**Organization:** Adventist Healthcare Shady Grove Medical Center

**Title:** A Team-Based, Innovative Approach to Providing Safer Care by Reducing the Incidence of Chronic Lung Disease in the Premature Newborn

**Background, Project Description and Goals:**
To decrease the incidence of chronic lung disease through the implementation of best practice, evidenced-based multidisciplinary care bundle tool in premature babies with respiratory distress syndrome at the Shady Grove Medical Center NICU.

**Project Description**

*Problem*

The first hour of a premature baby’s life represents a critical time period during which neonatal teams must work efficiently and in synchrony to provide appropriate resuscitative and post-resuscitative respiratory care. The dynamic and complex care delivery system that teams providing care for critically ill, premature newborns (24 0/7 wks to <32 wks gestation) are often fraught with less than ideal care including errors of commission, omission, equipment issues, miscommunication and assumptions not challenged that often carry risks of short and long-term respiratory injury, lifelong developmental delay and potentially death.

Chronic lung disease is a disease that is most common in premature babies whose lungs are not full developed and have respiratory distress syndrome. While many premature babies require the use of a mechanical ventilator to survive, the ventilator’s forced breathing and high oxygen levels can damage a baby’s lungs, brain and eyes. Indeed, the diagnosis of chronic lung disease is directly associated with a significant increase in mortality as well as a number of important morbidities including neurodevelopmental delay (i.e. learning disability, cerebral palsy), blindness (retinopathy of prematurity), lung infections (RSV) and readmission to the hospital after discharge.

Because of the significant impact that the diagnosis of chronic lung disease has on a baby’s life, the SGMC NICU identified this patient safety outcome as a target for improvement. The incidence of CLD was tracked utilizing the Clinical Data Warehouse—a large-scale database that allows the analysis of clinical information collected from Pediatric’s electronic health record enabling comparative analyses with over 300 neonatal intensive care units (NICUs) throughout the United States.

*Solution*

A multidisciplinary team comprised of neonatologists, NICU nurses, dietitian, NICU leadership, and NICU respiratory therapists convened to construct a specific, tailor-made and innovative bundle tool of evidence-based “potentially-better practices (PBP)” for use in patients 24-32 weeks gestation which have been demonstrated to clearly reduce the
incidence of chronic lung disease in premature newborns. Another essential resource for development of the bundle tool was the sharing of information and collaboration with more than 20 NICUs in the U.S. through our participation in the Vermont Oxford Neonatal Network. We also engaged senior leadership of the hospital throughout the process.

Prior to implementation of the bundle, our NICU team did not have a standardized, systematic approach to the provision of safer, gentler respiratory care in this vulnerable patient population. The “Optimizing Respiratory Care” Bundle evolved into a checklist and incorporated all of the important actions required by the neonatal team to provide appropriate ventilation with an emphasis on the use of non-invasive ventilation strategies. The Bundle was implemented by systematically communicating the checklist to all team members via emails, NICU Division Meetings, NICU Staff Meetings, NICU staff lounge education bulletin board and one-on-one meetings.

Once the bundle was implemented, the changes in practice were supported by a well-orchestrated and collaborative, team approach that was highlighted by the use of the foundational tools and strategies from AHRQ-endorsed, evidence-based teamwork training system, TeamSTEPPS (Team Strategies and Tools to Enhance Performance and Patient Safety). TeamSTEPPS is a powerful initiative to improve and advance the culture of safety at the Unit level and, in our NICU QI project, specifically helped by members of the team understanding everyone’s roles and responsibilities, the ability to feel comfortable speaking up in a “Just Culture” and importantly, to highlight leadership’s role in supporting the innovative changes in practice.

**Process and Performance Improvement Methodology:**

Our team utilized an innovative “Optimizing Respiratory Care” Bundle Tool for the management of each and every baby between 24 0/7 weeks and <32 weeks gestation. To build our knowledge and create sustainable change we used PDSA cycles throughout this project.

The bundle consists of the following **best practices:**

a. Encourage and recommend antenatal steroids administration for mothers with impending preterm labor to enhance lung maturity
b. Kinder and gentler resuscitation-minimize lung injury in the delivery room by using non-invasive ventilation (initiation of CPAP in delivery room)
c. Early use of caffeine citrate
d. Reduce ventilator associated lung injury by aggressive extubation to noninvasive ventilation strategies
e. Avoid hyperoxia and restrictive oxygen use (tightly titrating supplemental oxygen to maintain oxygen saturations between 89-95%, use of oxygen blenders in the delivery room)
f. Optimize oral nutrition to promote lung growth
g. Room-Air Challenge test performed twice a week for babies receiving supplemental oxygen
h. Engage in a multidisciplinary Team Huddle before all high-risk deliveries to provide clarity around roles, responsibilities, equipment needs and address any concerns any member of the team has regarding the plan of care.

Adherence to the Bundle was addressed by the NICU team every day during our multidisciplinary, family-centered rounds. The rounds are extremely collaborative and attended by respiratory therapists, nurses, charge nurses, physicians, social workers, pharmacists and case managers and enable any member of the team to advocate on behalf of the baby for bundle compliance.

**Measureable Outcomes**

Figure 1 and Table 1 graphically display the decrease (red line) in the rate of chronic lung disease in patients 24-32 weeks gestation decreased from 11.3% in 2014 (62 total patients) to 5.3% in 2015 (57 total patients).

Figure 1. Incidence of Chronic Lung Disease at SGMC NICU. Patients 24-32 weeks gestation. 2014-2016.
Table 1. Rate of Chronic Lung Disease at SGMC NICU. Patients 24-32 weeks gestation. 2014-2016 demonstrating a 47% decrease in the rate of chronic lung disease in patients 24-32 weeks gestation decreased from 11.3% in 2014 (62 total patients) to 5.3% in 2015 (57 total patients).

Figure 2. Average days by Type of Respiratory Support. Patients 24-32 weeks gestation. 2014-2015.
Table 2. Average days by Type of Respiratory Support. Patients 24-32 weeks gestation. 2014-2015. The average number of days on the conventional ventilator increased from 4.8 to 13.3 reflecting a higher number of patients 24-26 weeks gestation in 2015.

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Avg days by Respiratory Support - Yearly

<table>
<thead>
<tr>
<th>Gestation: 24 wks, 25 wks, 26 wks, 27 wks, 28 wks, 29 wks, 30 wks, 31 wks, 32 wks</th>
<th>Birth Weight: 501 - 1500g</th>
<th>Patient Status: All</th>
<th>Admit Groups: Inborn</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Nasal Cannula</th>
<th>High Flow Nasal Cannula</th>
<th>Nasal CPAP</th>
<th>NIPPV</th>
<th>ConV Ventilator</th>
<th>High Flow Vent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Days</td>
<td>Patients</td>
<td>Avg Days</td>
<td>Patients</td>
<td>Avg Days</td>
<td>Patients</td>
<td>Avg Days</td>
</tr>
<tr>
<td>2014</td>
<td>11.2</td>
<td>27</td>
<td>10.1</td>
<td>33</td>
<td>20.7</td>
<td>53</td>
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<tr>
<td>2015</td>
<td>13.9</td>
<td>21</td>
<td>10.4</td>
<td>23</td>
<td>18.5</td>
<td>54</td>
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</tbody>
</table>

Note: Patients will be counted for every support type they use on over the course of their stay.
Figure 3. Number of ventilator days, 2014-2016. This demonstrates a reduction in the percentage of patients cared for with mechanical ventilation from 27.4% to 15.8% from 2014 to 2015, representing a 42% reduction. This significant decrease in patients who required mechanical ventilation in spite of an increase in the average number of ventilator days which likely reflects a sicker, higher acuity population in 2015 compared to 2014.
Table 3. Number of ventilator days, 2014-2016. The percentage of patients who were managed with mechanical ventilation decreased significantly in spite of an increase in the average number of ventilator days.

<table>
<thead>
<tr>
<th></th>
<th>Patients</th>
<th>Average Ventilator Days</th>
<th>Patients on Mech Ventilation</th>
<th>Network 33%</th>
<th>Network 63%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>82</td>
<td>7.1</td>
<td>27.4%</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>2015</td>
<td>57</td>
<td>16.3</td>
<td>16.8%</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>2016</td>
<td>0</td>
<td>0.0</td>
<td>0.0%</td>
<td>2</td>
<td>13</td>
</tr>
</tbody>
</table>
**Innovation**

Advances in neonatal intensive care have resulted in improved survival of extremely low birth weight infants. However, it has also increased the incidence of serious morbidities such as chronic lung disease among survivors. Although the pathogenesis of chronic lung disease is believed to be multifactorial and complex, much of the focus is traditionally on injurious factors such as oxygen toxicity, ventilator associated lung injury and inflammation. Our team-based, QI approach to reducing what is thought to be one of the most important neonatal outcomes was unique and innovative since it was based on a holistic approach involving every interdisciplinary group — including the family — who touches babies in our NICU including administration, medical, nursing, pharmacy, respiratory care and nutrition. In this quality and safety improvement initiative, we have demonstrated that a comprehensive, team-based multidisciplinary approach to both respiratory and non-respiratory (nutrition, pharmacologic, teamwork, etc.) care practices was associated with a **47%** reduction to 5.3% in the incidence of chronic lung disease in our patient population.

**Sustainability**

Although we recognize that we have achieved short term success with the reduction of Chronic Lung Disease, we know the heart and soul of improvements in Quality and Safety is sustainability: locking in and maintaining the improvements in both process and outcome metrics over time. To that end, our plan is to measure bundle compliance and the rate of chronic lung disease monthly and to continue to reduce our chronic lung disease rate using rapid cycle improvement methodology.

Another dimension of sustainability will be to take advantage of the six key components that the Institute for Healthcare Improvement identifies for holding gains:

1. **Supportive Management Structure.** We will continue to enlist support from Physician and Nursing leadership and suggest recruiting an Executive Sponsor for this and every QI project.

2. **Structures to “fool proof” Change.** Consider using pre-populated Chronic Lung Disease Reduction tools/order sets in Cerner EMR.

3. **Robust, Transparent Feedback System.** We plan to publicly post both process and outcome chronic lung disease improvement data in the NICU on easy to read graphs.

4. **Shared Sense of the Systems to be Improved.** We will “over-communicate” to all stakeholder team members to share an understanding of the processes and systems that we are seeking to improve.

5. **Culture of Improvement and a Deeply Engaged Staff.** We will ensure that all team members are clear on the QI project and view improvement as part of their job.

6. **Formal Capacity Building Programs.** We will continue to educate and build upon our staff’s understanding of QI initiatives to evolve to a culture where improvement work is integrated into every day activity in the NICU.
Family Integration

NICU families are central to the provision of safe, high-quality care. We integrated our families into our project by flattening the hierarchy and inviting them to become active, co-champions of the reduction of chronic lung disease initiative by providing education them about the components of the CLD reduction bundle on our multidisciplinary, family-centered rounds that occur every day of the week.

In summary, our collaborative, team-based, multidisciplinary and innovative approach to reducing harm in the Shady Grove Medical Center NICU, by both utilizing a best practice bundle tool and actively promoting a culture of safety demonstrated a significant, measurable and sustainable reduction in the incidence of chronic lung disease in premature babies born between 24 – 32 weeks gestation.

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