IAEM Clinical Guideline

Management of Hyperosmolar Hyperglycaemic State in Adults

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Revision History

Date	Version	Section	Summary of changes	Author
March 2026	1.0	All	Final version	EMC, DD, LOS, CP

CONTENTS

GLOSSARY OF TERMS

ANP	Advanced Nurse Practitioner
BSL	Blood Sugar Level
DKA	Diabetic Ketoacidosis
ED	Emergency Department
HDU	High Dependency Unit
HHS	Hyperosmolar Hyperglycaemic State
ICU	Intensive Care Unit
SBP	Systolic Blood Pressure
T1DM / T2DM	Type 1 Diabetes Mellitus / Type 2 Diabetes Mellitus
VBG	Venous Blood Gas

PARAMETERS

Target audience:	All medical and nursing staff working in an Emergency Department (ED) who are involved in the assessment and care of patients over 16 years-old presenting with hyperosmolar hyperglycaemic state (HHS).
Patient population:	Patients aged over 16 years presenting with HHS as per the criteria outlined in this document.
Exclusion criteria	Paediatric patients under 16 years and pregnant patients.

AIMS

The aim of this guideline is to provide medical and nursing staff working in an ED with a structured approach to diagnose and manage an adult patient presenting with HHS.

Management of Hyperosmolar Hyperglycaemic State in Adults

INTRODUCTION

Hyperosmolar hyperglycaemic state is a medical emergency that affects patients with type 2 diabetes mellitus. While it occurs less frequently than other hyperglycaemic emergencies, it is associated with a mortality rate ten times greater than DKA.[1] The majority of HHS cases occur in patients over the age of 45 years and patients often have multiple co-morbidities. HHS patients are also very prothrombotic which leads to high rates of complications and higher mortality rates.[2]

The most common cause of HHS is infection, followed by non-compliance with medications, pancreatitis, physiological stress (surgery/trauma) and medications such as steroids and atypical antipsychotics.[3,4]

HHS most commonly presents with an altered mental state or delirium but can also present with polyuria, polydipsia, vomiting and weakness.[5,6] HHS can be difficult to identify as it can present with non-specific symptoms or symptoms that mimic other medical conditions. Emergency clinicians must have a high index of suspicion to diagnose the condition in a timely manner.

For a patient to be diagnosed with HHS they must meet the **following criteria[7];**

1. Blood glucose >30mmol/L
2. Serum osmolality >320milliosmoles where serum osmolality is calculated by:

   [2 x (Na + K)] + glucose + urea
3. Normal pH, normal bicarbonate, and ketones □ 3mmol/L

The main goal of treatment in HHS is to restore the circulating volume. HHS usually develops over days to weeks[2], as such the fluid losses are much greater than other diabetic

emergencies. Typical fluid loss in HHS is 100-220ml/kg, this can be up to 15L in a 70kg patient so fluid replacement should begin as soon as the diagnosis of HHS is made.

The management of HHS in the ED is outlined in the algorithm shown on pages 8 and 9 and in the sample prescription charts shown in the Appendices.[8]

INVESTIGATIONS

Investigations should be aimed at

i) Diagnosing HHS

ii) Identifying the underlying cause of the HHS.

A VBG will give values for blood glucose, sodium, potassium, pH and bicarbonate and should be run immediately for any patient who is suspected to have HHS. Ketones can be obtained by a capillary blood sample or using a urine dip stick.

Common causes of HHS can be ruled in or out using the following tests:

1. FBC and CRP: raised white blood cells and CRP can be used to assist diagnosis of infection.
2. Electrocardiogram (ECG): myocardial infarction is a recognised precipitant for HHS. These can often be “silent” in patients with diabetes.
3. Amylase: this can used to identify pancreatitis as a cause of HHS
4. Urine dip stick: will identify a urinary tract infection
5. Chest x-ray: can be used to diagnose pneumonia as a trigger for HHS

A renal profile should be sent on all patients for a serum potassium, sodium, and urea reading.

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Management of Adult Hyperosmolar Hyperglycaemic State (HHS)

Time 0 to 60 minutes[4,7,8]

HHS Diagnosis

- Blood glucose >30mmol/L ☐
- Serum osmolality >320milliosmoles where serum osmolality is calculated by: ☐
  [2 x (Na + K)] + glucose + urea
- Normal pH, bicarbonate and ketones ≤ 3 ☐

Initial Management- Time 0-60 minutes

- ABC assessment
  - Ensure the patient is protecting their airway (HHS may present with a reduced GCS)
  - Apply oxygen to maintain saturations between 94-98%
  - Gain large bore IV access (18G or larger)
- Call for senior help and establish continuous cardiac monitoring
- Check vital signs every 30 minutes or every 15 minutes if the patient is hypotensive or has a reduced GCS.
- Begin IV fluid replacement with 0.9% saline (See Box 1 for details)
- Send blood for venous blood gas (VBG), serum ketones, FBC, U&E, CRP, blood cultures. Consider troponin, LFTs and amylase depending on history.
- Request ECG, CXR, MSU.
- Commence IV insulin as per protocol (see box 3 for details). Do not omit the patient's long-acting insulin.
- Full history and examination and consider precipitating factors (infection/sepsis, non-compliance with insulin, pancreatitis, MI, physiological stress)
- Consider the need for HDU/ICU care (see box 2)

Box 1: Initial Fluid Replacement

- Give 1000ml 0.9% saline over the first 60 minutes. Repeat if SBP remains <90mmHg and call for senior/ICU input
- When SBP is >90mmHg consider more rapid replacement
- Be cautious in patients with heart or renal failure

Box 2: Severe HHS- consider escalation to ICU/ HDU if one of the following is present

- Serum osmolality >350mOsm/kg
- Sodium >160 mmol/L
- pH <7.1
- Potassium <3.5 or > 6 mmol/L on admission
- GCS <12
- O2 saturations <92% RA
- SBP <90mmHg
- Pulse >100 or <60
  Urine output < 0.5ml/kg/hr
- AKI or serum creatinine > 200mmol/L
- Hypothermia
- MI/ CVA/ other severe comorbidity

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Adult Hyperosmolar Hyperglycaemic State (HHS) Management

60 minutes to 6 hours[4,7,8]

Aims:

- Replacement of all fluid loss by 24 hours
- Urine output >0.5ml/kg/hr
- Reduction in serum osmolality of 3-8 mOsm/kg/hr
- Maintain blood glucose between 10-15mmol/L in the first 24 hours (max 5mmol/hr decrease)
- Avoid hypokalaemia
- Prevent complications (Fluid over load, osmotic demyelination, thrombosis, pressure sores)

Monitoring

- Hourly serum osmolality for the first 6 hours
- Hourly blood glucose for the first 6 hours
- Hourly potassium and sodium for the first 6 hours
- Accurate fluid balance chart
- Consider urinary catheter if incontinent or anuric at 60 minutes

Continuous Fluid Replacement

- Give 500-1000ml/hr 0.9% saline (depending on severity of dehydration)
- Aim to achieve a positive balance of 2-3L at 6 hours
- If serum osmolality is falling at a rate of >8 mOsm/kg/hr reduce the rate of 0.9% saline infusion
- If serum osmolality is falling at a rate of <3 mOsm/kg/hr increase the rate of 0.9% saline infusion

Box 3: IV Insulin Infusion – 50 units Actrapid in 49.5mls 0.9% saline

- **Only** start an insulin infusion when the there is a positive fluid balance AND the blood glucose has plateaued (measure on two subsequent occasions) OR serum ketones >1.0mmol/L
- The insulin infusion should be started at a rate of 0.05units/kg/hr
- Where the serum ketones are >3 mmol/L use the insulin infusion as per the DKA protocol
- If blood glucose falls below 14 mmol/L add 10% dextrose at a rate of 125ml/hr

Additional Considerations

- HHS is a prothrombotic state. Patients should receive prophylactic low molecular weight heparin
- Foot and pressure area protection
- Switch to subcutaneous insulin once the patient is eating and drinking normally. Stop the IV insulin infusion 30 minutes after subcutaneous insulin given.

Potassium Replacement

- Potassium <3.5 mmol/L replace with 40mmol and senior review
- Potassium 3.5 - 5.0 mmol/L replace with 40mmol
- Potassium >5.5 do not replace

SPECIAL CONSIDERATIONS

Elderly / Multimorbid Patients

Special consideration should be taken when fluid resuscitating elderly or multimorbid patients. Senior or specialist advice should be sought in the case of patients who are elderly, have chronic kidney disease, are on dialysis or have heart failure.

Pregnant Patients

Specialist input should be sought early for any pregnant patient presenting with HHS. These patients are outside the scope of this guideline.

Appendix 1: Sample HHS Insulin infusion Prescription Chart

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Adult Hyperosmolar Hyperglycaemic State (HHS) Insulin Prescription[7,8]

Fixed Rate Insulin

For HHS until blood glucose <14mmol/L (50 units Actrapid in 49.5mls of 0.9% saline)						weight _____kg	
	(0.05unit/kg/hr)	Adjusted Rates					
DATE & TIME							
RATE	unit/hr	unit/hr	unit/hr	unit/hr	unit/hr	unit/hr	unit/hr
PRESCRIBED BY							
IMC NUMBER							
GIVEN BY							
CHECKED BY							

Variable Rate Insulin

For HHS if patient is not eating (50 units Actrapid in 49.5mls of 0.9% saline)				
Blood Glucose	Insulin rates (unit/hr)	Insulin rates (unit/hr)	Insulin rates (unit/hr)	Insulin rates (unit/hr)
<4	Stop insulin, treat hypoglycaemia and check blood glucose in 30 minutes			
4.1- 7.0	1			
7.1 - 10.0	2			
10.1 - 12.0	3			
12.1- 14.0	4			
>14.	6			
Prescribed by				
IMC number				

Regular Long Acting Subcutaneous Insulin

DATE & TIME				
NAME OF INSULIN				
MORNING DOSE	units	units	units	units
EVENING DOSE	units	units	units	units
PUMP RATE	units/hr	units/hr	units/hr	units/hr
PRESCRIBED BY				
IMC NUMBER				

Appendix 2: Sample Continuous IV Insulin Prescription and electrolyte monitoring chart

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Adult Hyperosmolar Hyperglycaemic State (HHS) Insulin Infusion & Electrolyte Monitoring[7,8]

Insulin Infusion And Monitoring

Date	Time	Blood Glucose	Serum Ketones	Insulin Infusion Rate	Signature & IMC Number		pH	K^+	HCO^3	Na^+

Appendix 3: Sample IV Fluid Prescription Chart

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Adult Hyperosmolar Hyperglycaemic State (HHS) IV Fluid Prescription[7,8]

IV Fluid and Potassium Replacement

Date	Fluid Type & Additives	Rate	Signature & IMC Number		Start & Finish Times		Signature & NMBI Number	

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