Clinical Safety & Effectiveness
Cohort # 18

The implementation of an Oxygen Targeting protocol in the NICU
The Team

• Division
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  Veronica Rettig, NNP-BC  CS&E Participant
  Irene Sandate, NNP-BC  CS&E Participant
  Joey Rose, RRT-NPS  Team Member
  Merideth Mobley, RN  Team Member
  Abbie Aburizik, MBA  Facilitator

• Sponsor Department:
  Margarita Vasquez, M.D. – Associate Professor, Department of Neonatology
AIM Statement

The aim of this project is to implement an oxygen targeting protocol for all patients in the NICU receiving supplemental oxygen with a goal of 50% compliance within 60 days of implementation.

The process begins when a patient who requires oxygen therapy is admitted to the unit and ends when patient no longer requires oxygen therapy. It is important to implement this protocol in order to improve long-term outcomes of NICU patients, specifically retinopathy of prematurity.
Project Milestones

• Team Created September 2015
• AIM statement created January 2016
• Weekly Team Meetings January 27 - present
• Background Data, Brainstorm Sessions, Workflow and Fishbone Analyses September 2015 – February 2016
• Interventions Implemented March 1– March 25 2016
• Data Analysis January 8 - present
• CS&E Presentation June 3, 2016
Background

- Retinopathy of prematurity (ROP) is a potentially blinding eye disorder that primarily affects premature infants weighing 1250 grams or less that are born before 31 weeks of gestation.

- This disorder is one of the most common causes of visual loss in childhood and can lead to lifelong vision impairment and blindness. ROP was first diagnosed in 1942.

- There are approximately 3.9 million infants born in the U.S. each year; of those, about 28,000 weigh 1250 pounds or less.

- About 14,000–16,000 of these infants are affected by some degree of ROP. About 1,100–1,500 infants annually develop ROP that is severe enough to require medical treatment. About 400–600 infants each year in the US become legally blind from ROP.

- Several complex factors may be responsible for the development of ROP. The two major risk factors of ROP are the use of oxygen and a decreased gestation period.

- Excessive oxygen contributes to ROP through regulation of vascular endothelial growth factor (VEGF).

- The NICU at UH has a high rate of infants who develop severe ROP and require treatment. A protocol to maintain SpO2 saturations within a specific range to prevent hyperoxia did not exist.
### Background

**UH VON 2011-2013**

ROP statistics

<table>
<thead>
<tr>
<th></th>
<th>UH Rate 2011-2013</th>
<th>Type C NICU Mean</th>
<th>Type C NICU Q1</th>
<th>TYPE C NICU Q3</th>
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<tbody>
<tr>
<td>Any ROP - All Eligible</td>
<td>32.3%</td>
<td>36.0%</td>
<td>26.2%</td>
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<tr>
<td>Any ROP - Inborn</td>
<td>28.4%</td>
<td>33.5%</td>
<td>22.4%</td>
<td>45.4%</td>
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<tr>
<td>Surgery - All Eligible</td>
<td>4.7%</td>
<td>3.4%</td>
<td>0.7</td>
<td>5.0%</td>
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<tr>
<td>Surgery - Inborn</td>
<td>3.5%</td>
<td>2.8%</td>
<td>0</td>
<td>4.3%</td>
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<tr>
<td>Anti-VEGF Injection</td>
<td>5.8%</td>
<td>1.4%</td>
<td>0</td>
<td>2.0%</td>
</tr>
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Plan: Process Analysis

1. Established patient in the NICU develops oxygen requirement
2. Phone call - incoming admission to NICU
   - Get team and equipment together
   - Pick up patient and transport to NICU
3. Does patient have an oxygen requirement?
4. RT to set up equipment
5. RN to set up monitor/alarm limits
Plan: Fish Diagram

Environment
- alarm volume
- direction of alarm sound
- alarm fatigue

Materials
- availability of supplies before, during, and after shifts
- sensitivity signs
- no notification when increased oxygen
- no protocol
- no education

Process
- set up without order
- lack of compliance
- setting correct alarm limit
- use of analyzer: accuracy, availability
- alarm volume
- clocks not working

People
- setting correct alarm limits
- correct order selected
- O2 adjustment in increments
- oxygen saturation
- hand off communication
- break time
- perception of time

Measurement
- variables per patient
- EMR
- alarm limits
- how many verbal orders
- trending O2 sats
- outdated orders

Machines
- no education
- no protocol
- lack of compliance

Problem Statement
Oxygen targeting is not standard practice in the NICU
Plan: Pre-intervention Data Collection

### SPO2 GUIDELINE DATA COLLECTION SHEET

**Patient Label**: 

<table>
<thead>
<tr>
<th>Mode</th>
<th>NC</th>
<th>HFNC</th>
<th>NIV</th>
<th>VENT</th>
<th>HFOV</th>
<th>INO</th>
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<tr>
<td>Flow PreB/MAF</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>FiO2/SpO2</td>
<td>/</td>
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<td>/</td>
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<td></td>
</tr>
<tr>
<td>Alarms</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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### Time

<table>
<thead>
<tr>
<th>Time</th>
<th>03:00</th>
<th>11:15</th>
<th>19:00</th>
<th>23:00</th>
<th>07:00</th>
<th>11:00</th>
<th>15:00</th>
<th>19:00</th>
<th>03:00</th>
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</table>

### Flow PreB/MAF

<table>
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<th></th>
<th>1L</th>
<th>2L</th>
<th>2L</th>
<th>2L</th>
<th>2L</th>
<th>2L</th>
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</table>

### FiO2/SpO2

<table>
<thead>
<tr>
<th>FiO2/SpO2</th>
<th>07/93</th>
<th>07/94</th>
<th>07/92</th>
<th>07/97</th>
<th>07/96</th>
<th>21/94</th>
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### Alarms

<table>
<thead>
<tr>
<th>Alarms</th>
<th>85-98</th>
<th>85-100</th>
<th>85-100</th>
<th>85-100</th>
<th>85-100</th>
<th>85-100</th>
</tr>
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</table>

**Baby girl ROP**  
**MRN 12345678**
Pre-intervention Data

Baseline Order Entered Correct

Percent of Time

weeks
Pre-intervention Data

Both Alarms Correct

Percent of Time

weeks

1 2 3 4 5 6 7 8

UCL

CL

LCL

0.1 0.0 0.0

0% 2% 4% 6% 8% 10% 12% 14%

-6% -4% -2% 0% 2% 4% 6%
DO: Implementing the Change

3 phases

   Lessons learned:
   - No standardized approach to oxygen targeting in place in NICU
   - Vast amount of literature and none of it which came to a specific conclusion on what an appropriate target range should be
   - Need to limit the data collected only to what applies to protocol

2. Education, oxygen target cards & algorithm at each bedside  - March 1-25 2016
   Lessons learned:
   - Over 200 staff members needed to be trained, needed to be concise
   - During education period, we learned that it would be beneficial to assess learners knowledge – a pre/post test was developed

3. Quality checks – March 28, 2016 to present
   Lessons learned:
   - Continuation of long-term data collection needed but will need to modify the team
   - May need to decrease the amount of data collected and the interval
Do: Intervention

Enter order set for oxygen targeting for all patients unless otherwise ordered

Does patient have a diagnosis of MAS or PPHN?

Yes

Enter order set for patients with DX of MAS or PPHN

No

Does patient have a suspected or known cardiac defect?

Yes

Enter order specific to the cardiac defect as per cardiology recommendations

No

Does patient have an oxygen requirement?

Yes

RT to set up equipment

No

Enter order set for patients who do not require O2

Follow protocol for high oxygen alarm

High Oxygen saturation alarm

Alarms

Low Oxygen saturation Alarms

Follow protocol for low saturation alarm
Do: Protocol Education

Mandatory In-service on Oxygen Targeting in X-Ray Conf. Room

Tues, Mar 1st 0630
Thurs, Mar 3rd 0630
Tues, Mar 8th 0630
Tues, Mar 10th 0630

Oxygen Targeting in the NICU

Rolando Macias, MD
Veronica Rettig, NNP-BC
Irene Sandate, NNP-BC
2016
Oxygen Targeting Pre & Post Test

1. Hyperoxia plays a big role in which of the following disease processes?
   A. Retinopathy of Prematurity
   B. Chronic Lung Disease
   C. Necrotizing Enterocolitis
   D. All the above

2. Oxidative Stress is defined as
   A. An imbalance between production of free radicals and antioxidant defenses.
   B. Stress related to the implementation of a new oxygen targeting protocol
   C. An uncharged highly reactive molecule that has unpaired electrons that can cause damage to cells

3. The area of the eye treated with laser therapy in patients with retinopathy of prematurity can eventually have normal function/vision.
   True
   False

4. The current oxygen saturation alarm limit orders for patients on oxygen who do not have PPHN or a cardiac defect are:
   A. 88-98
   B. 85-96
   C. 85-105

5. A term infant is not at risk for the effects of hyperoxia.
   True
   False
Do – protocol algorithm

High Oxygen Saturation Alarm

1. Silence & Observe x 2 minutes
2. If O2 sat still high, ↓ FiO2 by 2-5%
3. Repeat

Low Oxygen Saturation Alarm

1. Evaluate Wave Form & Heart Rate (? Correlating)
2. Evaluate Patient (Airway, Suction, Reposition)

Saturations > 75-84%:
1. Observe x 2 minutes
2. Still < normal range
   - Increase FiO2 by 2-5%
   - Observe 2 minutes
   - Continue to increase FiO2 2-5% until back within range
   - If > 10% increase in FiO2 notify NNP/MD

Saturations < 75% & HR > 120:
1. Observe x 1 minute
2. Still < 75%
   - Increase FiO2 by 5-10% & give ventilator breaths if intubated
   - Observe 1-2 minutes
   - If still low call NNP/MD to bedside
   - If unable to wean notify NNP/MD
   - Once sats > 85% begin to wean aggressively to within 3% from baseline
Implementation

Ready...Set...O₂'s
Infant receiving O₂ (unless otherwise ordered)
- Target SpO₂ 88-95%
- Alarm Limits 85-96%
Before YOU go - check my O₂!

Ready...Set...O₂'s
MAS/PPHN
- Target SpO₂ > 95%
- Alarm Limits 95-100%
Before YOU go - check my O₂!

Ready...Set...O₂'s
Congenital Heart Disease
- Target SpO₂ ___ to ___%
- Alarm Limits ___ to ___%
Before YOU go - check my O₂!
# Do: Interventions based on issues/drivers from fish diagram

| Environment       | • Alarms project back: new monitors in the future (1/2 million dollars for 52 monitors)  
<table>
<thead>
<tr>
<th></th>
<th>• Alarm fatigue: implementation of order set</th>
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</thead>
</table>
| People            | • Protocol developed  
|                   | Educational in-services for nurses and respiratory therapists  
|                   | Daily quality checks                                                                 |
| Measurement       | • Checklist for handoff  
|                   | • Pre-Post test given at in-services and will repeat in 6 months  
|                   | • Trend O2 saturations using EMR and present at daily huddles                       |
| Machines          | • Plant engineering to fix and synch all clocks in unit                               |
| Material          | • O2 target cards & algorithms at each bedside  
|                   | • Notification of increased O2 requirement addressed in algorithm                    |
|                   | • Lack of accountability will be addressed by nurse managers as needed                |
| Process           | • New employee orientation to include presentation on O2 targeting protocol            |
CHECK: Results/Impact

Order Entered Correct

Percent of Time

weeks

Intervention  Post-Intervention
CHECK: Results/Impact

Both Alarms Correct

Percent of Time

weeks

Intervention
Post-Intervention
ACT: Sustaining the Results

Short term audits
  • Daily to weekly

Long-term audits
  • Quarterly review of patients who require treatment for ROP
  • Vermont Oxford Network (data obtained on a yearly basis)

Education
  • PRN based on compliance
  • Yearly competency for nurses
  • Part of new employee orientation to the NICU
Return on Investment

• UHS 2015

7 cases severe ROP that required laser or injection with anti-VEGF

Potential cost of one treatment of laser or anti-VEGF injection = $11,500/case

Anti VEGF injection = $3513 for 0.3 mg dose
$7314 for 0.5 mg dose

Facility cost of Laser or injection = $190
Patient exam = $100
Cost of one day in NICU bed = $3900

Potential ROI for prevention of Reactive Oxygen Species (ROS) comorbidities (CLD, IVH, NEC) = PRICELESS
Conclusion/What’s Next

Compliance
• Peaked within a few weeks of intervention to ~65%
• 8 weeks post-intervention, at ~ 30%

Barriers to sustaining the results
• Conflicting orders
• alarm fatigue
• Some programming issues with the monitors have been identified

Plan
• Working with IT to modify order set
• Contacting monitor manufacturer to modify alarms
• Continue audits (RT → RNs)
• Relay audit data to nursing staff at daily huddles
• Graphs showing compliance to be placed on LEAN board in unit
• One on one counseling with staff who is not compliant
Team Picture
Thank you!