Liver Transplant INPATIENT Hyperglycemia Protocol

For use in the immediate post-transplant inpatient setting (1 page summary included on Pg.5)

- **All patients placed on regular insulin drip immediately post-OLT**
  - Use EPIC order set: GEN IP INSULIN INFUSION PROTOCOL
  - Discontinue any prior insulin and/or oral hypoglycemic agents

- **Transition off insulin drip**
  - **SICU team will manage glucose during ICU phase of care. The following guidelines have not been adopted by the SICU physicians, but may be a basis for discussion if glucose management strategies differ.**
  - When to transition:
    - If taking PO, or
    - Preparing for transfer to floor, or
    - Low daily insulin drip requirement (< 20 units/day)
    - In SICU greater than 72 hours with stable blood sugars
    - Prescriber discretion
  - How to initiate:
    - All insulin orders should be placed in EPIC within the order set called: BASAL, BOLUS, CORRECTION (BBC) INSULIN ORDERS
    - Extrapolate 24-hour insulin requirement from most recent 8 hours of infusion
    - If extrapolated 24-hour requirement:
      - <20 units: Order Correction insulin only
        - Select type of insulin and frequency of administration based on patients diet
          - NPO, continuous tube feeds: Regular insulin q6h
          - Eating: Humalog ACHS
          - Switch orders whenever diet is transitioned
        - Strength: LOW DOSE CORRECTION
      - ≥20 units: Order Basal (NPH) + Correction insulins
        - BASAL Insulin Orders
          - How to initiate:
            - Type of basal insulin is NPH
            - Amount of NPH to order
              - Total daily bolus dose = 40% of actual 24-hour insulin requirement
            - Administer in divided doses, AM dose > PM dose due to effect of steroids—e.g., 2/3 in the morning

(at breakfast or 0900), 1/3 in the evening (at dinner or 2100)

- How to adjust:
  - Assess blood sugars daily and adjust insulin regimen as necessary to achieve goal FSBG of 100-180 before meals and at bedtime
    - For blood sugars at goal:
      - Continue current regimen
    - For blood sugars > goal:
      - Assess amount of correction insulin used each day
      - If >5 units of correction, add approximately 40% of 24-hour correction requirement to NPH doses.
        - Adjust morning dose based on afternoon/evening FSBG readings
        - Adjust evening dose based on bedtime/morning readings.
    - For blood sugars < goal:
      - Decrease AM and/or PM NPH dose, as appropriate:
        -If AM sugars are low, decrease the evening dose
        -If PM sugars are low, decrease the morning dose
  - Consider discontinuing basal when requiring < 10 units/day
  - May transition basal insulin to glargine if patient used glargine or detemir prior to transplant
  - May add bolus with meals if patient is insulin-experienced and has significant post-prandial hyperglycemia

- CORRECTION Insulin Orders
  - Select type of insulin and frequency of administration based on patient's diet
    - NPO, continuous tube feeds: Regular insulin q6h
    - Eating: Humalog ACHS
    - Switch orders whenever diet is transitioned

        - Choose strength of correction scale based on actual 24-hour insulin requirements
            - < 40 units/day: LOW DOSE CORRECTION
            - 40-80 units/day: MEDIUM DOSE CORRECTION
            - > 80 units/day: HIGH DOSE CORRECTION
    - BOLUS Insulin Orders
        - Not to be used routinely in insulin-naïve patients
        - For insulin-experienced patients, may begin to add bolus insulin (lispro) when patient has significant oral intake

- **Discharge**
    - All OLT recipients will receive diabetes education from the diabetes educators prior to discharge
        - Consult for diabetes educator should be ordered several days prior to expected discharge
            - Place consult order in EPIC: **INPATIENT CONSULT TO DIABETES EDUCATOR**
    - The diabetes educators and transplant coordinators will educate all patients
        - On the proper use of their glucometer, administration of insulin and their individual insulin regimen
        - How to check and record fingerstick blood glucose ac&hs
        - How to maintain a daily log which includes fingerstick results
        - To bring the daily log with them to all transplant clinic visits so the transplant team can assess
    - Discharge insulin regimen will be determined on day of discharge based on the prior 24-48 hours and will be individualized for each patient.
        - **Patients consistently (previous 24-48 hours) requiring Basal (NPH/glargine) + Correction insulin**:
            - Discharge on a Basal + Correction regimen
                - Basal (NPH):
                    - Amount: re-evaluate dose prior to discharge and adjust as necessary to achieve goal FSBG of 100-180 before meals and at bedtime (refer to previous section for details)
                    - Frequency of administration: with breakfast and at bedtime
                    - Adjust morning NPH dose based on afternoon/evening FSBG readings.
                    - Adjust evening NPH dose based on bedtime/morning FSBG readings.
                - Basal (glargine or detemir):

        - Amount: re-evaluate dose prior to discharge and adjust as necessary to achieve goal AM glucose of 100-180
        - Consider adding mealtime bolus if AM glucose at goal but hyperglycemic at other times of day
    - Correction:
        - Type: Humalog (Novolog substituted if insurance prefers)
        - Choose strength of correction based on actual 24-48 hour insulin requirements
            - < 40 units/day: LOW DOSE CORRECTION
            - 40-80 units/day: MEDIUM DOSE CORRECTION
            - > 80 units/day: HIGH DOSE CORRECTION
- **Patients consistently (previous 24-48 hours) requiring Correction insulin only:**
    - Assess amount of correction patient is requiring to determine discharge regimen
        - If requiring < 5 units/day of correction
            - Discharge on No insulin
            - Patient still requires education from diabetes educator
            - Patients should still check and record FSBG ac&hs
            - Patients should call if FSBG above 150 x 3 consecutive readings or any reading above 250
        - If requiring > 5 units/day of correction at any time over previous 24 – 48 hours
            - Discharge with LOW DOSE CORRECTION Humalog insulin. (Novolog substitution if insurance prefers.)
- **Patients consistently requiring no insulin while on regular diet, no history of DM:**
    - May consider discharging without FBSG checks (glucose on labs only)

Correction insulin protocols:

Protocol		100-149	150-199	200-249	250-299	300-349	>350
Low dose	Before meals	0	1	2	3	4	5
	Bedtime	0	0	1	2	3	4
Medium dose	Before meals	0	1	3	5	7	8
	Bedtime	0	0	2	3	5	7
High dose	Before meals	0	2	4	7	10	12
	Bedtime	0	0	2	5	7	10

LIVER TRANSPLANT INPATIENT HYPERGLYCEMIA PROTOCOL SUMMARY (See full protocol)

<table>
<tr><th rowspan="2">OLT Patient Population</th><th rowspan="2" colspan="2">Criteria</th><th rowspan="2">Insulin Protocol</th><th colspan="2">Protocol Details</th><th></th></tr>
<tr><th>Insulin Type & Frequency</th><th>Dose Amount / Strength of Correction</th><th>Adjustments</th></tr>
<tr><td>Immediate post OLT</td><td colspan="2">All patients</td><td>Insulin Drip</td><td>Regular</td><td>Continuous drip</td><td>Use transition criteria to transfer off drip to other insulin protocols</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td rowspan="3"><u>Transition to subcut insulin per SICU team when (one of):</u>
1) Taking PO
2) Transfer to the floor
3) Low insulin drip req. (<20 units/day)
4) Long SICU stay with stable blood sugars
5) Prescriber discretion</td><td colspan="7">Suggested strategy below, but transition per SICU team</td></tr>
<tr><td rowspan="2">Extrapolate 24 hour insulin requirement</td><td><20 units</td><td>Correction</td><td>Select based on intake
1) NPO/continuous TF = Regular insulin q 6 hrs
2) PO = Humalog ACHS</td><td>LOW DOSE correction</td><td></td></tr>
<tr><td>≥20 units</td><td>Basal
+
Correction</td><td><u>Basal Protocol</u>
-NPH insulin BID preferred (AM dose>PM dose, e.g., 2:1)
-may transition to home basal where applicable
-may add bolus for insulin-experienced pts
<u>Correction Protocol</u>
Select based on intake
1) NPO, continuous tube feeds = Regular insulin q 6 hrs
2) PO = Humalog ACHS</td><td><u>Basal Protocol</u>
Total daily bolus dose = 40% of actual 24-hour insulin requirement

<u>Correction Protocol</u>
Based on actual 24h insulin requirements:
LOW = <40 units/day
MEDIUM = 40-80 units/day
HIGH = >80 units/day</td><td><u>Basal Protocol</u>
Goal FSBG 100-180 ac&hs
1) @ goal = no change
2) > goal = if using ≥ 5 units of correction, add approx. 40% of 24-hr correction requirement to dose
3) < goal = decrease dose as appropriate
4) NPH only: Adjust AM and PM doses independently</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td rowspan="3">At Discharge</td><td rowspan="3">Discharge insulin determined on day of discharge based on prior 24-48 hours</td><td>Basal
+
Correction</td><td>Basal
+
Correction</td><td>As above</td><td>As above</td><td rowspan="3">Per Endocrine NP, outpatient team discretion</td></tr>
<tr><td rowspan="2">Correction Only</td><td>FSBG > 200</td><td>Humalog (may substitute with Novolog if insurance prefers)</td><td>LOW DOSE correction</td></tr>
<tr><td>No FSBG > 200</td><td colspan="2">No INSULIN. Check FSBG ac&hs. Call if above 150 x 3 consecutive readings or any reading above 250.</td></tr>
</table>

Note: Use the following EPIC order sets: GEN IP INSULIN INFUSION PROTOCOL (insulin drip), BASAL, BOLUS, CORRECTION (BBC) for all other insulin protocols