

Provincial Clinical Knowledge Topic Diabetic Ketoacidosis, Adult – Inpatient V 1.0

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Revision History

Version	Date of Revision	Description of Revision	Revised By
1.0	March 26, 2018	Completion of Topic	Fraulein Morales, Saifal Anwar

Important Information Before You Begin

The recommendations contained in this knowledge topic have been provincially adjudicated and are based on best practice and available evidence. Clinicians applying these recommendations should, in consultation with the patient, use independent medical judgment in the context of individual clinical circumstances to direct care. This knowledge topic will be reviewed periodically and updated as best practice evidence and practice change.

The information in this topic strives to adhere to Institute for Safe Medication Practices (ISMP) safety standards and align with Quality and Safety initiatives and accreditation requirements such as the Required Organizational Practices. Some examples of these initiatives or groups are: Health Quality Council Alberta (HQCA), Choosing Wisely campaign, Safer Healthcare Now campaign etc.

Guidelines

This Topic is based on the following guidance:

- [Diabetes Canada Clinical Practice Guidelines](#) on Diabetic Ketoacidosis (DKA)

Keywords

- Diabetic Ketoacidosis (DKA)
- Hyperosmolar hyperglycemic State (HHS)
- Hyperglycemia

Diabetic Ketoacidosis, Adult - Inpatient Order Set

Order Set Restrictions: Excludes pregnant population

Order Set Keywords: Diabetic Ketoacidosis (DKA), Hyperosmolar hyperglycemic State (HHS), and Hyperglycemia

Admit, Discharge

- Admit to Service _____ under care of Dr _____
- Anticipated Date of Discharge _____

Diet

- NPO
- Diabetic Diet
- Other: _____

Patient Care

Activity

- Activity as Tolerated
- Fall Prevention Risk Assessment

Vital Signs

- Vital Signs every 30 minutes x 2; then every hour x 4; then every 2 hours x 24 hours; and then Authorized Prescriber to reassess
- Vital Signs every _____ hour(s)
- Orthostatic vitals every _____ hour(s)

Intake and Output

- Intake and Output every 8 hours, continue until intravenous therapy discontinued
- Intake and Output every _____ hour(s)

Consider Foley catheter insertion if clinically indicated

- Foley Catheter- Insert
- Foley Catheter- Reassess daily

Monitor

Consider if severe hyper/hypokalemia with ECG changes, suspected acute coronary syndrome as precipitating cause or as per physician discretion

- Bedside Cardiac Monitoring

Point of Care Testing

POCT glucose, i.e. capillary blood glucose, may be inaccurate if a patient is critically ill. Use non-POCT, non-capillary glucose to assess accuracy prior to reliance on POCT glucose. See POCT glucose procedure for details and other potential interferences.

- Blood Glucose Monitoring – POCT every 1 hour while on IV insulin infusion or until anion gaps is normalized

- Blood Glucose Monitoring – POCT every _____ hour

Respiratory Care

- O2 Therapy – Titrate to Saturation to maintain SpO2 between 92-96%
- O2 Therapy – Titrate to Saturation to maintain SpO2 between 88-92%
- Notify Authorized Prescriber if oxygen requirement increase by greater than 2L

Laboratory Investigations

Hematology

- Complete Blood Count (CBC) with differential

Chemistry

- Electrolytes (Na, K, Cl, CO2)
- Creatinine
- Glucose Random
- Beta-Hydroxybutyrate
- Serum Osmolality
- Lactate
- Calcium (Ca)
- Albumin
- Magnesium (Mg)
- Phosphate
- Lipase
- Beta HCG
- Troponin
- CK
- Hemoglobin A1C

Blood Gases

- Arterial Blood Gas

Urine Tests

- Urine Osmolality Random
- Urinalysis Random
- Urine Bacterial Culture

Therapeutic Drug Monitoring and Toxicology - *If clinically indicated*

- Acetaminophen
- Ethanol (Blood Alcohol)
- Ethylene Glycol
- Isopropanol
- Methanol
- Salicylate

Repeating Labs

- Electrolytes (Na, K, Cl, CO₂) and serum osmolality every 2 hours x 4; then every 4 hours until anion gap has normalized
- Venous Blood Gas every 2 hours x 4, then every 4 hours until anion gap and HCO₃ have normalized
- Complete Blood Count (CBC) with differential daily

Others

- Blood Cultures
- Other: _____

Diagnostic Investigations - Order imaging studies if there is clinical concern for a precipitating cause of DKA

- Chest X-ray 2: PA & Lateral (GR Chest, 2 Projections)
- Electrocardiogram - 12 lead
- Other: _____

Intravenous Therapy

- Intravenous Cannula – Insert: Initiate IV

Intravenous Fluid Replacement – Initial Resuscitation

Severe Dehydration/Hypovolemic Shock

- IV Bolus: 0.9% NaCl infusion IV 1000 mL over 1 hour
- IV Bolus: 0.9% NaCl infusion IV 2000 mL over 1 hour

Mild or Moderate Dehydration

- IV Bolus: 0.9% NaCl infusion IV 500 mL over 1 hour for _____ hours and then at 250 mL/hour for _____ hours

Intravenous Fluids Replacement Once Euvolemic – Potassium Added

If plasma corrected Sodium (Corrected plasma [Na⁺] = Measured [Na⁺] + [3/10 × ([Glucose (mmol/L)] – 5)] is more than 135 and if plasma osmolality is falling less than 3 mmol/kg/hour; choose the following intravenous solution.

For potassium chloride supplementation – see [Potassium Replacement orders](#) below

Reassess fluid rate and type every 2 hours depending on hydration status, serum sodium and serum osmolality.

- 0.45% NaCl infusion IV (add potassium chloride supplementation as per potassium replacement orders) at 250 mL/hour ; reassess fluids every 2 hour
- IV Fluid (other): _____ infusion IV (add potassium chloride supplementation as per potassium replacement orders) at _____ mL/hour

Medications

Potassium Replacement

Adjust potassium chloride supplementation based on most recent electrolyte results

If Serum potassium is less than 3.3 mmol/L:

- HOLD insulin infusion until serum potassium is GREATER than 3.3 mmol/L

Must choose ONE below:

- Choose IV solution with potassium chloride 40 mmol/L (maximum rate is 10 mmol/hour in peripheral line)
- potassium chloride 10 mmol in sterile water 100 mL IV over 1 hour ; give 3 doses
- potassium chloride (liquid) _____ mmol PO every _____ hour(s) for _____ day(s)
- potassium chloride (1500 mg tab = 20 mmol) _____ mmol PO every _____ hour(s) for _____ day(s)

If Serum potassium is 3.3 – 5.5 mmol/L:

- Choose IV solution with potassium chloride 20 mmol/L
- Choose IV solution with potassium chloride 40 mmol/L (maximum rate is 10mmol/hour in peripheral line)

If Serum potassium is greater than 5.5 mmol/L OR if urine output is less than 30 mL/hour:

- HOLD potassium chloride in IV solution

Sodium Bicarbonate

Consider ONLY if blood pH is less than 7.0 on Arterial Blood Gas or Venous Blood Gas despite fluid resuscitation and potassium replacement.

- sodium bicarbonate 50 mmol in 50 mL D5W IV once, infuse over 1 hour

Reassess need for repeat infusion

- Repeat arterial blood gas or venous blood gas 1 hour after IV sodium bicarbonate

Magnesium

If clinically indicated, infuse over 2 or 4 hours

- magnesium sulphate 2 g in 100 mL 0.9% NaCl IV once, infuse over 2 hours
- magnesium sulphate 4 g in 200 mL 0.9% NaCl IV once, infuse over 4 hours

Phosphate

Not recommended unless serum phosphate concentration below 0.32 mmol/L, cardiac dysfunction, anemia, or respiratory depression. If needed use:

- Sodium phosphate (15 mmol phosphate, 20 mmol sodium) in D5W 100 mL over 4 hours x 1 dose

Insulin Therapy Infusion

- HOLD insulin infusion if serum potassium is less than 3.3 mmol/L (*Immediate potassium chloride correction required*)
- Initiate insulin as soon as serum potassium is more than 3.3 mmol/L, and repeat electrolytes every 2 - 4 hours

- Notify Authorized Prescriber if blood glucose is less than 7 mmol/L at anytime

For patients on Sodium-glucose co-transporter 2 (SGLT2) inhibitors SGLT2 and in DKA

For patients on SGLT2 inhibitors with Blood Glucose less than 14 mmol/L refer to – [Ongoing Insulin Management – Start once blood glucose is LESS THAN 14 mmol/L for 2 consecutive readings](#) AND refer to [Intravenous Fluid Replacement Orders \(Glucose less than 14 mmol/L\)](#)

For patients on SGLT2 inhibitors with Blood Glucose equal to or greater than 14 mmol/L refer to - [Initial Insulin Management – When blood glucose is EQUAL to or GREATER than 14 mmol/L](#)

- Hold SGLT2 (complete medication name, dose, route, frequency):
-

Initial Insulin Management – When blood glucose is EQUAL to or GREATER than 14 mmol/L

When glucose is less than 14 mmol/L for 2 consecutive readings, proceed to order section [Ongoing Management](#) for fluid, electrolytes and insulin replacement orders.

- Regular insulin (HumuLIN ®R) at _____ units/hour IV infusion (mix 100 units of Humulin R in 100 mL D5W) **and** adjust based on every 1 hour capillary blood glucose results as follows:
 - If glucose decreases by 1 to 4 mmol/L, continue current insulin IV rate
 - If glucose fail to decrease on 2 consecutive readings, double insulin IV rate
 - If glucose decreases by more than 4 mmol/L, reduce insulin IV rate by half

Ongoing Insulin Management – Start once blood glucose is LESS THAN 14 mmol/L for 2 consecutive readings

The goals are to maintain glucose between 12-14 mmol/L until acidosis is reversed (when CO₂ is or HCO₃ are normalized and to continue insulin infusion until acidosis is resolved.

Intravenous Fluid Replacement Orders (Glucose less than 14 mmol/L)

If plasma corrected Sodium (Corrected plasma [Na⁺] = Measured [Na⁺] + [3/10 × ([Glucose (mmol/L)] – 5)]) is more than 135 and if plasma osmolality is falling less than 3 mmol/kg/hour; choose the following intravenous solution

- D5W – 0.45% NaCl infusion (add potassium chloride supplementation as per potassium replacement orders)
- D5W – 0.9% NaCl at _____ mL/hour (add potassium chloride supplementation as per potassium replacement orders)

Insulin Infusion (Glucose less than 14 mmol/L)

- Decrease current insulin infusion rate by 50%, then adjust to maintain glucose at 12-14 mmol/L based on hourly glucose monitoring:

Glucose (mmol/L)	Insulin Adjustment
Less than 7 (any time)	Hold Insulin infusion and Contact Authorized Prescriber
7 - 9.9	Decrease rate by 1 unit/hour
10 - 11.9	Decrease rate by 0.5 units/hour
12 - 14	Maintain current rate
14.1 - 16	Increase rate by 1 unit/hour
Greater than 16	Increase rate by 2 units/hour

- Contact Authorized Prescriber to change insulin order or IV fluid orders if:
 - Glucose is out of range (12-14 mmol/L) for 2 consecutive readings
 - Subcutaneous Insulin should be started once acidosis is resolved (pH greater than 7.3, normalized anion gap and CO₂, or HCO₃) and when patient is tolerating oral diet (subcutaneous insulin to be initiated)

Subcutaneous Insulin Orders

Start basal insulin (long acting) two hours prior to stopping IV insulin infusion

- Continue IV insulin infusion for 2 hours post subcutaneous basal insulin **and then** discontinue IV insulin
- Continue home insulin (type/dose) _____
- [Basal Bolus Insulin Therapy \(BBIT\) Order Set](#)
- [In-Hospital Orders for Self-Management of Insulin Pump Order Set](#)
- Other(s) _____

Transitions and Referrals

- Consult Dietitian
- Consult Social Worker
- Consult/Referral to Diabetic Education Program/Health Care Team (resources as applicable)
- Other: _____

Analytics

Baseline Analytics – Measure #1 Order Set Usage

Name of Measure	Number of times order set Diabetic Ketoacidosis, Adult - Inpatient Order Set used
Definition	Number of times order set Diabetic Ketoacidosis, Adult - Inpatient is used. Overall, by zone, by sites, by domain (ED, Inpatient, etc.), and by units. Will be required on an ongoing basis with the ability to filter by location, time period, domain, etc.
Rationale	Intended to measure how often the order set cited in the knowledge topic is being used, in what domain, and be for different lengths of time. May indicate areas with adoption issues or gaps in topic
Rationale	It is important to see how often the protocol is being used to determine if it improve outcome and reduce health care cost, and also to standardize care across the province
Cited References	Diabetes Canada Clinical Practice Guidelines on DKA American Diabetes Association guidelines

Analytics – Outcome Measure #2

Name of Measure	Compliance to clinical standards of CKT ie. Scoring tools, specific items/orders in the order set
Definition	The elements of the CKT for which it is important to measure compliance against specific items/orders in the order set are: <ul style="list-style-type: none"> • Compliance to fluid resuscitation, electrolyte replacement, initial insulin infusion rat, insulin use, hypoglycemia episodes, transition to subcutaneous insulin, time to resolution of DKA, Diabetes education and dietitian referrals • Practice pattern and compliance to the protocol can be measured eg, initial fluid resuscitation, when and how rapidly potassium is being replaced and insulin adjustments •
Rationale	Measure compliance to specified clinical standards within the CKT To determine rate of compliance to Diabetes Canada Clinical Practice Guidelines regarding diabetic ketoacidosis management
Cited References	Diabetes Canada Clinical Practice Guidelines on DKA American Diabetes Association guidelines

Analytics – Outcome Measure #3

Name of Measure	Assessment of DKA treatment patterns and length of stay
Definition	Length of stay and incidence of re hospitalization with DKA post-acute management
Rationale	Severity of DKA will affect length of stay and admission to ward vs I-Care vs ICU The protocol might also help in finding the incidence of causes of DKA, and complications
Cited References	Diabetes Canada Clinical Practice Guidelines on DKA American Diabetes Association guidelines

Relevant Clinical Knowledge Topics

[Basal Bolus Insulin Therapy, Adult – Inpatient \(BBIT\)](#)

[Diabetic Ketoacidosis, Adult – Emergency Department \(DKA, Diabetes, Hyperglycemia, HHS\)](#)

[Insulin Pump Therapy, Pediatric and Adult – Acute Care](#)

Relevant Guidelines, Procedures, Protocols, and Polices

Insulin Pump In-Hospital Therapy – ipumpit.ca

[Basal Bolus Insulin Therapy Website](#)

(Note: BBIT is appropriate if patient requires subcutaneous insulin)

- [How to BBIT: An Educational Resource for Prescribers AHS Adult Subcutaneous Basal Bolus Insulin Therapy \(BBIT\)](#)

[AHS Glycemic Management Policy – Adult](#)

- [Procedure: Treatment of Hypoglycemia - Adult HCS-206-01](#)
- [Procedure: Treatment of Hyperglycemia - Adult HCS-206-02](#)
- [Resource: Glycemic Management Policy Suite FAQ](#)

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Name	Title	Zone
<i>Knowledge Lead</i>		
Eliana Castillo	Physician	Provincial
Evan Minty	Physician	Provincial
Heidi Choi	Physician	Provincial
Benjamin Sugars	Physician	Provincial
<i>Topic Lead</i>		
Fraulein Morales	Physician	Edmonton
Saifal Anwar	Physician (GIM Fellow)	Edmonton
<i>Working Group Members</i>		
Lorelei Domaschuk	Area Manager Chronic Disease Management	Central Zone
Alison Mackay	Physician	South Zone
Shannon Ruzycki	Physician (GIM Fellow)	Calgary Zone
Michel Sauve	Physician	North Zone
<i>Clinical Support Services</i>		
Rhonda Roedler	Pharmacy Information Management Governance Committee (PIM-GC) <i>on behalf of</i> Pharmacy Services	Provincial
James Wesenberg	<i>on behalf of</i> Laboratory Services - Provincial Networks	Provincial
Bernice Lau	<i>on behalf of</i> Diagnostic Imaging Services	Provincial
Carlota Basualdo-Hammond & Marlis Atkins	<i>on behalf of</i> Nutrition & Food Services	Provincial
<i>Clinical Informatics Lead</i>		
Leng My	Registered Nurse	Provincial

Additional Contributors

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