Quality Improvement (QI) Initiative on Reducing the Incidence of Necrotizing Enterocolitis.

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Background: Necrotizing Enterocolitis (NEC) is a cause of significant morbidity and mortality in premature infants. The average incidence of NEC in inborn infants < 35 weeks gestation at our institution was 8.2% for years 2012 and 2013.

Aim: To reduce the incidence of NEC to below 5% in the < 35 week gestational age (GA) inborn population.

Setting: Penn State S. Milton S Hershey Medical Center has a level IV NICU with 42 NICU beds and an annual delivery volume of approximately 208 infants < 35 weeks GA / year.

Mechanism/Initiative: The team reviewed the literature and developed 8 better practice guidelines to implement consistently which prior to the QI initiative were not uniformly practiced.

Design/Methods: A bundle of 8 better practices (listed below) were developed and applied to our patient population. These included;
1) Use of colostrum < 24 hours of life
2) Initiation of mother’s milk or donor breast milk within 48-72 hours of life
3) Avoidance of nil per os (NPO) and continuing minimal enteral feeds during medical management of patent ductus arteriosus (PDA)
4) Discontinuation of all feeds 4 hour pre, during and post blood transfusion
5) Limitation of empiric antibiotics to < 48-72 hours
6) Discontinuation of antacid use
7) Indomethacin infusion to be given over 2 hours
8) Appropriate positioning of umbilical venous catheters (UVC) above the liver

These measures were monitored and collected prospectively following the inception of the QI initiative. Infant outcomes were followed until 36 weeks postmenstrual age or discharge, which ever was earlier. NEC diagnosis was based on the modified Bells criteria (Grade II and above), i.e. there had to be radiologic evidence of pneumatosis. Donor breast milk was only available for infants < 32 weeks GA in cases with inadequate supply of breast milk by 48 hours of life. Educational sessions with the clinical care team and use of visual cue cards were added to reinforce the QI recommendations. An interim analysis to monitor compliance to the 8 clinical guidelines was done at 2 intervals (after the first 6 months = 1st interim analysis; then after the next 4 months = 2nd interim analysis).

Measures: Compliance to the QI recommendations was monitored for each enrolled infant. Binomial quantification for each measure was attained and a distinct time stamp for introduction of colostrum, start of feeds, when indomethacin treatment was administered, quantification of feeds during indomethacin use, number of hours feeds held with each blood transfusion, age of infant when antibiotic treatment was discontinued and a radiology report of line placement with daily X-ray imaging was attained. Data was collected on a weekly basis and entered into a dataset on a monthly basis.

Results: Since September 2014, 147 infants have been followed. NEC was diagnosed in only 4 patients (2.7%). Of these 4 patients there was non-adherence to at least one of the guidelines in 3. After the 1st interim analysis of 88 patients at 6 months following the start of the QI initiative, we attempted to improve the compliance with the guidelines by using cards with visual cues placed at the patient bedside (Figure 1). Overall compliance of the 147 patients to the new feeding recommendations resulted in 80% of infants receiving colostrum < 24 hours of life, 77% of infants receiving mother’s milk or donor breast milk < 48-72 hours of age. PDA was diagnosed in 27 infants (18%) and 7 (26%) received treatment with indomethacin. Compliance to PDA management was 86% and 98% for the indomethacin infusion rate and the maintenance of minimal enteral feeds respectively. Blood transfusion was administered in 33 infants (22%) with 97% compliance to withholding feeds during...
transfusion. Limiting empiric antibiotic use to < 48-72 hours occurred in 87% of infants and only one infant (0.01%) received antacid. UVC was placed in 36 infants, with appropriate position maintained in 93% of infants (Table 1 and Figure 2). A run chart presentation of the data set is presented in Figure 3.

**Discussion:** The incidence of NEC was reduced from a historical average of 8.2% to 2.7% (a 67% reduction). We sustained > 80% compliance with the 8 better practice guidelines. The apparent drop in the use of human milk in < 48-72 hours in the 2nd interim analysis was due to recruitment of patients > 32 weeks GA, who were ineligible to receive donor milk. Compliance with the QI recommendations was improved by placing visual cue cards at the bedside. Of note, 3 of the 4 NEC cases presented within the first 5 months of the QI initiative and there was non-adherence to at least 1 guideline in all of them. We speculate that with improved compliance, the incidence of NEC will continue to fall.

Figure 1: QI visual cue card placed at patient bedside

Table 1: Demographic and compliance trends in inborn infants < 35 weeks gestation

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<thead>
<tr>
<th></th>
<th>Pre-QI</th>
<th>Post-QI</th>
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<tbody>
<tr>
<td></td>
<td>Total (n=416)</td>
<td>1st Interim (n=88)</td>
</tr>
<tr>
<td>NEC Incidence (n=4) (%)</td>
<td>34 (8.2)</td>
<td>3 (3.4)</td>
</tr>
<tr>
<td>Gestational Age (Mean ± S.D)</td>
<td>*</td>
<td>31.6 ± 2.9</td>
</tr>
<tr>
<td>Colostrum &lt;24 hours (%)</td>
<td>*</td>
<td>79.5</td>
</tr>
<tr>
<td>Mother’s milk/donor milk &lt; 48-72 hours (%)</td>
<td>*</td>
<td>81.8</td>
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<tr>
<td>Indomethacin infusion &gt;2 hours (%)</td>
<td>0</td>
<td>75.0</td>
</tr>
<tr>
<td>Gut prime/protect trophic feeds (%)</td>
<td>(n=4; n=3)</td>
<td>97.7</td>
</tr>
<tr>
<td>Hold feeds for transfusion (%)</td>
<td>(n=33)</td>
<td>95.5</td>
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<tr>
<td>Empiric antibiotics &lt;48-72 hours (%)</td>
<td>(n=109)</td>
<td>86.0</td>
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<tr>
<td>UVC position above liver (%)</td>
<td>*</td>
<td>92.0</td>
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* = Pre-QI initiative compliance is currently being determined
% compliance is based on patients who qualified for each individual measure within the analysis time frame (n=1st interim analysis; n=2nd interim analysis).
Figure 2: Changes in NEC incidence and compliance with practice recommendation

![Trends in Compliance and NEC incidence Following QI initiative](chart1.png)

Figure 3: Run chart of compliance to practice recommendation

![Run Chart of Compliance to Practice Recommendations](chart2.png)