Definition:
For purposes of this guideline, we define hypoglycemia as a plasma glucose value of <50 mg/dL. The precise definition of hypoglycemia in infants and children continues to be controversial. This is because normal distributions of glucose values depend on conditions of feeding and fasting, and also vary with clinical factors such as age, gestation, and/or weight. Despite this natural variation, we use a single threshold to define hypoglycemia for diagnostic purposes because the overall goal of identifying children with hypoglycemia is to protect their central nervous systems from irreparable damage.\(^1,2,3\)

Etiology:
Hypoglycemia occurs when the rate of appearance of glucose into the plasma space is less than its rate of utilization. This can be caused by defective glucose production, increased glucose utilization, or some combination of the two. In infants and children, important causes of hypoglycemia include:

- **Hormonal:** adrenal insufficiency (Addison disease, ACTH deficiency, CAH, etc.), growth hormone deficiency, hyperinsulinism (congenital hyperinsulinism, insulinoma, Beckwith-Wiedemann Syndrome, “dumping syndrome,” exogenous insulin administration, etc.), hyperthyroidism, and hypopituitarism
- **Metabolic:** disorders of carbohydrate metabolism (disorders of glycogenolysis, gluconeogenesis, and glycosylation), disorders of amino acid metabolism (methylmalonic aciduria, etc.), and disorders of fatty acid metabolism (MCAD, etc.)
- **Ketotic hypoglycemia**
- **Toxic ingestions:** for example, oral hypoglycemic agents, salicylates, and beta-blockers
- **Other conditions causing increased glucose requirements:** for example, sepsis and burns
- **Other conditions causing decreased glucose production:** for example, liver dysfunction and Reye syndrome

Diagnostic Evaluation:

- **History:** A thorough history is always important; however, particular attention should be paid to the timing of episode and relationship to food intake, recent illnesses, possibility of toxic ingestion, birthweight and gestational age (especially if a neonate), family history of hypoglycemia, sleeping habits, growth and developmental history, prior history of hypoglycemia, history of recurrent abdominal pain, and weight loss
- **Physical examination:** On examination, pay attention to evidence of hypopituitarism (micropenis, cleft lip or palate, short stature, blindness, midline defects), glycogenosis (hepatomegaly), adrenal insufficiency (hyperpigmentation, hypotension), Beckwith-Wiedemann (macrosomia, macroglossia, hemihypertrophy, and omphalocele), toxic ingestion (altered mental status not improved by glucose correction, vital sign changes, mydriasis, nystagmus, etc.), CAH (ambiguous genitalia), liver dysfunction (jaundice, hepatomegaly, ascites)
- **Laboratory tests:** prior to correction of hypoglycemia, a critical serum sample should be collected for diagnostic testing (refer to Practice Recommendations and Clinical Management)
- **Imaging tests:** not required during initial evaluation

Critical Points of Evidence

**Evidence Supports**
Specimens for identifying etiology of hypoglycemia should be obtained at presentation and before treatment. Treatment should focus on maintain glucose >70 mg/dL. Hypoglycemia should be treated with glucose; either oral or intravenously depending on circumstances.

Guideline Inclusion Criteria:
Blood glucose < 50 mg/dL

Guideline Exclusion Criteria:
Patients with a previously diagnosed hormonal or metabolic disorder known to cause hypoglycemia
Patients admitted to NBN or NICU
Diabetes mellitus

For questions concerning this pathway,
[Click Here]

Last Updated February 2015
Laboratory Testing
Diagnostic testing (aka “critical sample”) (1,4) should be collected at the time of hypoglycemia and prior to treatment. Testing aims to identify the underlying etiology of the hypoglycemic event. (Strong recommendation, high-quality evidence)

The following blood tests are recommended (priority level provided in case not enough blood collected):
- Highest priority: BMP, beta-hydroxybutyrate, and lactate
- Medium priority: free fatty acids, insulin level, C-peptide, cortisol, growth hormone, ammonia, and acetoacetate
- Lowest priority: free carnitine, acylcarnitine profile, IGFBP-1, serum amino acids, and pyruvate
- Consider serum toxicology screen for ethanol and salicylates if indicated

Blood glucose should be monitored every 15 minutes until > 70 mg/dL then every 30 minutes. (Strong recommendation, low-quality evidence)

Monitoring
In the emergency department setting, patients should be placed on a cardiac monitor, continuous pulse oximetry, and telemetry. Vital signs should be monitored every 5 minutes until stable and then every 15 minutes for one additional hour. Neurologic checks should be assessed every 15 minutes for one hour or until patient is deemed stable. (Strong recommendation, low-quality evidence)

In the inpatient setting, patients should be placed on continuous pulse oximetry. Vital signs and neurologic checks should be monitored every 15 minutes until patient is stabilized. (Strong recommendation, low-quality evidence)
Following treatment of hypoglycemia, capillary blood glucose should be monitored via point-of-care testing every 15 minutes until > 70 mg/dL and then every 30 minutes. Blood glucose monitoring can be further spaced or discontinued based on patient’s response to treatment.

*(Strong recommendation, low-quality evidence)*

**Management**

Symptomatic hypoglycemia in non-diabetes mellitus patients should be rapidly corrected with IV dextrose infusion.

*(Strong recommendation, moderate-quality evidence)*

IV dextrose (~0.2-0.5 g/kg/dose) should be administered at varying concentrations based on patient’s age and fluid availability:

- **Infants/Children up to 12 years old:** D10W 2 - 5 ml/kg/dose
  
  *(This dosing can be used for older children on the inpatient unit, where D25W and D50W may be unavailable)*

- **Adolescents:** D25W 1 - 2 ml/kg/dose | MAX = 100 ml/dose

- **Adolescents/Adults:** D50W 0.5 - 1 ml/kg/dose | MAX = 1 amp (50 mL/dose)

Based on ability to tolerated oral fluids and complex carbohydrate snacks, patients may require initiation of dextrose-containing maintenance fluids to stabilize blood glucoses. Rate of dextrose-containing IV fluids may need to be further adjusted based on blood glucose measurements. *(Strong recommendation, moderate-quality evidence)*

**Consults/Referrals:**

Consider consultation with an endocrinologist or metabolic specialist

**Admission Criteria**

No strict admission criteria exist, and provider discretion is indicated; however, the following criteria can serve as a guide in the emergency department setting:

- Patient unable to maintain blood glucose > 70 mg/dL without the need for continued IV dextrose administration

- Inability to tolerate oral fluids and complex carbohydrates

- No clear etiology apparent on initial evaluation or lab work inconsistent with ketotic hypoglycemia

- Age < 1 year

- No close follow-up care available

**Discharge Criteria**

- Patient able to maintain blood glucose > 70 mg/dL without the need for IV dextrose for > 2 hours

- Tolerating oral fluids and complex carbohydrates

- Close follow-up ensured

- Patient’s history and exam are not concerning for an underlying hormonal or metabolic etiology of hypoglycemia, unless work-up and treatment with subspecialist has already been initiated

**Follow-Up Care**

Follow-up with a primary care provider within 1-2 days of discharge; however, ongoing follow-up will be required as some laboratory testing may take days or weeks for results

Follow-up with endocrinology and metabolics as indicated

**Outcome Measures**

Emergency Department & Inpatient Length of Stay

Readmissions to the Emergency Department & Hospital

New-onset hypoglycemia patients with critical samples obtained

For questions concerning this pathway, [Click Here](#)

Last Updated February 2015
Emergency Department Hypoglycemia Pathway
Evidence Based Outcome Center

**Inclusion Criteria**
Blood glucose < 50 mg/dL

**Place peripheral IV**
- AND -
Initiate patient monitoring

Seizing
OR
Apnea

**Initial Diagnostic Labs:**
Collect Critical Sample Prior to Treatment:

**High Priority:**
- BMP
- Beta Hydroxybutyrate
- Lactate

**Tier 2 priority labs (if enough blood):**
- Free fatty acids
- Insulin
- C-peptide
- Acetoacetic acid

**Tier 3 priority labs (with remaining blood):**
- Free carnitine
- Acylcarnitine profile
- IGFBP-1
- Save Serum Tube (-70 C | spin and hold)

Urine organic acids
- Urine reducing substances
  Consider urine toxicology

IV dextrose (0.2-0.5 g/kg/dose) should be administered at varying concentrations based on patient’s age and fluid availability:
- Infants/Children up to 12 years old: D10W 2 - 5 ml/kg/dose
- Adolescents: D5W/1 - 2 ml/kg/dose | MAX = 100 ml/dose
- Adolescents/Adults: D50W 0.5 - 1 ml/kg/dose | MAX = 1 amp (50 ml/dose)

**Monitor POC glucose q15 min until >70 mg/dL, then q30 min**
- For glucose < 50 mg/dL, repeat IV dextrose bolus (weight-based as per above), obtain any critical labs not previously done, and return to q15 min POC glucose checks until >70 mg/dL then q30 min
- Initiate, adjust, or discontinue dextrose-containing IVF as needed based on glucose levels and po intake

**Disposition**
- Discharge home
- (Family should continue to provide snacks with complex carbs at home)

**ADMIT to hospital**
- Start D5 NS, D5 ½ NS or D10 NS @ maintenance fluid rate
- Offer po as tolerated

**Exclusion Criteria**
- Patients with a previously diagnosed hormonal or metabolic disorder known to cause hypoglycemia
- Patients admitted to NBN or NICU
- Diabetes mellitus
- Patients with a previously diagnosed hepatic, renal, or metabolic abnormalities
- Patients with a previous or current diagnosis of hypoglycemia

**Criteria to consider**
- Maintains POC glucose > 70 mg/dL
- Age > 1 year
- Tolerating po
- Consistent with ketotic hypoglycemia (presence of ketones with history of prolonged fasting, normal growth parameters, no hepatomegaly)
- Has PCP who can review pending labs

**Discharge**
- Is at the discretion of provider
- Samples must be placed on ice

For questions concerning this pathway, [Click Here]
Last Updated February 4, 2016
**Inpatient Hypoglycemia Pathway**

**Evidence Based Outcome Center**

### Inclusion Criteria
- Blood glucose < 50 mg/dL

**Place peripheral IV - AND - Initiate patient monitoring
(if not previously done)**

### Exclusion Criteria
- Patients with a previously diagnosed hormonal or metabolic disorder known to cause hypoglycemia
- Patients admitted to NBN or NICU
- Diabetes mellitus

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### Initial Diagnostic Labs:

#### Collect Critical Sample Prior to Treatment:

**High Priority:**
- BMP
- Beta Hydroxybutyrate
- Lactate

**Tier 2 priority labs (if enough blood):**
- Free fatty acids
- Insulin
- C-peptide
- Acetoacetic acid

**Tier 3 priority labs (with remaining blood):**
- Free carnitine
- Acylcarnitine profile
- IGFBP-1

Save Serum Tube (-70 C | spin and hold)

Urine organic acids
Urine reducing substances
Consider urine toxicology

---

**Administer IV Dextrose (0.2 g/kg/dose):**
- D10W at 2 ml/kg/dose

**ED Admit for hypoglycemia**

- Tolerating po?
  - Yes
    - Provide sugary beverages @ maintenance fluid rate
    - Provide complex carbohydrate snacks
  - No
    - Start D5 or D10 NS with or without KCl @ maintenance fluid rate
    - Offer po as tolerated

**Monitor POC glucose q15 min until >70 mg/dL, then q30 min x 2**

- For glucose < 50 mg/dL, repeat IV dextrose bolus (weight-based as per above), obtain any critical labs not previously done, and return to q15 min POC glucose checks until >70 mg/dL then q30 min. Consider calling for critical response team (CRT) to obtain additional nursing resources. Consider transfer to higher-level of care if unable to stabilize glucose.

- Initiate, adjust, or discontinue dextrose-containing IVF as needed based on glucose levels and po intake

- Consider consult with endocrinology for further instruction

**If glucose remains > 70 mg/dL, space checks to q2hrs x 2 and then q4hrs.**

- If applicable, wean IVF as able

- Continue to offer complex carbohydrates po

**Discontinue pathway at provider’s discretion**

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**For questions concerning this pathway,**

[Click Here]

Last Updated February 4, 2016
## Hypoglycemia Critical Sample Laboratory Tests

**Evidence Based Outcome Center**

For questions concerning this pathway, [Click Here](#).

Last Updated February 4, 2016

### Laboratory test

<table>
<thead>
<tr>
<th>Laboratory test</th>
<th>Sunquest menumonic</th>
<th>Special instructions</th>
<th>Acceptable tubes</th>
<th>Minimum amount of blood (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Priority Labs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMP</td>
<td>BMPNL</td>
<td></td>
<td>MINT GREEN</td>
<td>0.5 ml</td>
</tr>
<tr>
<td>BHOB (beta hydroxybuturate)</td>
<td>BHOB</td>
<td></td>
<td>MINT GREEN</td>
<td>0.5 ml</td>
</tr>
<tr>
<td>Lactic Acid</td>
<td>LACT</td>
<td>Keep on ice once collected</td>
<td>GREY</td>
<td>1 ml</td>
</tr>
<tr>
<td><strong>Total blood needed for High Priority labs:</strong></td>
<td></td>
<td></td>
<td></td>
<td>2 ml</td>
</tr>
<tr>
<td><strong>Tier 2 priority testing (order if enough blood is collected after high priority labs)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MISC: Free fatty acids MAYO 8280</td>
<td>MISCB: FREE FATTY ACIDS</td>
<td>Lab-spin w/in 45min of draw</td>
<td>GOLD</td>
<td>1 ml</td>
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<tr>
<td>Insulin</td>
<td>INS</td>
<td></td>
<td>GOLD</td>
<td>1 ml</td>
</tr>
<tr>
<td>MISC: Acetoacetate to MAYO</td>
<td>MISCB: ACETOACETATE</td>
<td></td>
<td>PURPLE</td>
<td>2.4 ml</td>
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<tr>
<td>c-peptide</td>
<td>CPEP</td>
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<td>MINT GREEN</td>
<td>1.5 ml</td>
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<tr>
<td>Cortisol</td>
<td>CORT</td>
<td></td>
<td>MINT GREEN</td>
<td>1 ml</td>
</tr>
<tr>
<td>Growth Hormone</td>
<td>GRHM</td>
<td></td>
<td>MINT GREEN</td>
<td>1 ml</td>
</tr>
<tr>
<td>Ammonia</td>
<td>AMON</td>
<td>Keep on ice once collected</td>
<td>MINT GREEN</td>
<td>1 ml</td>
</tr>
<tr>
<td><strong>Total blood needed for High Priority &amp; Tier 2 labs:</strong></td>
<td></td>
<td></td>
<td></td>
<td>10.9 ml</td>
</tr>
<tr>
<td><strong>Tier 3 priority testing (order with remaining blood after higher priority)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IGFIBP-1</td>
<td>SMM</td>
<td></td>
<td>GOLD</td>
<td>1 ml</td>
</tr>
<tr>
<td>Pyruvic Acid</td>
<td>PACID</td>
<td>Lab use pyruvic acid tube in ref STAT</td>
<td>MINT GREEN</td>
<td>1 ml</td>
</tr>
<tr>
<td>Free &amp; total carnitine (not in acylcarnitine profile) profile</td>
<td>carntf</td>
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<td>MINT GREEN</td>
<td>0.5 ml</td>
</tr>
<tr>
<td>Acyl-carnitine profile - order as MISC until pathnet go-live</td>
<td>misc - ACYLM</td>
<td></td>
<td>MINT GREEN</td>
<td>0.5 ml</td>
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<tr>
<td>Amino acids, plasma</td>
<td>AAP</td>
<td>LAB ONCE CENTIFUGED-CRITICAL FROZ</td>
<td>MINT GREEN</td>
<td>1 ml</td>
</tr>
<tr>
<td><strong>Total blood needed for all Critical Sample Labs (High priority, Tier 2, &amp; 3)</strong></td>
<td></td>
<td></td>
<td></td>
<td>14.9 ml</td>
</tr>
</tbody>
</table>

### Blood Tube

<table>
<thead>
<tr>
<th>Blood Tube</th>
<th>Minimum blood volume (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOLD</td>
<td>3 ml</td>
</tr>
<tr>
<td>MINT GREEN</td>
<td>8.5 ml</td>
</tr>
<tr>
<td>PURPLE</td>
<td>2.4 ml</td>
</tr>
<tr>
<td>GREY</td>
<td>1 ml</td>
</tr>
<tr>
<td><strong>Total blood needed for Critical Sample</strong></td>
<td>14.9 ml</td>
</tr>
</tbody>
</table>
References

EBOC Project Owner: Mark Tabarrok, MD

Approved by the Hypoglycemia Guideline Evidence-Based Outcomes Center Team

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Hypoglycemia Guideline EBOK Team:
Mark Tabarrok, MD
Joshua Smith, MD
Melissa Cossey, MD
Harris Hayley, DO
Patrick Boswell

EBOC Committee:
Sarmistha Hauger, MD
Mark Shen, MD
Deb Brown, RN
Robert Schlechter, MD
Levy Moise, MD
Sujit Iyer, MD
Tory Meyer, MD
Nilda Garcia, MD
Meena Iyer, MD
Stephen Pont, MD
Michael Auth, DO