



DAYTON CHILDREN'S HOSPITAL
CLINICAL PRACTICE GUIDELINES

DISCLAIMER: This Clinical Practice Guideline (CPG) generally describes a recommended course of treatment for patients with the identified health needs. This CPG is not presented and should not be used as a substitute for the advice of a licensed independent practitioner, as individual patients may require different treatments from those specified, and guidelines cannot address the unique needs of each patient. Dayton Children's shall not be liable for direct, indirect, special, incidental or consequential damages related to the use of this CPG.

Diabetic Ketoacidosis Clinical Practice Guideline

ED care = Red

2. Risks for DKA include:
- Known diabetic
 - Illness
 - High blood sugar
 - Noncompliance
 - Insulin pump problem
 - Poor blood sugar control by history

Document:

- Respiratory status (Kussmaul breathing)
- Cardiovascular status (BP, perfusion)
- Hydration status
- Mental status
- Polyuria, polydipsia and polyphagia
- Weight loss
- Look closely for sources of infection
- Patient on insulin pump (status: disconnected or infusing)
- Last insulin dose received prior to DCH arrival

3. Istat CG8 or blood gas/electrolytes, bedside finger stick glucose (FS Glucose) can be done without physician order per triage protocol.

4. **Patient with diabetes or suspected diabetes with a pH less than 7.30 AND/OR Bicarbonate less than 15 mEq/L with ketones denotes DKA.*** This can occur before or after first hour fluid bolus.

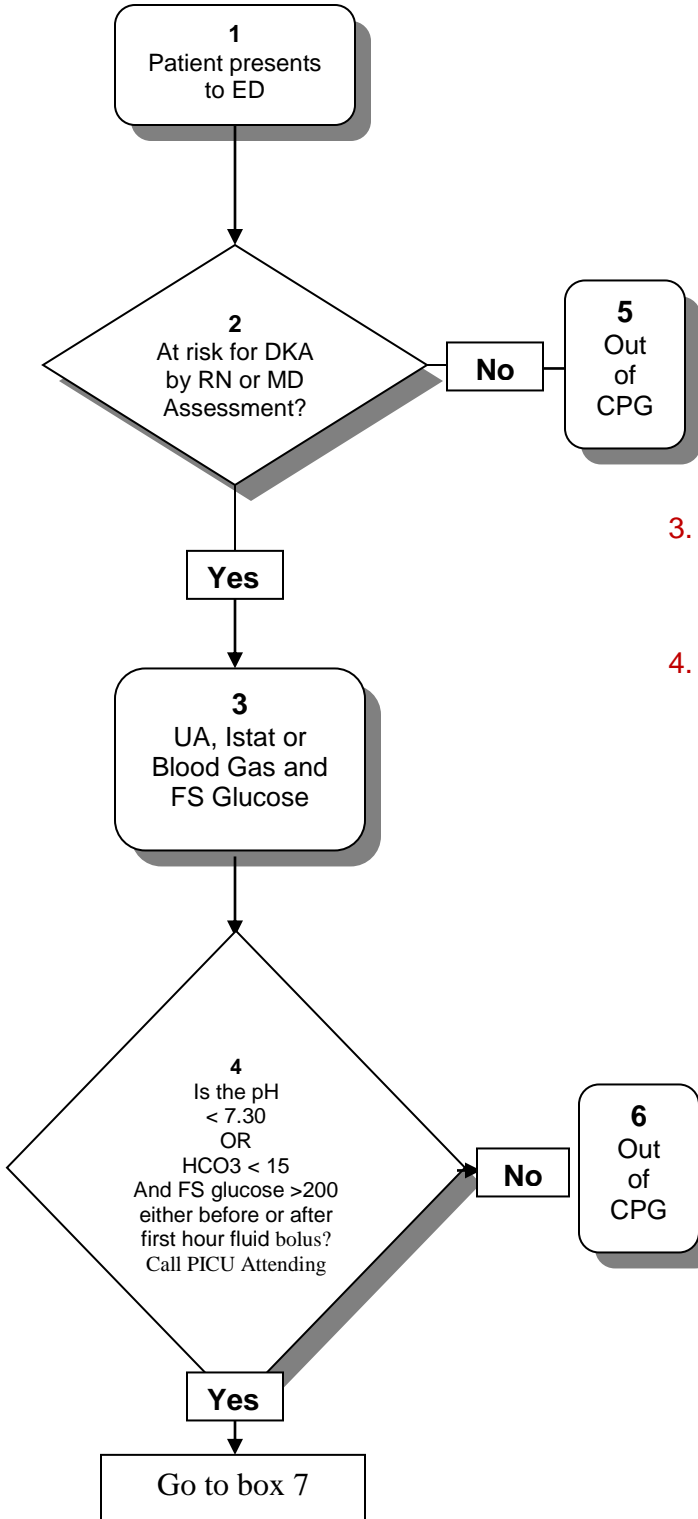
*Patients without prior diagnosis of DM who present with elevated blood sugars (>200), elevated HbA1c and a beta-hydroxybutyrate >3 are to be considered a new onset diabetic with DKA. Known patients with DM may not have an elevated glucose due to treatment before arrival.

***If initial Istat/Blood Gas pH is ≤ 7.25 , Order insulin drip immediately and call PICU.**

*If patient does not meet above criteria consider other causes of hyperglycemia, ketonuria and acidosis.

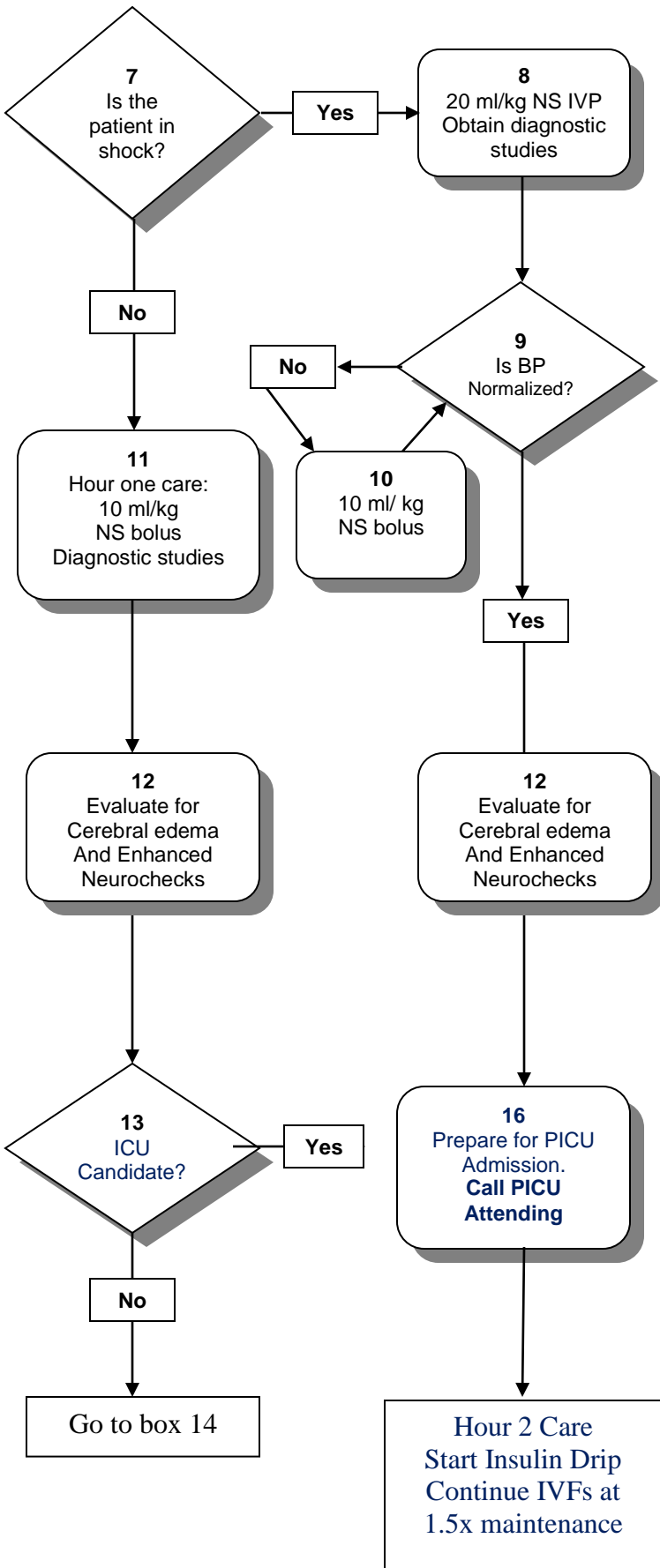
***Think of hyperosmolar hyperglycemia syndrome if patient presents with hyperglycemia (>600 mg/dl), dehydration, altered mentation but is not acidotic. (ie Bicarbonate ≥ 15) and ketones are minimal. Check Serum osm. If Serum osm >320, consider HHS and Contact Intensivist.**

*If patient is in DKA and has an insulin pump requiring an admission, the insulin pump must be stopped.



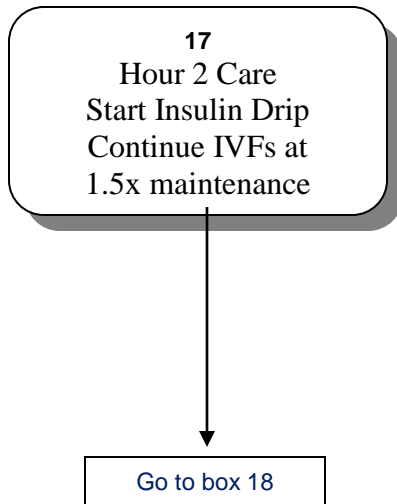
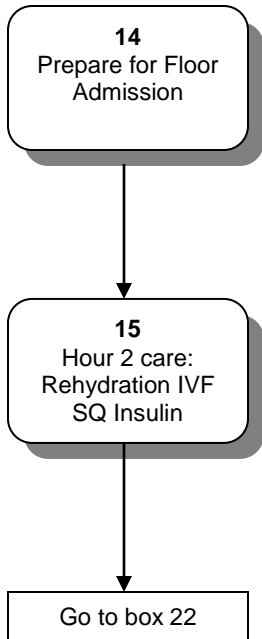
Blood Gas = Venous or Capillary blood gas

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7. Contact Intensivist immediately if:
 - a. Patient is in shock (low BP, decreased perfusion)
 - b. Blood glucose > 1000 mg/dL
 - c. Glasgow coma scale < 8 ; Consider intubation if GCS \leq 5
8. Give 20 mL/Kg bolus of NS IV over 1 hour (1L max) if in shock. Vital signs every 1 hour with neuro checks
Diagnostics studies include:
 - a. Glucose, serum beta-hydroxybutyrate
 - b. Istat, Bun, Cr, Phos, Mg, UA, CBC, HbA1c
 - c. Consider EKG if hyperkalemia >6
 - d. Pregnancy test
 Consider culturing for infection and start IV antibiotics if indicated.
Hour one care starts once IV fluids started.
Repeat Istat or Blood Gas (only if initial pH was 7.26 -7.3)
And bedside glucose at the end of hour one.
9. If after 30-40 mL/Kg of IVF and BP is low, discuss management with Intensivist.
10. Give 10 mL/Kg bolus of NS IV over 1 hour (1L max) if not in shock.
11. Patient is not in shock if: normal BP with acceptable HR & adequate capillary refill.
Obtain diagnostic studies as listed in #8 above.
Hour one care starts once IV fluids started.
Repeat Istat or Blood Gas (only if initial pH was 7.26 -7.3)
And bedside glucose at the end of hour one.
12. Monitor for the development of cerebral edema (Especially in first 4-8 hours of treatment)
Risk factors:
 - a. Severe Dehydration (Elevated BUN/ Creatinine)
 - b. Severe Acidosis (pH <7)
 - c. New Onset DM
 - d. Younger children (< 5 years)
 - e. Treatment with bicarbonate
 - f. Rapid fall in corrected sodium (> 2 meq/L/h)
 - g. **Excessive fluids in first 4 hours(> 40 ml/kg)**
 Early Identification of Cerebral edema:
 Age-inappropriate incontinence, recurrent emesis, persistent headache, fluctuating level of consciousness, abnormal verbal or motor response to pain, cranial nerve deficit, sudden deceleration in Heart Rate by 20 bpm not attributable to improved hydration or sleep, elevated diastolic BP >90.
 Treatment of Cerebral edema:
 - a. Decrease IV fluid rate
 - b. Mannitol (0.25 – 1 gram/Kg) IV push **OR**
 - c. Hypertonic saline (3%) (5-10 ml/kg) IV over 30 minutes.
 - d. Intubation with neuroprotective strategy
 - e. CT scan to rule out other CNS causes of neurological deterioration
13. **PICU criteria includes DKA** and any of the below findings after Hour 1 Care:
 - a. PH \leq 7.25 at anytime in our ED
 - b. Blood glucose > 600 mg/dL
 - c. HCO₃ \leq 14meq/L on initial BMP or Istat
 - d. Age \leq 5 years
 - e. Need to monitor for cerebral edema
 - f. Mental status changes or persistent headaches
 - g. Initial Potassium of < 3.0 mEq/L
 - h. Severely ill clinical appearance
 - i. Vital signs are needed more often than q 2 hours

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14. With known diabetics with mild acidosis may consider admission to floor. Discuss appropriate placement with endocrinologist or hospitalist.

FLOOR criteria includes all of the following:

- a. **pH >7.25 after repeat Istat or Blood Gas at the end of hour one**
- b. $\text{HCO}_3^- > 14$ meq/L on BMP
- c. Age > 5 years
- d. Tolerating po fluids
- e. Clinically improving
- f. Not on insulin drip (patients who are on an insulin drip cannot be admitted to the floor)

15. Hour 2 care for **floor** admission starting in ED:

- a. Note results of Istat or Blood Gas/BMP and bedside glucose done at end of hour one fluid bolus.
- b. IV fluids to be run at a rate of 1.5 times maintenance (maximum of 200 ml/hour) for 48 hours.
- c. Initial IV fluids with **NS**
Hold potassium in IVF:
 - i. Until patient voids & serum K level <6 mEq/L
 - ii. If renal failure suspected
Adjust IV potassium concentration based on serum K.
- d. Occasionally may need IV glucose based on serum glucose level, ability to take po fluids and insulin therapy.
- e. SQ short acting insulin as needed.
- f. Consider repeat BMP and bedside glucose at end of hour 2.
- g. Resident work up, admit orders & to floor by end of hour 2.

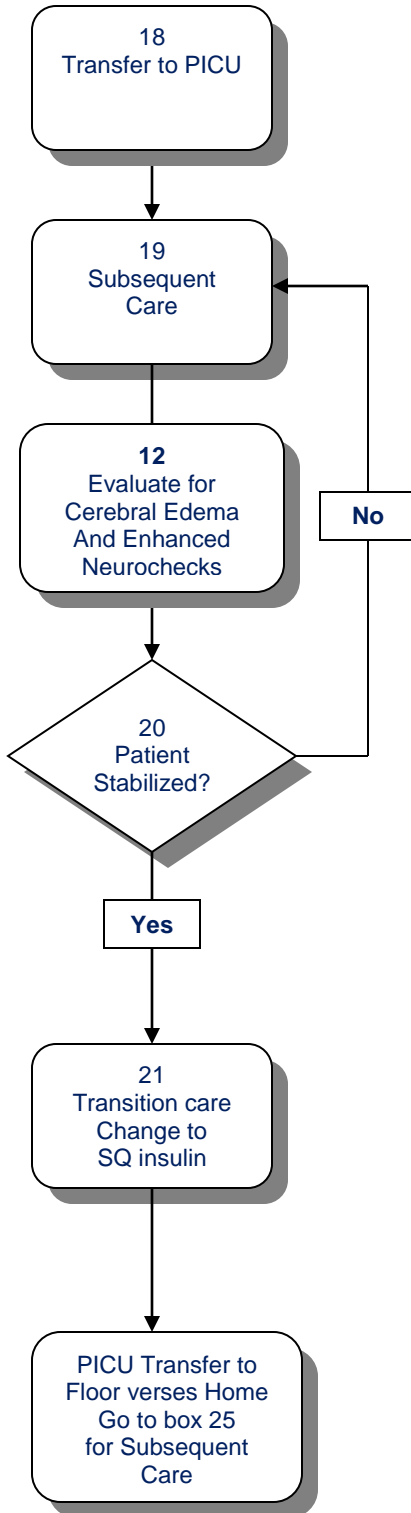
17. Hour 2 care for **PICU** admission starting in ED:

- a. Note results of Istat or Blood Gas/ BMP and bedside glucose done at end of hour one.
- b. Vital signs q 1 hour,
- c. Neurochecks q 1 hour OR q 30 minutes if risk factor identified
- d. IV fluids: For Patients With Suspected Renal Failure or Serum K > 6 mEq/L or no urine output
 1. NS (no potassium)
 2. May change to **D5 NS when serum glucose < 300 and insulin drip running.**
 3. IV fluids to be run at a rate of 1.5 times maintenance (maximum of 200 ml/hour) for 48 hours.

For patients with urine output, without renal failure and K < 6 mEq/L

1. **NS with 20 mEq KCl/L**
2. May change to **D5 NS with 20 mEq KCL/L** for when serum glucose < 300 and insulin drip running.
3. IV fluids to be run at a rate of 1.5 times maintenance (maximum of 200 ml/hour) for 48 hours.
Adjust IV K concentration based on serum K level.
Adjust IVF glucose conc. based on serum glucose levels.
If serum glucose falls over 100 mg/dl per hour notify attending.
- e. Insulin drip: 100 units of Regular insulin in 100 mL NS (1 unit/ mL) to run at 0.1 units / Kg/ hr. **Start at 0.05 units/ Kg/ hr for children < 5 years and new onset diabetics.**
- f. Consider repeat BMP and bedside glucose at end of hour 2.
- g. Admit team work up, admit orders & transfer to PICU by end of hour 2.

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18. Transfer patient to PICU:
Continue hour 2 care if not completed.
 - a. Consult endocrinologist if necessary.
 - b. Notify diabetes educator for new onset DM
 - c. Consult social worker if second DKA admit in one year and/or HbA1c >10%
 - d. Consult psychology if patient has recurrent DKA admissions.
 - e. Vital signs, neurochecks q 1 hr for patients on insulin drip.

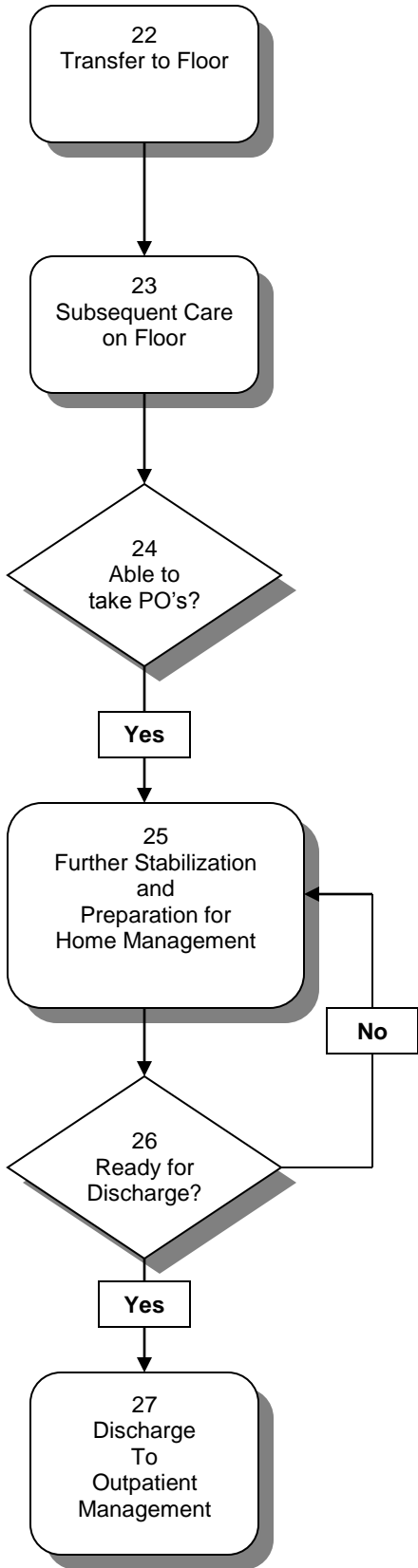
19. Subsequent care in PICU:
Continue appropriate IVF and insulin drip (see PICU order set and 3 bag system).
 - a. If glucose does not fall by 50 mg/dL per hour for 2 consecutive hours, increase insulin infusion for next hour.
 - b. If serum glucose falls over 100 mg/dl per hour add or adjust dextrose as needed **(Target range 150-250 or 200-300 if <5 years old or hyperosmolar)**
 - c. If biochemical parameters of DKA do not improve adjust the insulin drip and/or the glucose load per the intensivist.
 - d. If patient's clinical condition is not improving, also consider causes of insulin resistance (**obesity, metabolic syndrome**) or errors in insulin administration.
 - e. Correct hypokalemia and/or hypophosphatemia by adding appropriate electrolytes to IVFs.
 - f. Monitor Lytes, Ca, Mg, glucose, amylase, lipase, lactic acid and blood gases as needed.
 - g. Start long acting insulin dose (Lantus,Levemir or Tresiba) at bedtime. Use half of the home dose or newly calculated dose.
 - h. **After the initial 4-6 hours of treatment** consider changing the IVFs if hyperchloremic acidosis is a concern.

20. Floor Criteria for transfer out of PICU:
 - a. Clinical evidence of correction of acidosis
normal anion gap (<12) or beta-hydroxybutyrate of <1 mmol/L
(a HCO₃ level of < 18 can be seen due to hyperchloremic acidosis even though the ketoacidosis is resolved)
 - b. K level ≥ 3.0
 - c. Patient is clinically able to tolerate PO fluids.
 - d. Insulin drip no longer helpful or needed

*May be discharged directly from PICU if normal HCO₃, normal beta-hydroxybutyrate, hydration complete, education complete if needed and safe social situation.

21. Transition Care while in PICU:
 - a. Discuss transfer of patient's care with endocrinologist or hospitalist.
 - b. If patient on insulin pump, place new infusion site.
 - c. SQ insulin dose appropriate for patient depending on time of day, persistent acidosis, previous home dose or per pump device.
 - d. Stopping insulin drip 20 minutes after first dose of SQ insulin.
 - e. Appropriate ADA meal for patient depending on age, previous meal plan and ability to take regular or sick day (regular clears) meal.
 - f. Stop dextrose in IV fluids if adequate PO intake. Continue IVF if still dehydrated or ketones persist.
 - g. Follow up laboratory studies and blood sugar monitoring.
 - h. Laboratory studies if new onset diabetes mellitus (may be done on floor):
 - i. Free T4, TSH, ATAGC
 - ii. Islet cell, insulin and GAD antibodies, c-peptide
 - iii. TTGGA, total IGA
 - i. Initiating diabetes education if necessary.

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- 22. Transfer patient to floor from ED:
 - a. Continue hour 2 care if not completed.
 - b. Notify diabetes educator if new onset DM.
 - c. Consult social worker if second DKA admit in one year and/or HbA1c >10%
 - d. Consult psychology if patient has had recurrent DKA admissions.

- 23. Subsequent Care on floor from ED
 - a. Continue appropriate IVF
 - b. FS glucose initially q 2 hr
 - c. SQ fast acting insulin Q 2 – 3 hours as needed
 - d. Vital signs and neurochecks initially q 2 hours, then as determined by patient status.
 - e. Additional labs as needed: Blood Gas, BMP, urine ketones and beta-hydroxybutyrate
 - f. Laboratory studies if new onset diabetes mellitus:
Free T4, TSH, ATAGC
Islet cell, insulin and GAD antibodies, TTGGA, total IGA, c-peptide

- 24. Once vomiting has subsided attempt sips of PO clears or ice chips as prescribed.

- 25. Start or resume home insulin regimen:
 - a. Long acting insulin (Lantus, Levemir, Tresiba) plus fast acting insulin at meals (Novolog, Humalog, Apidra or Admelog) **OR** combination intermediate insulin (NPH) and fast acting insulin **OR** 70/30 insulin.
 - b. Restart Insulin pump on home settings after placing new infusion site
 - c. Give additional insulin doses as indicated for ketone correction or missed long acting insulin.

FS glucose: QAC, QHS, QMN and Q0300 as needed
 Start appropriate ADA diet or home meal plan
 Continue IVF until rehydration complete or urine ketones are negative x2.
 Consider labs: BMP, beta-hydroxybutyrate, urine ketones and others as needed.
 Continue assessment and education by diabetes team.

- 26. Discharge home criteria include:
 - a. Acidosis and any other chemical imbalances are corrected
 - b. Rehydration completed
 - c. Tolerating PO's
 - d. Home insulin dose has been determined
 - e. Diabetic assessment and teaching has been completed
 - f. Social / home situation stable for discharge
 - g. Follow-up arrangements have been made