



## GUIDELINE

# ADULT HYPEROSMOLAR HYPERGLYCAEMIC STATE (HHS)

Disclaimer: This document does not override decision based on clinical judgement and experience of the prescriber.

## SCOPE

Site	Service/Department/Unit	Disciplines
Sir Charles Gairdner Hospital	All areas	Medical, Nursing, Allied Health

This guideline must NOT be used in children (<18 years). Seek advice from senior clinician or diabetes specialty unit in cases of uncertainty.

Continuous cardiac monitoring must be instituted when intravenous potassium chloride is administered at a rate of greater than 10mmol/hour (WA Policy for Intravenous Potassium 0444/13)

## INTRODUCTION PURPOSE

These guidelines are for the treatment of adults with Hyperosmolar Hyperglycaemic State (HHS), previously known as hyperosmolar non-ketotic coma (HONK).

Seek advice from senior clinician or diabetes specialty unit in cases of uncertainty

## DEFINITIONS

<b>Hyperosmolar Hyperglycaemic State (HHS)</b>	An extreme metabolic derangement characterised by severe hyperglycaemia, hyperosmolality (manifested by hypernatraemia and haemoconcentration) without evidence of substantial ketosis.
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## GUIDELINE

Staff must adhere to the following procedure when managing an adult patient with Hyperosmolar Hyperglycaemic State (HHS).

The guideline must be adapted to the clinical situation where necessary.

All management must be recorded in Adult Hyperosmolar Hyperglycaemic State Guidelines and Management Record (MR 838), see [appendix 1](#).

## DIAGNOSIS CRITERIA

- Hypovolaemia
  - Marked hyperglycaemia (>30 mmol/L)
  - Increased plasma osmolality (> 320 mmol/kg or mosm/kg)
  - Calculated osmolality = 2(Sodium) + glucose + urea (all in mmol/L)
- (N.B. osmolality and osmolarity units can be used interchangeably in this clinical scenario)

If the patient does not meet any of the above criteria, re-consider diagnosis

**NOTE:** If the patient has Type 1 diabetes or is hyperglycaemic (blood glucose level >11mmol/L) with:

- acidosis (venous bicarbonate <18 and/or pH <7.35), and
- blood (capillary) ketones ≥3mmol/L

Follow the SCGH Adult Diabetes Ketoacidosis Management Guidelines ([include LINK to DKA guideline](#)).

## NEW PRINCIPLES FOR THE MANAGEMENT OF HHS

1. Correct hypovolaemia first by using 0.9% sodium chloride solution for resuscitation. Do not use Hartmann's or colloid. Expect an initial rise in sodium level
2. Closely monitor electrolytes, as there is a high risk of abnormalities and cerebral oedema
3. **Treat hyperglycaemia with intravenous (IV) fluids only**
4. Only commence insulin when:
  - blood glucose is no longer falling with IV fluids, **or**
  - if significant ketonaemia (blood (capillary) ketones: **>1 mmol/L**)
5. Secondary risk prevention must commence. Assess foot risk score on admission

**Consider critical care admission and senior clinician review if one or more of the following is present:**

- Osmolality >350 mosmol/kg
- Systolic Blood Pressure (SBP) <90 mmHg
- Plasma Sodium (Na<sup>+</sup>) > 160 mmol/L
- Pulse <60 or >100 bpm
- pH < 7.1
- Hypo or hyperkalaemia
- Urine output < 0.5 ml/kg/hr
- Glasgow Coma Scale (GCS) < 12 or abnormal AVPU score
- O<sub>2</sub> saturation < 92% on room air
- Other serious co-morbidity

## ESSENTIAL ASSESSMENT TO DETERMINE THE SEVERITY OF HHS

The following assessment must be carried out to determine the severity of HHS:

- Blood ketones
- Blood glucose
- Venous bicarbonate
- Venous (or arterial) pH
- Potassium - beware of initial low potassium; if level <3.5mmol/L, call for senior medical advice immediately
- Serum osmolality
- Serum Creatinine
- Systolic Blood pressure (BP)
- Glasgow Coma Scale (GCS)

## INTRAVENOUS FLUID REPLACEMENT

**Assess severity of dehydration in the patient and use sodium chloride 0.9% (+/- potassium) for fluid replacement WITHOUT insulin initially.**

This alone will lower blood glucose which will in turn, reduce osmolality.

- Aim to achieve positive fluid balance of 3 to 6 litres within the first 12 hours of intervention and 100% of estimated fluid losses by 24 hours
- Typically, fluid losses approximate 110 to 220 mL/kg (i.e. 11 to 22 L for a 100kg patient)
- Provided osmolality is decreasing appropriately, continue patient on sodium chloride 0.9%, **even if plasma sodium is increasing**
- All fluid, after the first bag, should contain potassium chloride unless urine output is <0.5 mL/kg/hr or serum potassium remains > 5.5 mmol/L
- **Caution** is needed, particularly in the elderly, where rapid rehydration may precipitate heart failure

**Table 1: Example of fluid regimen (speed up initial fluids as clinically indicated)**

1 <sup>st</sup> bag	0.9% sodium chloride	1000mL over 1 hour
2 <sup>nd</sup> bag	Sodium chloride 1L with 40mmol potassium chloride	1000mL over next 2 hours
3 <sup>rd</sup> bag	Sodium chloride 1L with 40mmol potassium chloride	1000mL over next 4 hours
4 <sup>th</sup> bag	Sodium chloride 1L with 40mmol potassium chloride	1000mL over next 4 hours
5 <sup>th</sup> bag	Sodium chloride 1L with 40mmol potassium chloride	1000mL over next 6 hours

## INTRAVENOUS POTASSIUM MANAGEMENT

- Initial potassium is often high, particularly if patient has renal impairment
- Caution needs to be taken if urine output is less than 0.5mL/kg/hr
- Insulin and fluid replacement often cause an acute drop in potassium, particularly within the first 1 to 2 hours

\*\*Rate of potassium infusion through peripheral lines must be no more than 20mmol potassium chloride per hour in HHS. The **patient must be on a cardiac monitor if receiving > 10mmol/hr potassium chloride, or if serum potassium is >5.5mmol/L or <3.0mmol/L**)

**Table 2: Medical action according the patient's potassium level**

Parameters	Action
Potassium > 5.5 mmol/L	Nil replacement required
Potassium 3.5 to 5.5 mmol/L	20mmol to 40 mmol potassium (premixed bags only) **Maximum rate 20mmol/hr with cardiac monitoring
Potassium < 3.5 mmol/L	<b>Senior medical review required immediately</b>

## INSULIN MANAGEMENT

Only start low dose IV insulin 0.05 units/kg/hour (e.g. 80kg = 4 units/hr) if:

- Significant ketonaemia - bedside blood (capillary) ketones >1 mmol/L  
OR
- Blood glucose level falling at a rate of less than 5 mmol/hr despite adequate fluid replacement
  - Add 50 units of Actrapid® to 50mL of sodium chloride 0.9%
  - Once commenced, if blood glucose is falling at a rate less than 5mmol/L per hour with adequate fluid balance, increase the insulin rate to 0.1 units/kg/hr
  - Beware of hypoglycaemia
  - Aim to keep blood glucose at 10 to 15 mmol/L in the first 24 hours
  - Once blood glucose falls below 14 mmol/L, commence 10% glucose at 125mL/hr **and continue sodium chloride 0.9% solution as clinically indicated**
  - **Patients must always continue their usual long-acting basal insulin at the usual dose**

## MONITORING

Check every hour for the first 6 hours, then 2 hourly if satisfactory response to interventions:

- Repeat plasma sodium, potassium, urea and blood glucose testing
- Calculate serum osmolality [2(sodium)+glucose+urea] and plot on the osmolality graph on MR 838 (see Figure 1 for image)



## ACKNOWLEDGMENTS

FSH Adult Hyperosmolar Hyperglycaemic State FSH-END-GUI-0003

## KEY RELATED DOCUMENTS

- Intravenous Therapy. SCGH Nursing Practice Guideline 4. Updated August 2016.
- Medication Management. SCGH Nursing Practice Guideline 51. Updated June 2018.
- Medicines Management. SCGH Hospital Policy 141. September 2017.
- Adult Diabetic Ketoacidosis (DKA) Guidelines and Management Record (MR 836), SCGH
- Adult Variable Rate Intravenous Insulin Guideline and Management Record MR826 SCGH
- Adult Hyperosmolar Hyperglycaemic State Guideline and Management Record (MR 383), SCGH
- SGLT2 inhibitors (gliflozins) and euglycaemic ketoacidosis guideline (draft)

## KEY LEGISLATION, ACTS &

- Medicines and Poisons Act 2014, Medicines and Poisons Regulations 2016, Health Services Act 2016
- MP 0077/18 Statewide Medicines Formulary January 2018
- OD 0647/16 WA National Standard for User-Applied Labelling of Injectable Medicines, Fluids and Lines, October 2016
- OD 0561/14 WA High Risk Medication Policy, September 2014
- Australian Commission on Safety and Quality in Healthcare. National terminology, abbreviations and symbols to be used in the prescribing and administering of medicines in Australian hospitals. 2008.
- OD 0385/12. National Recommendations for User-Applied labelling of Injectable Medicines, Fluids and Lines. Issued 2012.

## STANDARDS

NSQHS Standard:



## MONITORING

Evaluation, audit and feedback processes will be reviewed to monitor outcomes.

- Use Clinical Incident Management Systems to review trends and investigate incidents as required

## REFERENCES

1. Garrison, E et al (2014). Inpatient management of women with gestational and pregestational diabetes in pregnancy- review and expert opinion. *Curr Diab Rep* 14:457.
2. Savage, MW et al (2010). The Management of Diabetic Ketoacidosis in Adults. London, Joint British Diabetes Societies Inpatient Care Group. Retrieved from: <https://www.diabetes.org.uk/Documents/About%20Us/Our%20views/Care%20recs/Joint%20British%20Diabetes%20Societies%20Inpatient%20Care%20Group%20-%20The%20Management%20of%20Diabetic%20Ketoacidosis%20in%20Adults%20-%20Guidelines.pdf>
3. The King Edward Memorial Hospital DKA in pregnancy clinical guideline.
4. The Royal Women's Hospital - Melbourne DKA in pregnancy clinical guideline.

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<b>Date first Issued</b>	//	<b>Last Reviewed</b>		<b>Review Date</b>	dd/mm/yyyy	<b>Version</b>	1
<b>Endorsed by:</b>	Drug and Therapeutics Committee Nursing Practice Guidelines Committee Medication Safety Committee?				<b>Date:</b>	DD/MM/YYYY DD/MM/YYYY DD/MM/YYYY	

## APPENDICES

## Appendix 1: Adult HHS Management Record

SIR CHARLES GAIRDNER OSBORNE PARK HEALTH CARE GROUP <b>ADULT HYPEROSMOLAR HYPERGLYCAEMIC STATE (HHS - FORMERLY KNOWN AS HONK) GUIDELINES AND MANAGEMENT RECORD</b> WARD _____ DOCTOR _____	SURNAME	UMRN											
	GIVEN NAMES	DOB	GENDER										
	ADDRESS	POSTCODE											
		TELEPHONE											
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<b>ENTRY CRITERIA:</b> (Tick boxes if criteria present, if none re-consider diagnosis). Does patient have characteristic features of- Hypovolaemia <input type="checkbox"/> Marked Hyperglycaemia (>30 mmol/L) <input type="checkbox"/> Increased serum/plasma osmolality (>320 mosmol/kg) [2(Sodium)+glucose+urea in mmol] <input type="checkbox"/>													
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<b>ESSENTIAL INITIAL RESULTS AND ASSESSMENT OF SEVERITY</b> Blood (capillary) ketones _____ mmol/L      Blood glucose _____ mmol/L Venous bicarbonate _____ mmol/L      Venous (or arterial) pH _____ Potassium _____ mmol/L Beware Initial low potassium, if level <3.5 mmol/L call for senior medical advice immediately Serum Osmolality _____ mosmol/kg      Creatinine _____ µmol/L Systolic Blood pressure _____ mmHg      GCS (Glasgow Coma Scale) _____													

MR 838 ADULT HYPEROSMOLAR HYPERGLYCAEMIC STATE GUIDELINES AND MANAGEMENT RECORD