Reducing Morning Hypoglycemia in Children Undergoing Treatment for ALL

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St. Jude Children’s Research Hospital, Memphis, TN
The Children’s Hospital at Saint Francis, Tulsa, OK
Novant Health Hemby Children’s Hospital, Charlotte, NC

July 12-13, 2017
Institutional Overview St. Jude Affiliate Program

• A network of 8 pediatric hematology-oncology clinics, hospitals, and universities united to extend the mission of St. Jude.

• Serves as a referral base to St. Jude for patients eligible for protocol-based care.

• Serves as a site where care can be administered to the patient close to home enabling more children to benefit from the care and benefits of St. Jude.

• Collaborates with staff of St. Jude to deliver protocol related care to pediatric oncology patients.

• St. Jude Benefits = 437 accruals on trials from the affiliates thru 2.27.17
<table>
<thead>
<tr>
<th>Hospital</th>
<th>Institutional Overview Charlotte</th>
<th>Institutional Overview Tulsa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affiliate Clinic at Novant Health Hemby Children’s Hospital</td>
<td>The Children’s Hospital at Saint Francis is located in Tulsa, Oklahoma</td>
<td></td>
</tr>
<tr>
<td>Care Region</td>
<td>Greater Charlotte</td>
<td>Tulsa and throughout eastern Oklahoma as well as neighboring states.</td>
</tr>
<tr>
<td>Affiliation</td>
<td>Presbyterian Medical Center which is a community based non-teaching hospital.</td>
<td>An academic center associated with the University of Oklahoma and Oklahoma State University</td>
</tr>
<tr>
<td>Staff</td>
<td>4 physician providers, 3 nurse practitioners, 7 full-time nurses, two full-time child life, a pediatric counselor, and a LCSW.</td>
<td>3 physicians, 1 nurse practitioner, 7 registered nurses, a pharmacist, a child life specialist, a pediatric psychologist and a LCSW.</td>
</tr>
<tr>
<td>Volume</td>
<td>over 5000 patient visits per year and has typically 40 new diagnoses of children with cancer per year.</td>
<td>over 4000 patient visits a year with an average of 60 newly diagnosed oncology patients a year.</td>
</tr>
</tbody>
</table>
Problem Statement

32% of children on therapy for ALL at the Charlotte and Tulsa St. Jude affiliates experienced morning hypoglycemia based on a clinic blood sugar result of <70 mg/dl between January and March 2017 putting patients at risk of symptomatic hypoglycemia and corresponding procedure delays, increased resource utilization, decreased patient satisfaction and risk for adverse cognitive outcomes.
# Team Members

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Job Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Sponsor</td>
<td>Caroline Russo</td>
<td>Team support – resources and implementation</td>
</tr>
<tr>
<td>Team Leader</td>
<td>Dr. Ashraf Mohamed</td>
<td>Oversee the completion of the QTP project – Tulsa team leader</td>
</tr>
<tr>
<td>Core Team Member*</td>
<td>Dr. Christine Bolen</td>
<td>Charlotte team leader</td>
</tr>
<tr>
<td>Core Team Member*</td>
<td>Patricia Rice</td>
<td>Tulsa team</td>
</tr>
<tr>
<td>Facilitator</td>
<td>Jennifer Morgan</td>
<td>Team member who facilitates the team meetings to optimize group processes.</td>
</tr>
<tr>
<td>Other Team Member^</td>
<td>Meredith Speas</td>
<td>Charlotte clinic nurse</td>
</tr>
<tr>
<td>Other Team Member^</td>
<td>Lena Gleaton</td>
<td>Charlotte procedure nurse</td>
</tr>
<tr>
<td>Other Team Member^</td>
<td>Beth Benjamin</td>
<td>CMA for Charlotte</td>
</tr>
<tr>
<td>Other Team Member^</td>
<td>Suzanne Boyd</td>
<td>Tulsa Clinical Pharmacist</td>
</tr>
<tr>
<td>Other Team Member^</td>
<td>Rusty Wilson</td>
<td>Tulsa Nurse Tech/procedure coordinator</td>
</tr>
<tr>
<td>Other Team Member^</td>
<td>Teri Caldwell</td>
<td>Tulsa Inpatient/Outpatient Nurse Liaison</td>
</tr>
<tr>
<td>Other Team Member^</td>
<td>Rhonda Speyer</td>
<td>Tulsa Clinic Director</td>
</tr>
<tr>
<td>Patient/ Family Member</td>
<td>Heather Snyder</td>
<td>Charlotte Leukemia patient parent</td>
</tr>
<tr>
<td>QTP Improvement Coach</td>
<td>Megan McKinney</td>
<td>Tulsa Leukemia patient parent</td>
</tr>
<tr>
<td></td>
<td>Stephanie Amport</td>
<td>Provides remote support to the team regarding the science of quality improvement and participation in the QTP.</td>
</tr>
</tbody>
</table>
Top Causes based on Survey Results: Staff, Parent, Common in Both
Top causes of morning hypoglycemia per staff are related to NPO, Nausea/Vomiting, Medications, Delays, Lack of food, Knowledge and Policy.
Giving 6MP at night, without food and lack of education are the top gaps per patient/parent questionnaire regarding knowledge of morning hypoglycemia and prevention.
(n=16)
Aim Statement

By October, 2017, reduce morning hypoglycemia (blood sugar less than 70 mg/dl) in children on therapy for ALL at the Charlotte and Tulsa St. Jude affiliates by 50%.
Staff survey on potential causes of morning hypoglycemia

1. In your opinion, what are the most common causes of morning hypoglycemia for patients with Acute Lymphoblastic Leukemia (ALL) in the medical setting? Please select five choices and rank them 1st through 5th (i.e. 1st choice = top choice, 5th choice = last choice).

- [ ] Caregiver/patient unaware of hypoglycemia risk/prevention
- [ ] Patient refuses breakfast prior to lab draw/visit
- [ ] Caregiver not offering food to patient prior to lab draw/visit
- [ ] Patient has had nausea or vomiting within 24 hours prior to lab draw/visit
- [ ] NPO for a procedure
- [ ] Delay in a scheduled procedure (i.e. isolated LP)
- [ ] Procedure is in a different area of hospital (i.e. PICC vs OR)
- [ ] Medical staff uneducated on symptoms/risk of hypoglycemia
- [ ] Lack of policy for procedural hypoglycemia prevention (when to eat, what to eat)
- [ ] Patient currently on medications contributing to hypoglycemia (SMI, insulin, metformin)
- [ ] Young age
- [ ] Early bedtime prior to being NPO for procedure
- [ ] Early supper prior to being NPO for procedure
- [ ] Poly water

Parent survey to assess the current state process

**Patient/Parent Questionnaire**

1. Did you receive any education on hypoglycemia (Low Blood Sugar)?
   - Yes_____ No_____

2. Did you receive any educational materials on hypoglycemia? Yes_____ No_____

3. Are you aware that snacks are available in the clinic for patients? Yes_____ No_____

4. When your child is scheduled for a procedure, do you wake the child up prior to 6 am the morning of the procedure and have your child drink few ounces of clear juice?
   - Yes____ No____

5. When do you usually give your child 6MP? am_____ pm_____

6. Do you usually give 6MP with food? Yes_____ No_____

7. If the answer is No to Q#6, how far from meal or snack do you give 6MP? 1 h --- 2h

8. Do you give your child 6MP to take at night? Yes_____ No_____

9. Do you give your child a snack before bedtime? Yes_____ No_____
Outcome Measures

• **Outcome Measure:** % morning hypoglycemic episodes (BS<70 mg/dl)
• **Patient population:** Pediatric ALL patients on treatment seen in the Tulsa and Charlotte St. Jude Affiliates and had glucose level drawn.
• **Calculation methodology:**
  - Numerator: Number of hypoglycemic episodes (BS <70 mg/dl)
  - Denominator: Number of patients on treatment for ALL
• **Data source:** Epic patient medical record review of lab results.
• **Data collection frequency:** Monthly
• **Data quality limitations:** A single patient can have multiple episodes of hypoglycemia in 1 month.
Process Measures 1

- **Process Measure 1:** % ALL patients on treatment who received hypoglycemia prevention education by the clinic nurse.
- **Patient population:** Pediatric ALL patients on treatment seen in the Tulsa and Charlotte St. Jude Affiliates.
  - Exclusions: Multi-day treatment patients will not receive hypoglycemia prevention education every time.
- **Calculation methodology:**
  - Numerator: Number of patients who received hypoglycemia prevention education
  - Denominator: Number ALL Patients that had blood glucose drawn that month
- **Data source:** Epic patient medical record review of patient education documentation.
- **Data collection frequency:** Monthly
- **Data quality limitations:**
Process Measure 2: % ALL patients on treatment and/or their caregivers who demonstrate knowledge of morning hypoglycemia causes and prevention.

Patient population: Pediatric ALL patients on treatment seen in the Tulsa and Charlotte St. Jude Affiliates.

Calculation methodology:
- Numerator: Number of patients/caregivers who demonstrate knowledge hypoglycemia prevention education
- Denominator: Number of patients on treatment for ALL

Data source: Patient/Caregiver survey regarding knowledge of morning hypoglycemia and prevention.

Data collection frequency: Prior to implementation of education, one month after receiving education, and then again in September 2017.

Data quality limitations: Same caregiver may not accompany the patient each visit.
Baseline Data (Jan - Mar 2017)

33% of ALL Patients on Therapy have morning hypoglycemia between Jan-Mar 2017

- Jan '17 (n=7) 55% Tuke, 2% Charlotte
- Feb '17 (n=6) 18% Tuke, 10% Charlotte
- Mar '17 (n=4) 9% Tuke, 7% Charlotte

American Society of Clinical Oncology
### Solutions to prevent morning hypoglycemia

<table>
<thead>
<tr>
<th>Impact</th>
<th>Effort</th>
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</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>Remind patients prior to procedure how to prevent hypoglycemia by RN/MD</td>
</tr>
<tr>
<td>HIGH</td>
<td>Reinforce 6MP does not need to be taken at night on empty stomach by RN/MD</td>
</tr>
<tr>
<td>LOW</td>
<td>Create brochure with risks and preventions for hypoglycemia for patients/families</td>
</tr>
<tr>
<td>LOW</td>
<td>Improve documentation regarding hypoglycemia education to identify teaching was done</td>
</tr>
<tr>
<td>LOW</td>
<td>Educate what type food to eat when taking 6MP by RN/MD</td>
</tr>
<tr>
<td>LOW</td>
<td>Improve assessment/management of patient’s N/V by RN/MD to increase desire to eat</td>
</tr>
<tr>
<td>LOW</td>
<td>Have patients take their blood glucose levels at home</td>
</tr>
<tr>
<td>LOW</td>
<td>HIGH</td>
</tr>
</tbody>
</table>
### ACTION PLAN FORM (PDSA Cycle 1)

**Practice/Institution:** St. Jude Affiliate Program  
**Dept./Unit:** Charlotte, NC and Tulsa, OK Affiliates

**Project AIM:** Reduce morning hypoglycemia (blood sugar less than 70 mg/dl) in children on therapy for ALL by 50%.

**Changes to Test and Implement to Reach Your Aim:**
1. Finalize education tool and process for education
2. Educate all staff on patient education process for hypoglycemia risks/prevention
3. Develop data collection tools/plan to assess education process
4. Determine measure of decreasing hypoglycemic episodes

<table>
<thead>
<tr>
<th>Change #</th>
<th>PDSA Cycle Start and End Dates</th>
<th>Plan for Testing Each Change/Intervention</th>
<th>Action Steps</th>
<th>Summary of Results</th>
</tr>
</thead>
</table>
2. Educate clinical staff to reinforce hypoglycemia education prior to procedures requiring fasting  
3. Educate clinical staff regarding 6MP guidelines  
4. Educate clinical staff regarding documentation of education for hypoglycemia in EMR  
2-4: PowerPoint, email and flyers were used to educate staff in Charlotte Aug., 2017 and Tulsa did the same in Sept., 2017. | Brochure: content same, format flexible. |
| 2.       | August 1, 2017 Sept. 29, 2017 | 1. Educate Clinical Staff who will complete the teaching  
2. Educate Clinical Staff when the teaching should take place  
3. Educate Clinical Staff what should be documented for education and where in Epic  
4. Disseminate information via staff meetings and email | Charlotte: NPs and MDs in the clinic will be completing the education and documenting with a “dot” phrase in Epic.  
Tulsa: Created “dot” phrase for education documentation. | Ensure “dot” phrase is consistent. |
   a. Review charts after start of patient education  
Charlotte sent knowledge assessment survey to parents Sept. 20-29, 2017 | |
| 4.       | September 1, 2017 October 31, 2017 | 1. Review hypoglycemic episode data from April to June 2017  
   a. determine numerator and denominator  
Charlotte Hypoglycemia Education Brochure

**Adventures of Sugar Girl and Her Fight Against Low Blood Sugar**

- Prevention of hypoglycemia is crucial to avoid complications.
- **6MP Update**: 6MP (Mercaptopurine) does not need to be taken on an empty stomach.
- **Morning Use**: 6MP can be given in the morning to help prevent low blood sugar.
- **Daily Dose**: 6MP should be given every day at the same time of day, as directed by your doctor.

**NPO Status Update**

- Clear liquids may be allowed up to 2 hours prior to scheduled procedures (e.g., LP, bone marrow).
- Small amounts of clear liquids, such as ½ cup, are preferred.
- Clear liquids include water, sprite, ginger ale, gatorade, powerade, and even popsicles.
- To prevent hypoglycemia, it is recommended to eat complex carbohydrates for dinner or snack prior to bedtime.

**Signs & Symptoms of Low Blood Sugar**

- Nausea/Vomiting
- Irritability
- Dizziness
- Headache
- Sweating
- Trembling
- Blurred Vision
- Pale Skin Color
- Confusion

**Complex Carbohydrates**

- Oatmeal
- Brown Rice
- Whole Wheat Bread, Pasta
- Whole Grains
- Corn
- Quinoa
- Beans
- Sweet Potato
- Apples/Oranges/Melons/Strawberries
- Milk
- Yogurt
Tulsa Hypoglycemia Education Brochure

Signs and Symptoms of Low Blood Sugar
- Nausea/Vomiting
- Irritability
- Drowsiness/tiredness
- Headache
- Sweating
- Shakiness
- Blurry Vision
- Pale Skin Color
- Confusion
- Sluggish in morning upon waking

Prevent the

CRASH!

The Adventures of Sugar Hero and the Fight Against Low Blood Sugar

Learn about the causes of low blood sugar - And ways to avoid it!

Things We Can Do to Help Prevent Low Blood Sugar

1. Eat a late dinner, to include complex carbs, the night before a sedated procedure.
2. Go to bed later and eat a snack before bed (ex. ½ a peanut butter sandwich).
3. Wake up early (at 6 a.m.) and give 6 oz. of clear juice like apple juice, cranberry juice, or Sprite/Ginger Ale.
4. Give 6MP daily, in the morning, to prevent low blood sugar overnight.

List of Complex Carbs
- Oatmeal
- Brown Rice
- Whole Wheat Bread or Pasta
- Whole Grains
- Corn
- Quinoa
- Beans
- Sweet Potato
- Apples, Oranges, Melon
- Strawberries, Apricots, Bananas
- Milk
- Yogurt
- Bran Muffin
- Granola
- Tortillas
- Popcorn

Mercaptopurine Update
- Mercaptopurine/6MP does NOT have to be given on an empty stomach.
- It is very important to take 6MP at the same time, either every day or as directed by your doctor.
- Sticking to the same schedule, at the same time, is your child’s key to successful therapy!
• For the standardization of patient education and documentation of education, a dot phrase was created to use with Epic medical record software in both Charlotte and Tulsa.
  – Reviewed time for NPO prior to procedure. Patient may have clear liquids up until two hours prior to procedure. To prevent low blood sugar in the morning, it is recommended to eat complex carbs for dinner or snack prior to bedtime.
  – Provided family with brochure educating on the signs and symptoms of hypoglycemia as well as recommendations for 6MP administration. Reviewed updates on 6MP administration with family to include that it may be given with food and it may be given in the morning.
Change Data - Charlotte

Charlotte - % of Hypoglycemic Episodes Per ALL Patients with at least 1 Glucose Level Drawn Per Month - p Chart

Charlotte - % Hypoglycemic Episodes Per ALL Patients with at least 1 Glucose Level Drawn Per Month - p Chart
Change Data - Tulsa

Tulsa - % Hypoglycemic Episodes Per ALL Patients with at least 1 Glucose Level Drawn Per Month - p Chart

Tulsa - % Hypoglycemic Episodes Per ALL Patients with at least 1 Glucose Level Drawn Per Month - p Chart
Change Data – Charlotte & Tulsa

Charlotte and Tulsa % Hypoglycemic Episodes Per ALL Patients with at least 1 Glucose Level Drawn Per Month - p Chart
Conclusions

• Pediatric patients being treated for ALL alter their dietary intake due to pre-procedural guidelines, 6MP administration guidelines, side effects of chemotherapy and just because they are kids making them susceptible to morning hypoglycemia.

• Ensure all families are educated regarding hypoglycemia risks & prevention.
  – Charlotte began educating families in Sept 2017
    • 90% of patient received education for hypoglycemia risks and prevention.

• Hypoglycemia episodes remain between 7-11% each month.
  – Education process just started in Charlotte and has not started in Tulsa to show a decrease in hypoglycemia episodes.
Next Steps/Plan for Sustainability

• Tulsa to start patient & family education process in October 2017.
  – Education documentation chart review will begin the month following start of education process.

• Charlotte and Tulsa will complete the parent follow-up survey to assess level of knowledge after hypoglycemia education

• Some patients experienced hypoglycemic episodes more frequently than others.
  – Investigate those more closely should they continue after hypoglycemic education is completed.

• Consider additional metric outcomes
  – % hypoglycemia episodes/# of glucose blood draws
  – Rate of hypoglycemic episodes/# hypoglycemic patients
# Patient Characteristics w/BG cut off of <70mg/dl (Jan 2011 – Dec 2016)

<table>
<thead>
<tr>
<th></th>
<th>Hypoglycemia group (&lt; 70 mg/dL)</th>
<th>Normoglycemia group (≥ 70 mg/dL)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (patients)</td>
<td>71 (82.6%)</td>
<td>15 (17.4%)</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>358 episodes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>40 (56.3%)^a</td>
<td>9 (60%)^a</td>
<td>49 (57%)^a</td>
</tr>
<tr>
<td>Females</td>
<td>31 (43.7%)^a</td>
<td>6 (40%)^a</td>
<td>37 (43%)^a</td>
</tr>
<tr>
<td>Proportion entered maintenance therapy</td>
<td>47 (66.2%)^a</td>
<td>7 (46.7%)^a</td>
<td>54 (62.8%)^a</td>
</tr>
<tr>
<td>Proportion not in maintenance therapy</td>
<td>24 (33.8%)^a</td>
<td>8 (53.3%)^a</td>
<td>32 (37.2%)^a</td>
</tr>
<tr>
<td>Mean age at time of diagnosis (years) [95% CI]</td>
<td>5.45 ± 4.10^b*[4.48 - 6.42]</td>
<td>8.87 ± 5.26^b*[5.95 – 11.78]</td>
<td>6.05 ± 4.48*[5.09 – 7.01]</td>
</tr>
</tbody>
</table>
### Distribution of BS Level During Hypoglycemia Episodes (Jan 2011 – Dec 2017)

<table>
<thead>
<tr>
<th>Hypoglycemia severity</th>
<th>Number of episodes</th>
<th>Percent</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>60-69 md/dL</td>
<td>255</td>
<td>71.2</td>
<td>71.2</td>
</tr>
<tr>
<td>50-59 mg/dL</td>
<td>76</td>
<td>21.2</td>
<td>92.5</td>
</tr>
<tr>
<td>40-49 mg/dL</td>
<td>25</td>
<td>7.0</td>
<td>99.4</td>
</tr>
<tr>
<td>30-39 mg/dL</td>
<td>2</td>
<td>0.6</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>358</strong></td>
<td><strong>100.0</strong></td>
<td></td>
</tr>
</tbody>
</table>
Optional Future Outcome Metrics

Charlotte and Tulsa - Hypoglycemic Episodes Per Glucose Level Drawn on ALL Patient - p Chart

Charlotte and Tulsa - Rate of Hypoglycemic Episodes per ALL Patient with Hypoglycemic Episode
Reducing Morning Hypoglycemia in Children Undergoing Treatment for ALL

**AIM:** By October, 2017, reduce morning hypoglycemia (blood sugar less than 70 mg/dl) in children on therapy for ALL at the Charlotte and Tulsa St. Jude affiliates by 50%.

**TEAM:**
- Jennifer Morgan – Facilitator SJ
- Ashraf Mohamed – Leader MD T
- Christine Bolen – MD CH
- Patricia Rice – Nurse T
- Clinic Nurses
- Procedure Nurses/Coordinator
- CMA/Techs
- Patient Parents

**PROJECT SPONSORS:**
- Carolyn Russo

**INTERVENTIONS:**
- Develop education tool and process for education
- Educate all staff on patient education process for hypoglycemia risks/prevention
- Develop data collection tools/plan to assess education process
- Determine measure of decreasing hypoglycemic episodes

**RESULTS:**

**CONCLUSIONS:**
- Hypoglycemia episodes remain between 7-11%.
- Charlotte is at 90% documentation rate for hypoglycemia education.

**NEXT STEPS:**
- Tulsa to begin education process in October 2017
- Charlotte and Tulsa to complete the parent follow-up survey to assess knowledge of hypoglycemia
- Investigate the treatment plan more closely those patients who continue to have hypoglycemic episodes after the education process has begun.
- Consider additional metric outcomes
  - % hypoglycemia/# glucose blood draws
  - Rate of hypoglycemic episodes/#hypoglycemic patients