polyuria
Weak	Blurred vision
Need to eat glucose straight away! X2 hyperfit OR X2 orange juice PLUS Sandwich	Headache

Types of Diabetes

- **Type 1 Diabetes**
- caused by insulin deficiency.
- it is an auto-immune condition where the body sets up an attack against the cells within it that make insulin
- often starts in childhood and can appear with little warning.
- approx. 10% of people with diabetes.

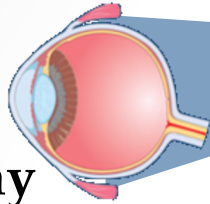
Types of Diabetes

- **Type 2 Diabetes**
- it is the most common form of diabetes.
- either the body doesn't produce enough insulin, or the cells in the body don't recognise the insulin that is present.
- often starts in adulthood after the ages of 30-40 years.

Type 2 diabetes is associated with serious complications

Diabetic retinopathy

Leading cause of blindness in adults^{1,2}



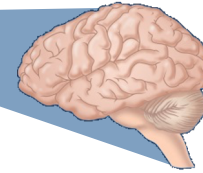
Diabetic nephropathy

Leading cause of end-stage renal disease^{3,4}



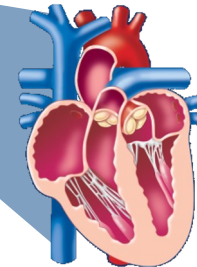
Stroke

2- to 4-fold increase in cardiovascular mortality and stroke⁵



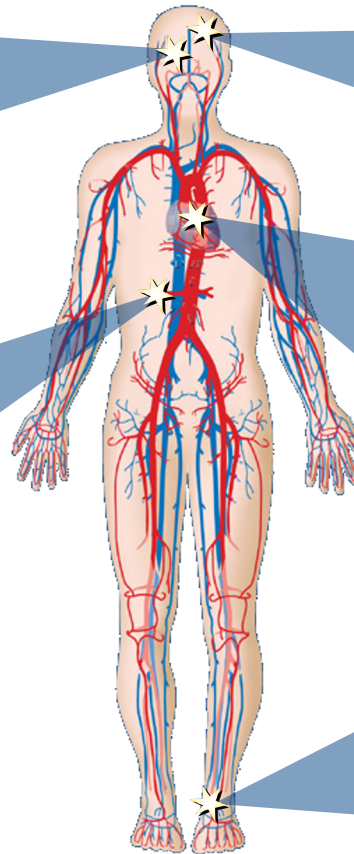
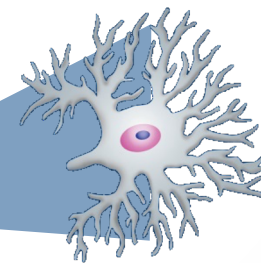
Cardiovascular disease

8/10 individuals with diabetes die from CVD events⁶



Diabetic neuropathy

Leading cause of non-traumatic lower extremity amputations^{7,8}



1. UK Prospective Diabetes Study Group. *Diabetes Res* 1990;13:1–11. 2. Fong DS, et al. *Diabetes Care* 2003;26 (Suppl. 1):S99–S102.

3. The Hypertension in Diabetes Study Group. *J Hypertens* 1993;11:309–317. 4. Molitch ME, et al. *Diabetes Care* 2003;26 (Suppl. 1):S94–S98.

5. Kannel WB, et al. *Am Heart J* 1990;120:672–676. 6. Gray RP & Yudkin JS. Cardiovascular disease in diabetes mellitus. In *Textbook of Diabetes*,

2nd edn., 1997. Edited by J Pickup & G Williams. Boston: Blackwell Sciences. 7. King's Fund Policy Institute. *Counting the cost: the*

real impact of non-insulin dependent diabetes. London: British Diabetic Association, 1996. 8. Mayfield JA, et al. *Diabetes Care* 2003;26 (Suppl. 1):S78–S79.

Diabetic Ketoacidosis (DKA)

- Metabolic starvation causes an increase in glucose supply which cannot be broken down due to insulin insufficiency, therefore, more glucose is produced.
- Eventually proteins are broken down for energy which leads to acidosis => ketones in blood.
- Urine output is increased to remove glucose from the system which leads to dehydration.
- Video:
<https://www.youtube.com/watch?v=r2tXTjb7EqU>

Common causes of DKA

- Insulin omission
- Infection
- Myocardial infarction
- Drugs such as steroids.

Early Signs and Symptoms

- Passing large amounts of urine
- Feeling very thirsty or hungry
- Dry mouth
- Nausea or vomiting
- Abdominal pain
- Tired, weakness, fatigue
- SOB, tachycardia, hypotension
- Unusual or fruity-smelling breath
- Confusion
- Increase in blood sugar and/or ketone levels
- Weight loss, poor skin turgor, sunken eyes
- In severe cases...shock

DKA Management - Adult

○ Step 1

Rapid ABC



Insert 18G
IV Cannula



Immediate
venous
blood gas,
FBC, U & E



Check capillary
blood glucose and
capillary blood
ketones

○ **Step 2**

Start IV fluids immediately!

SBP < 90mmHg

SBP > 90mmHg

Give 500 mls 0.9% Sodium Chloride over 10-15 minutes

Once SBP > or = 90 mmHg

Give 1000 mls 0.9% Sodium Chloride over first 60 minutes

If SBP remains < 90 mmHg, repeat!

Organise senior review if >1000 mls given and SBP remains <90 mmHg

Can prepare
insulin while this is
running

Prescribe and administer fluids and insulin infusion as below

❑ SBP < 90 mmHg

1. Give 500 mL 0.9% sodium chloride over 10-15 minutes
2. Repeat if SBP remains < 90 mmHg
3. Organise senior review if remains < 90 mmHg

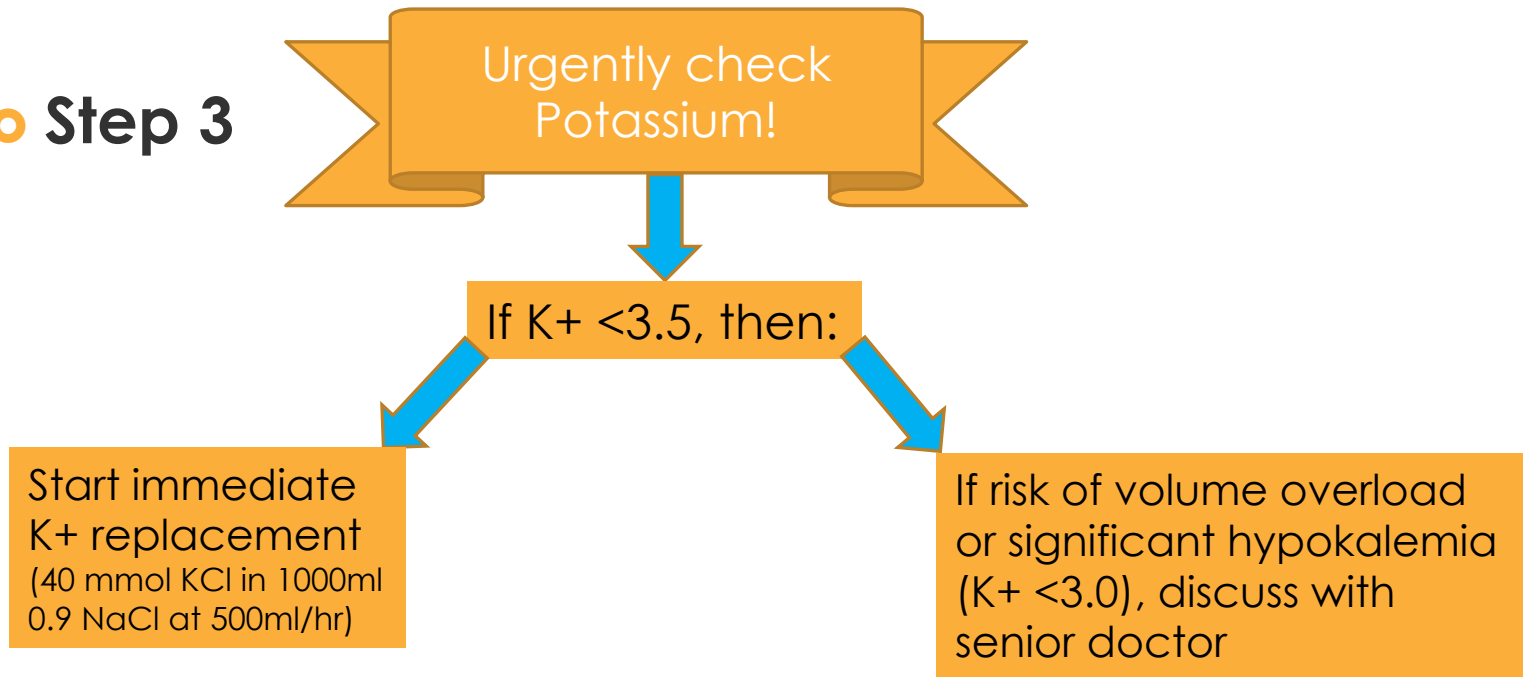
❑ Prescribe NaCl + KCl in ePrescribing

- Below is a typical regimen. Consider the clinical situation. **Individualise AND reassess.** If risk of volume overload or significant hypokalaemia ($K^+ < 3.0$), discuss with senior

ePrescribe
fluid and
potassium

Fluid	Volume
0.9% NaCl	1000 ml over first hour (often already started)

○ **Step 3**



Hold Insulin until potassium replacement underway, as once the "gates" open there is potential for K+ to drop.

Insulin infusion must be commenced within 30 mins.

potassium
replacement:

0.9% NaCl + 40 mmol KCl*	1000 mL over next 2 hours
0.9% NaCl + 40 mmol KCl	1000 mL over next 4 hours
0.9% NaCl + 40 mmol KCl	1000 mL over next 4 hours
0.9% NaCl + 40 mmol KCl	1000 mL over next 6 hours
0.9% NaCl + 40 mmol KCl	1000 mL over next 6 hours
Potassium-containing fluid in above must be administered via Agilia volumetric pump, drug profile name 'Potassium Chloride ---mmol/1000mL'. Ensure KCl concentration selected is 40 mmol / 1000 mL	

*If premixed bag is unavailable, add potassium chloride to 0.9% sodium chloride, not glucose (dextrose)

ePrescribe
glucose
(dextrose):

❑ ePrescribe KCL 20 mmol + NaCl 0.45% + Glucose 5% 1000ml at 80 mL/hr (premixed bag), as a concurrent fluid to insulin infusion (see below), only to be started when blood glucose ≤ 14 mmol/L

- This can be run alongside the 0.9% NaCl + 40 mmol KCl fluid, via separate IV access
- Commence potassium replacement when serum potassium < 5.5 mmol/L. Briefly interrupt and consider slower replacement if serum potassium rises above 5.5 mmol/L
- Hyperkalaemia common at presentation – usually falls when fluids/insulin commenced
- Renal failure or anuric patients require lower fluid and potassium replacement
- Under-replacement of potassium common. Seek advice if unsure

Note:

○ Step 4

Start Insulin infusion immediately!

Insulin infusion:

- ❑ **Start intravenous insulin infusion scale B** (unless clear reason otherwise) via Agilia syringe driver
 - Concurrent fluid (glucose-containing premixed bag above) **ONLY** to be started when blood glucose ≤ 14 mmol/L
- ❑ **Disconnect any subcutaneous insulin pumps until reviewed by diabetes specialist team**
- ❑ **All other anti-hyperglycaemic agents are usually withheld and recommenced (if appropriate) as per WDHB Intravenous Insulin Infusion protocol, section 6: Safe discontinuation of an insulin infusion.**

Chart regular insulin/Lantus

Lantus (insulin glargine):

- ❑ **If already on Lantus : prescribe USUAL Lantus dose given at USUAL time**
 - If presenting within 8 hours of usual timing, give usual dose on admission
- ❑ **For newly diagnosed diabetes, consider prescribing Lantus 0.25 units/kg once daily**

Note:

Subcutaneous Lantus is often withheld in error whilst on an insulin infusion. It is OK to give Lantus whilst on an insulin infusion

Diagnosis of DKA requires **ALL** three of the following:

- **Blood glucose** ≥ 11 mmol/L **OR** know diabetic
- **Blood ketones** ≥ 3 mmol/L
- **Venous pH** ≤ 7.3 **OR** bicarbonate ≤ 18 mmol/L
 - HCO₃ regulates pH which excrete and reproduce in kidneys. This indicates early sign of acidaemia before pH drops at times.

Please note!!

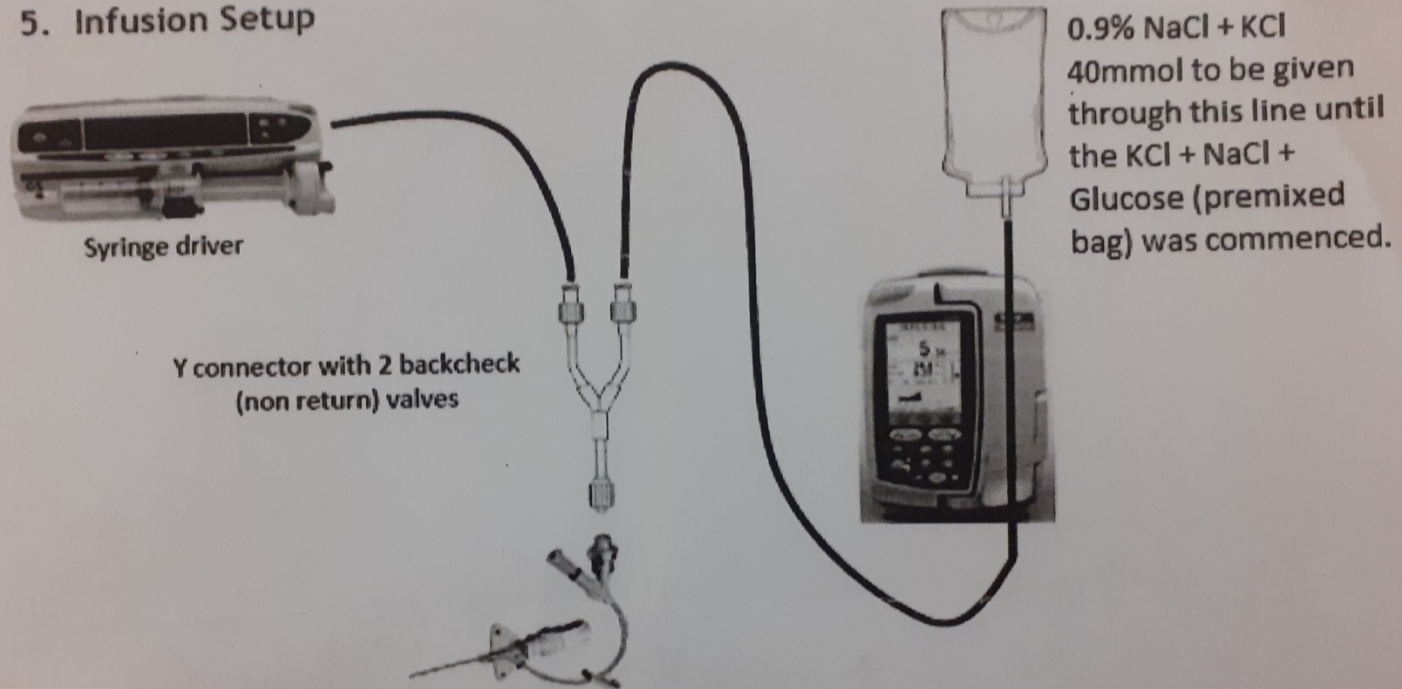
- There is a new funded medication currently prescribed to patients called **empagliflozin** which is a sodium glucose co-transport 2 inhibitor (SGLT2i).
- **Empagliflozin** decreased blood glucose by excreting it through urine. This increases risk of dehydration, hypotension, and hypoglycaemia in patients who are also taking insulin.
- These patients are at increased risk of DKA, however, due to the mechanism of the medication their glucose remains normal.
 - Hence why policy has changed to DKA including diabetics and not a specific BSL.
 - Always check ketones in unwell diabetics on empagliflozin

Empagliflozin

- Any patient (not just DKA) in an acute illness:
 - Withhold empagliflozin
 - Test ketones
 - If a patient becomes hyperglycaemic while empagliflozin is withheld then subcutaneous or intravenous infusion might be required.
 - Contact diabetes services

DKA / HHS Set-Up

5. Infusion Setup



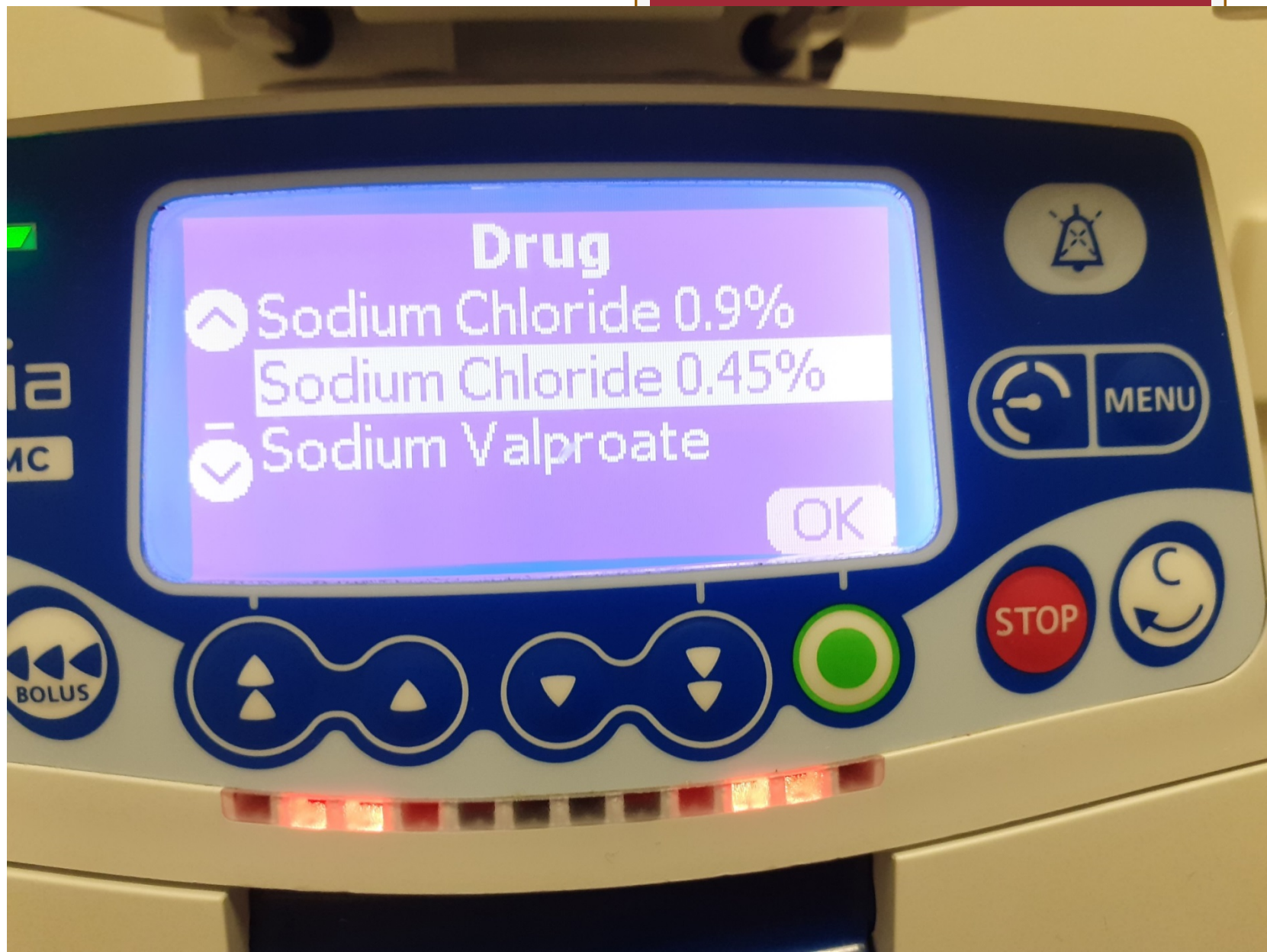
! Replacement fluid (NaCl) must initially be infused via second arm of insulin infusion Y connector but later should be given via a separate IV cannula when dextrose commenced

! Potassium chloride should be added to sodium chloride **NOT** dextrose

Intravenous Insulin Infusion – Adults

Blood glucose (mmol/L)	Insulin Infusion Rate (ml/hour)			
	Scale A (for ESRD and insulin sensitive patients e.g. ≤ 24 units per day)	Scale B (first choice in most patients)	Scale C (for insulin resistant patients e.g. ≥ 100 units per day)	Custom scale (to be written by doctor)
< 4	Treat HYPOGLYCAEMIA as per WDHB Hypoglycaemia Policy			
4.1 – 8.0	0.5	1	2	
8.1 – 12.0	1	2	4	
12.1 – 16.0	2	4	6	
16.1 – 20.0	3	5	7	
20.1 – 24.0	4	6	8	
≥ 24.1	6	8	10	

Intravenous Insulin Infusion – Adults



Drug

- ▲ Sodium Chloride 0.9%
- Sodium Chloride 0.45%
- ▼ Sodium Valproate

OK

STOP

MENU

BOLUS

MC

Continually reassess for resolution of:

- Bedside capillary ketones and blood glucose

AND

- pH and potassium

OR

bicarbonate

Insulin infusion titration

- If blood glucose persistently $< 5\text{mmol/L}$ for more than 60 minutes, move one scale to the left
 - If blood glucose persistently $> 12\text{mmol/L}$ and **not falling**, check pump for correct infusion rate and check line for patency before moving one scale to the right
- *Always Prescribe 10% Dextrose 150 mL intravenously PRN for hypoglycaemia (blood glucose $< 4\text{ mmol/L}$)

Ongoing management

- Potassium monitoring : at 2, 4, 6, 12, 24 hours – consider KCL either increase or decrease as per >5.5 or <5.5
- Hourly bedside blood glucose and ketones check
- Reassess fluid status as clinically indicated.
- Safe patient transfer to ADU monitored for 1st 12 hours.

Resolution of DKA

- **Ketoacidosis-** stop ketone production by giving insulin which will decrease blood glucose levels.
- **Dehydration-** lots of IV fluids.
- **Electrolyte imbalance-** replace potassium.

Resolution of DKA

- Usually resolves in 11 hours.
 - If greater, then consider another cause for DKA (MI or infection).
- When weaning off DKA protocol, subcutaneous insulin needs to be given **one hour** before intravenous insulin is stopped.
 - IV insulin has a 5 minute half life.

Resolution of DKA

- DKA is resolved when:
Blood ketones ≤ 0.3 mmol/L
Venous pH ≥ 7.3