NK 7EO: Describe and demonstrate how translation of new knowledge into nursing practice has affected patient outcomes.

At Massachusetts General Hospital (MGH), nurses are encouraged to take leading roles in the translation of new knowledge into practice, not only by their nursing colleagues, but by medical colleagues, as well. Florence Nightingale said, “It may seem a strange principle to enunciate as the very first requirement in a hospital that it should do the sick no harm.” In the examples that follow, nurses have led interprofessional teams that have focused on “doing the sick no harm.” Each example describes and demonstrates how the translation of new knowledge into nursing practice has improved patient outcomes.

In the first example, Jean Fahey, RN, MSN, ACNS-BC, Neuroscience Clinical Nurse Specialist (CNS), conducted a performance improvement project with the goal of reducing the utilization of indwelling urinary catheters on the two Neuroscience Units on Lunder 7 and 8. This project was the result of her participation in a prestigious program, Partners’ Clinical Process Improvement Leadership Program (CPIP), to which she was recommended by executive sponsors in both nursing, by Kevin Whitney, RN, MS, NEA-BC, Associate Chief Nurse, and medicine, by Aneesh Singhal MD, QA, Chair of the Department of Neurology.

The CPIP was launched in 2010 with the purpose of engaging clinical teams in the use of process improvement tools to reduce variations in care and to improve outcomes for patients. CPIP is a fast-paced, immersion program that gives participants the tools they need to evaluate and improve a process at their own institution, within the relatively short span of four months. Using specific tools such as process maps and cause and effect diagrams, clinicians are taught to perform root cause analysis and not just “jump to solutions.” Executive sponsors recommend participants to the program, especially those with project proposals that are aligned with Partners’ strategic goals of care redesign. CPIP encourages teams of two, usually a physician, along with a nurse or administrator. So, it was a unique opportunity for professional growth and development for the Neuroscience CNS to be selected as part of a team, along with Aurelie Cordier, MA, PM, Neurology Project Specialist.

In the second example, Janet Madden, RN, MS, CCNS, Clinical Nurse Specialist in the Newborn Intensive Care Unit at Massachusetts General Hospital for Children (MGHfC) and her team reduced the prevalence of retinopathy of prematurity (ROP) from 43.2% in 2006 to less than 10% in 2012 through a series of interprofessional interventions. And, in an important final step, Janet disseminated this knowledge to colleagues in an additional translational activity by publishing a manuscript in Advances in Neonatal Care.1

In the third example, Paula Restrepo, RN, BSN, a Staff Nurse in the Ellison 4 Surgical Intensive Care Unit (SICU) used the opportunity provided by her Munn Nursing Research Award (NK 4) to conduct a mentored, evidence-based practice project that resulted in the recommendation of discontinuing the use of graduated compression stockings that were being used concomitantly with intermittent pneumatic compression devices to prevent venous thromboembolism events (VTE) post-operatively. Her project resulted in a new guideline for practice specific to the Surgical Intensive Care Unit where patients often have significant contraindications to the use of pharmacologic VTE prophylaxis.

Example 1

Neuroscience’s Study of Indwelling Urinary Catheter Practices

Jean Fahey, RN, MSN, ACNS-BC, Neuroscience CNS, Co-Principal Investigator
Aurelie Cordier, MA, PM, Neurology Project Specialist, Co-Principal Investigator

1. Describe the purpose and the background.

The purpose of this interprofessional process improvement project was to reduce the overall utilization of indwelling urinary catheters (UCs) through the achievement of three aims over a four-month period. The first aim was to increase nurses’ awareness of a new UC guideline from a baseline of 30% to 80%. The second aim was to increase the occurrence of daily discussions about UC utilization among the RN–NP–MD team from a baseline of 30% to 50%. The third aim was to achieve a 20% reduction of inappropriate UCs from a baseline of 24%. These aims were scheduled to be completed by May 29, 2012.

The background of this project originated with the observation that there were no consistent guidelines to assist practitioners in making decisions regarding the utilization of UCs on two acute care neuroscience units (Lunder 7 & 8). It was also noted that there was little evidence of consistent daily communication between the Staff Nurses and the rest of the care team regarding the potential removal of UCs. Finally, it was noted that UCs were not removed in a timely manner. The co-investigators made these conclusions after a period of observation, as they were guided to do, in their CPIP course.

The prolonged use of UCs is the single most important risk factor for developing catheter-associated urinary tract infections (CAUTIs), which account for 40% of hospital-acquired infections. This project happened to occur when a new UC order set was being developed for the Physician Order Entry (POE) system. The Co-Investigators fully integrated this new policy into their project so that it was fully aligned with ongoing hospital initiatives. Using skills learned through the CPIP, the Co-Investigators convened an impressive interprofessional team at MGH.

2. Discuss who was involved and what units participated.

The Co-Investigators recruited a process improvement team which created strategies to reduce daily utilization of UCs. The process improvement team included the following clinicians:
- Allison Koran RN, BSN, and Alex Boed RN, BSN, Staff Nurses, Neuroscience
- Vik Rao, MD, Neurology Chief Resident
- Sue Algeri, RN, MS, and Ann Kennedy, RN, MS, Nursing Directors, Neuroscience
- Mary McDonough, RN, BSN, Nursing Director, Urology
- Adam Cohen, MD, Neurology Attending
- Paula Wright, RN, BSN, CIP, Infection Control Director
- Charlene Feilteau, RN, BSN, Patient Care Services Information Systems Services

2 http://www.cdc.gov/HAI/ca_utu/uti.html
The project also had the support of the following sponsors to ensure the team had the necessary resources to do its work:

- Aneesh Singhal MD, QA Chair of the Department of Neurology
- Lee Schwamm MD, FAHA, Vice-Chair of the Department of Neurology
- Kevin Whitney, RN, MA, NEA-BC, Associate Chief Nurse, Surgery and Interim Director, PCS Office of Quality & Safety

Danny Yagoda, MPH, Health Engineer served as the Project Coach. The two participating units involved were Lunder 7 & 8, both Neuroscience Units.

Pictured at left is the 2012 Class of the Partners Clinical Process Improvement Leadership Program, including PI, Jean Fabey, RN, MSN, ACNS-BC.

3. Describe how work was done.

Using the Plan-Do-Study-Act process, the team planned small tests of change. The first step in the process was to assess the then current practice. The team created the Indwelling Catheter Removal Process Map (attachment NK 7EO.a) from which they concluded that daily reassessment of the need for UCs occurred only 30% of the time. Next, the team created a cause and effect diagram that identified role-specific and contextual variables that were believed to contribute to prolonged UC use (attachment NK 7EO.b). The team then developed an Indwelling Urinary Catheter Guideline based upon the national guideline from the Centers for Disease Control and Prevention (attachment NK 7EO.c).

During the weeks of April 14 through April 23, 2012, the nursing staff were interviewed to assess their level of awareness of any UC Guideline, as well as the existing level of daily communication among RNs–NPs–MDs for UC removal. This established their baseline data, revealing that nurses were aware of any guidelines 30% of the time, and that discussions occurred daily regarding UC removal 30% of the time (see Table 1).

Next, the team designed and implemented two interventions–education and attestations. They used staff meetings one-to-one training, and emails to provide education to Staff Nurses regarding the UC Guideline. Posters regarding the new UC Guideline were displayed on both Neuroscience units for over two weeks. During the weeks of May 15 and May 29, 2012, Staff Nurses and Physicians were prompted to review the UC Guideline. The team implemented a simple system, using index cards, to reinforce the learning and engage nurses. Staff Nurses, who were caring for patients with a UC, were asked to take an index card and respond to two questions: “Are you aware of the UC Guidelines?” and “Did you talk to the team about the UC?” During these two weeks in May 2012, 100% of nursing staff surveyed attested to using the new UC Guideline. Daily discussions regarding UCs were then occurring 63% of the time, according to Staff Nurses’ self-report on the index cards. The team reinforced the learning by randomly selecting an index card from the collection in order to give away small gifts to thank staff for participating.
### Table 1. PDSA: Tests of Change

<table>
<thead>
<tr>
<th>Date of PDSA cycle</th>
<th>Description of intervention</th>
<th>Results</th>
<th>Action steps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weeks: April 14th &amp; April 23rd</strong></td>
<td><strong>Define Baseline Data</strong> Nursing staff were interviewed to assess the level of awareness regarding any UC Guideline as well as the existing level of communication with MDs/NPs for UC removal</td>
<td>Only 30% of nursing staff is aware of existing guidelines Discussions regarding UC removal happened only 30% of times</td>
<td>Need education Need to reinforce the importance of discussing UC status on rounds</td>
</tr>
<tr>
<td><strong>May 15th through May 29th</strong></td>
<td><strong>Posters &amp; Attestations</strong> Nursing staff and MDs were prompted to review the UC Guideline Nursing staff were asked to complete an attestation form regarding knowledge of the UC Guideline and communication with team</td>
<td>100% of nursing staff surveyed attested using the new UC removal guidelines 63% of discussions between nurses and the treating teams regarding UC Guideline are now taking place daily</td>
<td>Enforce guidelines utilization and make them part of education materials for each new nursing orientation Continue daily communication during interprofessional rounds (item on rounds checklist)</td>
</tr>
</tbody>
</table>

4. Describe the measurement used to evaluate the outcomes and the impact.

The team identified two process measures and one outcome measure for the project. The first process measure was the nurses’ awareness of the UC Guideline. The target population was Staff Nurses caring for patients on the Neuroscience Units (Lunder 7 and 8). They calculated the metric as:

\[
\text{UC Guideline Awareness} = \frac{\text{Number of completed interviews (pre) or attestation forms by nurses (post)}}{\text{Number of patients with UCs}}
\]

The data sources were the numbers of completed interviews with nurses in the pre-intervention period or the numbers of attestation forms completed by nurses in the post intervention period. This data is shown in Figure 1 below.
The second process measure was the daily RN–NP–MD discussion in which the necessity of the UC was discussed. The target population was all nursing staff on the Neuroscience units (Lunder 7 and 8). They calculated the metric as:

\[
\text{Daily discussions} = \frac{\text{Number of completed interviews (pre) or attestation forms by nurses (post)}}{\text{Number of patients with UCs}}
\]

The data sources were the numbers of completed interviews with nurses in the pre-intervention period or the numbers of attestation forms completed by nurses in the post intervention period. This data, shown in Figure 2 below, reveals that the intervention doubled the number of daily discussions that occurred among the RN–NP–MD team.

Figure 1. Nursing Staff Awareness of UC Guideline

Figure 2. Percent of RN–NP–MD Discussions about Removing UCs
The outcome measure was designed as the daily utilization rate of UCs. The patient population was all patients on the Neuroscience units (Lunder 7 and 8) during the time period of April 1, 2012 through May 29, 2012. The metric was calculated:

\[
\text{Daily Utilization} = \frac{\text{Total number of UCs/day}}{\text{Total number of patients on the observed units (n=64)}}
\]

The source of the data was the Daily Windows Classification Acuity Data for the time period noted above. The data is shown in Figure 3 below.

![Daily UC Utilization on MGH Neuroscience Units](image)

Figure 3. Daily UC Utilization on Neuroscience units (n=64 beds)

The data indicates that Staff Nurses were very aware of the UC Guidelines. The target of 80% was exceeded and was measured at 100% post-intervention. The daily discussions among the RN–NP–MDs are taking place more often. The target of 50% was exceeded and was 63% in the immediate post-intervention period. The overall reduction in UC utilization was noted, but the assessment of appropriate versus inappropriate UC use could not be determined due to the limitations of the study. The target of 20% reduction was almost achieved during the 4-month study period (21% post-intervention). The most recent data (see Figure 4 below) indicate that the target was achieved in August 2012 when the overall UC utilization rate fell to 17%. Thus, the 20% reduction was achieved, although it took slightly longer than predicted.
Going forward, sustainability strategies have been identified. All newly hired Staff Nurses will be taught the UC Guideline. The CNSs, Nursing Directors, and Resource Nurses will reinforce daily discussions among the RN–NP–MDs regarding UC utilization. The metrics will be monitored on a quarterly basis, along with other quality indicators. Finally, the UC Guideline is aligned with the new UC template for Physician Order Entry, which will permanently integrate the guideline into practice. Ideas to expand this practice improvement include determining where and why UCs are placed, evaluating whether proper technique is being used when UCs are placed, and performing overall surveillance to CAUTIs.

Example 2
Reducing Retinopathy of Prematurity
Janet E. Madden, RN, MS, CCNS, Principal Investigator
Deborah L. Bobola, RN, BSN, Clinical Scholar
MGHfC NICU Nursing Staff
Margaret Doyle Settle, RN, PhD, Nursing Director

1. Describe the purpose and background.

The purpose of this performance improvement project was to reduce the prevalence and severity of retinopathy of prematurity (ROP) among a population of infants born at less than or equal to 28 weeks gestation and/or weighing 1500 grams or less.

Retinopathy of prematurity (ROP) is a common disease of premature infants and the leading cause of childhood blindness in developed countries. In 2006, the MGH for Children (MGHfC) Newborn Intensive Care Unit (NICU) joined the Vermont Oxford Network
(VON), a collaboration of health professionals whose work is focused on improving the quality of care for NICU patients and their families. The VON maintains a database that includes information about the care and outcomes of high-risk newborns. Worldwide, more than 800 NICUs are enrolled in the VON. Since 2006, MGH NICU nurses have been able to view their performance against globally-benchmarked data.

The data shown in Table 3, shown as, “MGH 2006,” revealed some disappointing information to the NICU Staff. The NICU team learned that in three VON categories, the MGHfC data was higher than average. The categories were “any ROP,” “severe ROP,” and “ROP requiring surgery,” or Surgical ROP, the latter being twice that of comparable cohorts.

<table>
<thead>
<tr>
<th>Table 2. Comparison of Prevalence of ROP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any ROP (%)</td>
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<tr>
<td>MGH 2006</td>
</tr>
<tr>
<td>2006 Benchmarks:</td>
</tr>
<tr>
<td>VON</td>
</tr>
<tr>
<td>Massachusetts NICUs</td>
</tr>
<tr>
<td>All US NICUs</td>
</tr>
</tbody>
</table>

Described in this section are the components of the process improvement processes that are ongoing in order to continue to improve metrics as new information becomes available in this area.

2. Describe how the work was done.

The NICU team began by developing a Nursing Practice Guideline which evolved into the ROP Guideline in 2008, updated in 2010 and 2011 to ensure continued best evidence (attachment NK 7EO.d). The NICU Staff Nurses continue to closely adhere to the ROP Guideline. Over the years, Nurses have adjusted practice to embed best practices into the unit’s culture. They identify infants meeting criteria and maintain oxygen saturation at desired levels. They continue to create nursing assignments that support Staff Nurses at the bedside, providing them with the necessary flexibility to be readily available to intervene and co-manage these patients with the Respiratory Therapists. The susceptible infants are identified on the white boards (location of group report) as well as the cardiac monitor in the infants’ rooms. In addition, once an infant matures to 32 weeks gestation, they are examined on a regular schedule by Ophthalmologists from the Massachusetts Eye and Ear Infirmary. Each Monday, the Resource RNs receive an email identifying which infants will be examined that day. After the exams, the Ophthalmologists inform the staff of the exam findings and the exams are discussed at weekly interprofessional rounds. They are aware weekly of each infant’s status with respect to his/her eye development. The Staff Nurses continue to be vigilant for ways to fine tune these implementation processes to ensure excellent patient outcomes.
3. Describe who was involved.

The NICU Clinical Nurse Specialist (CNS) took a lead role in this project. The CNS was joined by a Staff Nurse, who is a Clinical Scholar, the highest level a nurse can achieve in the Clinical Recognition Program, discussed in (SE 4). The interprofessional team, including the Nursing Director, Medical Director, and Respiratory Therapy Supervisors, supported adherence to the ROP Guideline to ensure that all members caring for susceptible infants were following the same guideline. The direct care providers included all NICU Staff Nurses and Respiratory Therapists.

4. Describe the measurement used to evaluate the outcomes.

The Staff Nurses and entire interprofessional team monitored the incidence and severity of ROP on a weekly basis after the Ophthalmologists completed their exams. In addition, the data for each infant is submitted to VON and every case of ROP is included in their annual reporting.

Every incidence of ROP was documented by chart abstraction and submitted to the VON network. The earlier reductions in ROP, as described in the article written by the MGH CNS and Clinical Scholar (attachment NK 7EO.e), resulted in the reduction of the incidence of “any ROP” from 43.2% in 2006 to 6% in 2008; a reduction in “severe ROP” from 13.6% in 2006 to 2% in 2008, and a reduction in “surgical ROP” from 9.5% to 2%.

<table>
<thead>
<tr>
<th>Table 3. Comparison of Prevalence of ROP</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>MGH 2006</td>
</tr>
<tr>
<td>MGH 2008</td>
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<tr>
<td>VON</td>
</tr>
<tr>
<td>2006 Benchmarks:</td>
</tr>
<tr>
<td>Massachusetts NICUs</td>
</tr>
<tr>
<td>All US NICUs</td>
</tr>
</tbody>
</table>

The graph found in attachment NK 7EO.f contains the MGHfC NICU and VON ROP rates for the years 2010 through Quarter 2 of 2012.

- The top graph shows that 100% of newborns at MGHfC are screened for ROP, consistently exceeding the VON benchmark (93.80%) for all eight quarters.

- The lower graph shows that the prevalence of ROP ranged from 0.00% for four quarters to 8.33%, 11.11%, and 33.33% for one quarter, respectively while the VON benchmark for 2010 was 43.20%. The rate decreased significantly from Quarter 1 in 2010 from 33.3 3% to less than 12%. Again, MGHfC consistently exceeded the VON benchmark.

Although the intent is to prevent ROP for all infants in the MGHfC NICU, the NICU team believes that the interventions in place supported and sustained the gains in reducing the incidence and severity of ROP in the NICU.
Note: In 2012, the National Quality Forum recognized ROP as a quality indicator for newborn intensive care units. The work of the MGHfC NICU Staff Nurses has certainly been ahead of its time.

**Example 3**

*The Development of a Guideline for Graduated Compression Stockings versus Intermittent Pneumatic Compression Devices in the Surgical ICU*

*Munn Nursing Research Award*

Paula Restrepo, RN, BSN, Staff Nurse and Principal Investigator
Deborah L. Jameson, RN, MS, Clinical Librarian, Treadwell Library
Diane L. Carroll, RN, PhD, FAAN, Nursing Researcher and Mentor

1. Describe the purpose and the background.

The purpose of this evidence-based practice project was to: 1) identify the compliance rate of VTE prophylaxis with non-invasive mechanical modalities in SICU patients; 2) discover system barriers to VTE prophylaxis that are appropriate for system improvement processes; 3) develop a written guideline and an educational program to define and disseminate a standard of care for proper use of non-invasive mechanical modalities, both GCS and IPC devices; and 4) re-assess compliance rate of VTE prophylaxis with non-invasive mechanical modalities after implementation of the guideline.

Thromboembolic disease remains a significant source of morbidity and mortality in the surgical population. Continuous surveillance for signs and symptoms of venous thromboembolism (VTE) is a part of nursing care. With improvements in VTE prophylactic interventions, pharmacologic as well as non-invasive mechanical device, VTE is now potentially preventable. In the Surgical Intensive Care Unit (SICU) patients often have significant contraindications to the use of pharmacologic VTE prophylaxis. Non-invasive mechanical devices are widely used as the sole or adjunct method of VTE prophylaxis in this unit.

Evidence on clinical outcomes from randomized controlled trials evaluating mechanical devices versus no mechanical devices is sparse. In 2011, most evidence-based guidelines are recommending against the use of GCS for prevention of thromboembolism (Grade: strong recommendation; moderate-quality evidence).3,4,5

---


2. Describe how the work was done.

This was a mixed method design that included pre/post observation, focus groups, VTE prophylaxis guideline development and implementation. This project was guided by the Iowa Model of Evidence-Based Practice to Promote Quality Outcomes. The Principal Investigator and Clinical Librarian conducted a search of over 500 articles regarding the state of the science of VTE prophylaxis. The PI contacted international experts in the field, as well.

Next, the PI and her team conducted an observational study for three weeks. Data was collected as to the presence of a medical order followed by direct observation of patients to determine the adherence to the order. The study team was also to observe whether the pump was “on,” or not. The compliance rates were similar to published rates of compliance, around 78–80%.

Focus groups with SICU Staff Nurses were completed to identify current barriers and facilitators to the use of VTE prophylactic non-invasive mechanical devices. Nurses reported common problems associated with GCS, such as poor fit, binding, and wrinkles that may compromise skin integrity. Staff Nurses called this the “tourniquet effect.” The nurses reported that patients frequently find them to be hot and restricting. Staff Nurses also reported that the pump is often found not “on.” In addition Staff Nurses noted that the GCS made it more difficult to examine the foot for color, temperature, pulses, skin integrity, and edema.

Following the pre-observation period and focus groups, a written guideline on VTE non-invasive mechanical devices was developed based upon the literature and expert consultation. System barriers to use of non-invasive mechanical devices were addressed and SICU nurses participated in an education program.

Following guideline development and the education dissemination, a second observational period of 3 weeks was completed to assess compliance rate of VTE prophylaxis with non-invasive mechanical modalities in SICU patients.

3. Discuss who was involved and what units participated.

The research team was a SICU Staff Nurse, Medical Librarian and a Nurse Researcher and the study was completed in the SICU. Staff Nurses who were also students at local universities participated in data collection, as well as a Staff Nurse from the Clinical Research Center.

Support for this study was provided by the Clinical Translational Science Award UL 1RR025758 to Harvard University and the Massachusetts General Hospital from the National Center for Research Resources. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Resources or the National Institute of Health. This study was also supported by a Munn Nursing Research Award, described in NK 4.
4. Describe the measurement used to evaluate the outcomes and the significance.

The sample for the study is shown in Table 4. There were no significant differences in demographics or the days of observations between those patients observed prior to the implementation of the guideline, and those patients observed after the implementation of the guideline, as shown by non-significant \( p \) values.

<table>
<thead>
<tr>
<th>Table 4. Comparison of Demographic Characteristics Among Two Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-data Observations</strong></td>
</tr>
<tr>
<td>(n=95)</td>
</tr>
<tr>
<td>July 2010</td>
</tr>
<tr>
<td>Age (Years)</td>
</tr>
<tr>
<td>Gender (M/F)</td>
</tr>
<tr>
<td>Days of Observations</td>
</tr>
</tbody>
</table>

Using a data collection tool developed by the investigators to assess compliance with GCS and IPC, 601 pre- and 602 post-observations were made of subjects during two, 3-week time periods in the SICU. Each subject was observed by study staff twice daily to assess for 1) the presence of a medical order, and 2) the actual correct application of GCS and/or IPC. The mean observation days per subject were 3.56 pre and 3.86 days post.

In Table 5 below, the compliance rate for both components (medical order and correct application), did not change. There was no change in medical orders pre and post the GCS/IPC guideline. The reason for this was that the electronic order set contained orders for the concomitant use of both the GCS and the IPC. It was beyond the Principal Investigator’s control to have the order set changed during this time period. The Principal Investigator and her Mentor are currently working to have this revised. There was no significant difference in compliance regarding the use of GCS or IPC with a mean rate for 4 days of 76.5% pre and 76.3% post the implementation of the GCS/IPC Guideline.

<table>
<thead>
<tr>
<th>Table 5. Compliance Rates Pre/Post GCS/IPC Guideline Implementation</th>
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</thead>
<tbody>
<tr>
<td><strong>Day</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1- morning</td>
</tr>
<tr>
<td>afternoon</td>
</tr>
<tr>
<td>2- morning</td>
</tr>
<tr>
<td>afternoon</td>
</tr>
<tr>
<td>3- morning</td>
</tr>
<tr>
<td>afternoon</td>
</tr>
<tr>
<td>4- morning</td>
</tr>
<tr>
<td>afternoon</td>
</tr>
</tbody>
</table>
In the first quarter since the change, the SICU noted an **eight-fold decrease in the distribution of GCS** from the SICU storeroom. Further work needs to be done with colleagues in the Operating Room, as this policy is rolled out throughout the hospital.

**Implications for Practice**

The prevention of VTE is extremely important causing a tendency to “do everything possible” despite the fact that close examination of research findings revealed little evidence for GCS. In this study, a baccalaureate-prepared Staff Nurse conducted an impressive and rigorous review of the literature, in conjunction with a Nurse—Medical Librarian from the Treadwell Library. Her findings, supported by recent national guidelines, recommended **against** the use of GCS. As a result, nurses in the SICU are no longer using GCS but are using the IPC devices, for which there is more convincing evidence. They are now in the process of disseminating the guideline regarding mechanical devices to prevent VTE to other surgical areas, where pharmacologic VTE prophylaxis is also an issue. In addition, they are spearheading an initiative to update the Physician Order Entry so that GCS are not included in the order set along with IPC.

The photos below, taken by the PI, show the “tourniquet effect” and its sequelae 24 hours later.
This project was the result of a Munn Nursing Research Award granted in 2010. The formal presentation of the findings occurred on Nursing Research Day, May, 2012 (above) and is described in the Caring Headlines article found in attachment NK 7EO.g.

“Never doubt that a small group of thoughtful, committed Nurses [citizens] can change the world; indeed, it's the only thing that ever does.” Margaret Mead
Indwelling Catheter Removal Process Map

Point of Impact

Occurs 30% of the time

Patient Assessment

MD decides catheter is needed

MD writes an order

RN places catheter

Catheter needed, catheter remains

Daily Re-assessment of need

No further need

RN Obtains Order to D/C catheter

Catheter discontinued by RN

Occurs 70% of the time

Catheter remains

No Daily re-assessment of need
Cause & Effect Diagram

**Clinical Factors**
- Patient preference
- Unclear clinical needs

**Environment**
- Low priority
- No rounding done

**ACTION**
- Time trying to contact provider
- Ease of skin care or incontinent management
- Caregivers not familiar with patient
- Criteria not defined or communicated
- Maintain status quo
- No ownership

**MD**
- Low priority
- No ownership
- Incomplete / Inconsistent information on patient
- Poor assessment

**RN**
- Low priority
- No ownership
- Criteria not defined or communicated
- Poor assessment
- Caregivers not familiar with patient
- Rushed

**Prolonged Urinary Catheter Use**
**Indwelling Urinary Catheter Guideline**

**Indications for indwelling urinary catheter:**
- Immediate post-operative period
- After minor urological/gynecological/rectal surgeries
- Acute urinary retention/bladder outlet obstruction/difficult urinary catheter placement
- Monitoring of urinary output in critically ill patients
- Gross hematuria/risk for clotting
- Epidural in place; or prolonged effect of epidural after removal
- Chronic urinary retention/chronic indwelling catheter/no reasonable alternative
- Requires prolonged immobilization/unstable spine/multiple traumatic injuries
- Stage 3-4 sacral, perineal or truncal pressure ulcers
- Comfort measures, palliative care for a terminally ill patient
- Urethral trauma or post-op for radical prostatectomy

**YES indication for catheter**
- Continue to assess

**NO indication for catheter:**
- Discontinue indwelling catheter with order
  - Monitor bladder distention: (increased HR/RR, diaphoresis, restlessness)
  - Promote PO intake prn, provide privacy, offer toileting assistance

**No void after 6 hours**
- Bladder scan or straight catheter

**Void after 6 hours**
- Continue to Assess

>400 cc with adequate intake: straight catheterization with order, Q 4-6 hours to keep volume < 400 cc.

If straight catheterization required two or greater times for > 400 cc, consider straight catheterization program, or CNS/urology consult.
LEVEL OF PERSONNEL:

- RN
- MD
- NNP
- RRT

DESIGNATED CLINICAL AREAS:

- Blake 10 NICU
- Ellison 13 SCN and TCU
- Blake 14 L&D

APPLICABLE POLICY STATEMENT:

All infants at risk for ROP will be monitored with a pulse oximeter.

All infants with a gestational age of less than 32 weeks or a birth weight <=1500 grams, who are receiving supplemental oxygen, should be monitored in the PT ROP (Preterm at risk for ROP) default setting, set to alarm if the oxygen saturation falls to <89% or increases to >94%. (Monitor alarm limit set at 88% and 95% such that acceptable oxygen saturations are between 89% and 94%).

All infants with a gestational age of less than 32 weeks or a birth weight of <= 1500 grams, who are in room air, should be monitored in the PT ROP RA (Preterm, at risk for ROP, in room air) default setting.

Alarms are set at a “warning” level.

Bedside oxygen delivery equipment (flow meters and blenders) is standardized, such that:

- A 15 liter flow meter and blender is used solely for resuscitation bags.
- Nasal cannulas are weaned by flow only and can deliver oxygen via a 1 liter flow meter that is marked with 100 cc increments or a 250 cc flow meter that is marked with 25 cc increments.
- Nasal cannula oxygen is delivered via a 1 liter or 250 cc flow meter connected directly to wall oxygen, and the flow is adjusted to maintain saturations appropriate to desired saturations.
CRITICAL ELEMENTS:

Retinopathy of prematurity (ROP) is a well documented morbidity in premature infants born at less than 32 weeks gestation or with a birth weight of less than 1500 grams. It can also occur in infants born at a gestational age greater than 32 weeks, with a birth weight between 1500 and 2000 grams, who have had a particularly difficult clinical course. ROP is characterized by the abnormal proliferation of blood vessels in a developing retina. It is the leading cause of childhood blindness in developed countries. Oxygen saturation parameter guidelines are set to minimize the incidence of ROP and its complications.

Although the cause of ROP is thought to be multi-factorial, there have been a number of studies that have shown a relationship between oxygen therapy and ROP.

Eliminating hypoxic – hyperoxic episodes can decrease the incidence and severity of ROP.

All episodes of apnea, bradycardia and desaturation should be documented on the Apnea/Bradycardia/Desaturation record on the NICU flow sheet.

EQUIPMENT:

- An oxygen delivery system (ventilator and resuscitation bag, NCPAP circuit or nasal cannula)
- Pulse oximeter and probe
- A neonatal monitoring system

NURSING ACTIONS: | SPECIAL CONSIDERATIONS:
--- | ---
1. Upon admission of infant to unit, apply saturation probe and select appropriate oxygen saturation parameter default, determined by the infant's need for oxygen. | Select the default setting on the monitor that is relative to the infant's condition:
- PT ROP (Preterm, at risk for ROP, receiving supplemental oxygen)
- PT ROP RA (Preterm, at risk for ROP, in Room Air)

2. If infant is at risk for ROP and is receiving oxygen, select the ROP default. Titrate oxygen so that infant remains within parameters of the ROP default. | Minimizing oxygen use and maintaining oxygen saturations within these parameters can reduce the risk of ROP.
Failure to set oxygen saturation parameters appropriately is considered a performance issue.

3. For infants at risk for ROP, the oxygen saturation low limit alarm will be set at 88% and the oxygen saturation high limit at 95%, unless ordered otherwise. | If desired saturation parameters are different from the default parameters, a MD/NNP order must define the acceptable saturations for a specific infant.
The attending MD should be part of the discussion regarding appropriate saturations for any infant receiving oxygen and the decision to alter the saturation parameters.
All efforts should be made to minimize swings in both oxygen concentration and saturation as this increases the risk of developing ROP.

4. Monitoring of infants to maintain saturations within desired range and titration of oxygen is a collaborative effort of the RN and RRT. | Team approach provides additional staff members for bedside monitoring and management of oxygen saturations and delivery.
Provides greater opportunity for infant to be maintained within desired oxygen saturation range as much as possible.
Provides for better alarm management, thus
5. The infant should be continuously assessed if ventilator, $F_0_2$, or cannula flow is altered. RN or RRT must remain at bedside until patient is stabilized.

**MANAGEMENT of DESATURATIONS**

6. If the infant's oxygen saturation falls below 85%, inspired oxygen should be adjusted using the following approach:
   
   A. Increase ventilator oxygen concentration in increments of 3 to 5% every 30 seconds.
   
   B. Increase nasal cannula flow by 25 to 50 cc every 30 seconds when infant is on flows of less than 250 cc/min. When infant is on more than 100 cc, adjust flow in increments of 50-100cc.
   
   C. Resuscitation bags for at risk infants should be routinely set at 60% and when in use adjusted appropriate to the infant's saturation.
   
   D. During a desaturation event, evaluate for appropriateness of displayed value by assessing pulse oximeter's correlation with infant's heart rate:
      - Cyanosis
      - Apnea
      - Bradycardia
      - Decreased perfusion
      - Airway obstruction
      - Self-extubation
      - Other changes in condition
   
   E. If patient is apneic and desaturating, tactile stimulation or positive pressure breaths may be required to stimulate spontaneous respirations. Positive pressure should initially be delivered using a concentration of 0.6 and adjusted as necessary in response to the infant's condition.
   
   F. If a ventilated infant desaturates with handling or after a procedure and derecruitment has likely occurred, increase oxygen concentration in increments of 3 to 5%.
   
   G. Notify MD/NNP and RRT for assessment evaluation if oxygen requirement is 20% over baseline and unable to wean.
   
   H. RN/RRT must remain at bedside until consistent with delivery room resuscitation practice for infants at risk for ROP. Concentrations of oxygen should be adjusted according to infant's response.

Be sure that MD/NNP orders new settings.
patient returns to baseline settings or decision is made to maintain infant at increased settings.

**MANAGEMENT of HIGH OXYGEN SATURATIONS in INFANTS on MECHANICAL VENTILATION or NCPAP**

7. If the infant’s saturation is above 94%, wean oxygen by 3 to 5% every 30 seconds to achieve target range.
   - If infant is on a ventilator or NCPAP, do not wean oxygen if saturation is less than 90 or decreasing within 60 seconds following the last reduction in oxygen.
   - If infant is on NCPAP, wean oxygen by 3 to 5% every 30 seconds.
   - If oxygen is 21% and CPAP has been weaned to 5cm, notify MD or NNP to consider discontinuing CPAP.

The possibility of weaning or discontinuing CPAP should only be considered for those infants who are on short-term CPAP for an acute event. It may not be appropriate for those infants with chronic lung disease who require long-term CPAP.

**WEANING NASAL CANNULAS**

8. Nasal cannula should be weaned by flow.
   - If infant is on a low flow of less than 1 liter nasal cannula, wall oxygen, wean flow to next lower 100 cc increment and reassess. Continue weaning in 100 cc increments until desired oxygen saturation is achieved.
   - Once an infant is on a flow of 200 cc, the nasal cannula should be connected to the 250 cc flow meter and weaned in increments of 25 cc to maintain saturations within the target range.
   - Once an infant has weaned to a flow of 25 cc/min and continuously has saturations above the target range, consideration should be given to discontinuation of the nasal cannula.
   - Infants that desaturate on room air should have a thorough assessment of their respiratory/pulmonary status along with their overall status, with careful attention to the GI system to determine all possible causes of the desaturations.
   - If an infant cannot be completely weaned from the nasal cannula and requires a flow less than 25 cc/min, the RN or RRT may discuss liberalizing the oxygen saturation upper limit.

Weaning flow will decrease delivered oxygen concentration.

This may be confusing for parents who may be aware of efforts to minimize oxygen delivery. Thus, parents should be educated about the fact that oxygen is blended with room air and that the amount of oxygen that actually reaches baby is much less than 100%.

It is important that RN or RRT remain at the infant’s bedside for continuous assessment and alarm silencing during this time.

RN should ensure that the infant is positioned appropriately to minimize the impact of gastroesophageal reflux (GER). RN should ensure that nasal secretions are not occluding the airway. Other possibilities, such as inadequate caffeine level, should also be considered.

If an infant requires less than 25cc of flow and is maintaining a SP02 greater than 95% but cannot maintain this target range SP02 on room air after considering other reasons for the desaturation event, an order to allow a higher SP02 limit can be sought. However, if the infant maintains a SP02 >95%, a trial on room air must be attempted and the results documented a minimum of at least daily.

The saturation parameters determined should be
supported by an order in POE and only pertain to when the infant is receiving less than 25 cc/min of oxygen.

| 9. | Staff member must remain at bedside 5 minutes following a wean in oxygen. | Evaluates effectiveness of the wean in oxygen and minimizes swings in oxygen concentration. |
| 10. | If an infant that falls into the at-risk for ROP population (less than 32 weeks or with a birth weight of less than 1500 grams) is on room air, the high saturation limit may be increased to 101% or changed to the PT non-ROP default. | Must be returned to the ROP default if the patient requires oxygen therapy again. |
| 11. | Continue with this practice until the first retinal exam has been completed. | Saturation parameters will be discussed and re-evaluated with the NICU team and the ophthalmologist based on examination findings and the infant’s condition. |
| 12. | Document changes made, as well as, infant’s response, on the NICU flow sheet and in the nursing progress note. All apnea, bradycardia and desaturation events should be documented on the Apnea/Bradycardia/Desaturation section of the NICU flow sheet, as well. | Represents standard practice and provides guidance for subsequent changes. |
| 14. | Beside RNs and Resource nurses should engage in on-going dialog about the acuity of infants, changes in an infant’s status, and geographic feasibility and possibilities for assignments. | Allows for care needs of infants on ROP protocol to be met as effectively as possible. |
| 15. | Document the infant’s respiratory acuity accurately in the hospital’s Acuity and Complexity system. | Most infants on ROP protocol require constant monitoring of oxygen saturations to determine appropriate oxygen delivery. These infants should be scored as “acute” to reflect the nursing care and vigilance provided to them. |

**REFERENCES:**


**REVISION DETAIL:**

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A Data-Driven Approach to Retinopathy of Prematurity Prevention Leads to Dramatic Change
Janet E. Madden, MS, RN, CCNS; Deborah L. Bobola, BSN, RN

ABSTRACT
Retinopathy of prematurity (ROP) is a common disease of premature infants. It is characterized by an abnormal proliferation of blood vessels in the developing retina and is the leading cause of childhood blindness in developed countries. This article describes a systematic approach to prospectively reduce the incidence of ROP in a newborn intensive care unit (NICU). We realized the need for improvement when we reviewed comparative data indicating that our rates of ROP were higher than those in NICUs in our local area, across the United States, and around the world. After informal efforts appeared successful in significantly reducing ROP, we designed and implemented a more structured approach to ROP prevention that included improvements in practice related to oxygen administration and monitoring. An evidence-based guideline was developed, and education was provided to all direct care providers. We also standardized bedside oxygen delivery equipment and implemented new parameters related to nasal cannula weaning. Rates of ROP, severe ROP, and ROP requiring surgical intervention were reduced by more than 50% during the first year and more than 75% by the end of the second year after implementation of our unit-based program.

KEY WORDS: blindness, newborn intensive care unit, oxygen delivery, oxygen saturation parameters, oxygen toxicity, prematurity, retinopathy of prematurity

The VON maintains a database that includes information about the care and outcomes of high-risk newborns. Currently, more than 800 NICUs from around the world are enrolled in the VON. After we became members of VON, we received an objective and comparative view of our practice that was new to us. The VON data allowed us to compare rates of a variety of neonatal conditions and sequelae with NICUs around the world, across the United States, and within our own locale. We received our first summary of data in mid-2007 and found that our ROP rates were higher than others in NICUs in our local area, across the United States, and around the world. After informal efforts appeared successful in significantly reducing ROP, we designed and implemented a more structured approach to ROP prevention that included improvements in practice related to oxygen administration and monitoring. An evidence-based guideline was developed, and education was provided to all direct care providers. We also standardized bedside oxygen delivery equipment and implemented new parameters related to nasal cannula weaning. Rates of ROP, severe ROP, and ROP requiring surgical intervention were reduced by more than 50% during the first year and more than 75% by the end of the second year after implementation of our unit-based program.

INITIAL PROBLEM
Careful analysis of this data suggested that our rates of ROP in the 3 VON categories, “any ROP,” “severe ROP,” and “ROP requiring surgery,” were higher than the average VON rate in the entire network, in all US NICUs, and in Massachusetts NICUs. Our rate of surgical ROP was approximately twice that of comparable cohorts (Table 1).


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INITIAL RESPONSE

We shared the data with nursing, medical, and respiratory care staff at staff meetings and multidisciplinary practice forums, as well as informally during bedside conversations with those who are involved in care. As a first step in addressing the issue, we wanted to create an awareness that our patients might be at significantly greater risk of developing ROP and possibly blindness. Many staff members were surprised by the VON data and thought that the rates were elevated because of the number of patients transferred to our unit for retinal consults. However, we learned that the VON data excluded these patients.

Next, we focused on aspects of the nursing care of infants at risk for ROP. In the summer of 2007, our unit’s nursing director and clinical nurse specialist organized a group of nurses who were recognized as expert practitioners. The group identified 12 areas of clinical practice in which nursing care has a direct impact on outcomes. One of these areas was ROP, and a small task force was convened to concentrate efforts on ROP prevention and reduction. Although the cause of ROP is thought to be multifactorial, a number of studies have shown a relationship between oxygen therapy and ROP.4-5,8,9 Since bedside nurses are primarily responsible for monitoring infants’ oxygen saturations and adjusting oxygen administration, they could be instrumental in helping to prevent ROP. The group also reviewed the literature and determined that our ROP prevention oxygen saturation parameters of 86% to 93%10-12 were still appropriate. The group shared this information with staff and reinforced the importance of the parameters.

In addition, the task force emphasized that oxygen is a drug and must be treated as such, dispelling the sometimes unspoken belief that “more is better.” Informal audits were done by members of all disciplines, and nurses discussed how best to maintain infants within the target saturation range and regulate oxygen delivery. The nursing director and the clinical nurse specialist have found that peer-to-peer discussions are a powerful tool in changing individual practice. Past experience has shown that practice changes have been much more successful and sustained when staff are motivated by a clear understanding of best practices and a desire to do the right thing for their patients, as opposed to compliance with an administrative expectation as the motivator.

More stringent saturation parameters did result in a need for increased nursing observation and vigilance because alarms sounded more frequently. However, much of the time, actual intervention or titration of oxygen was unnecessary. The need for closer observation did require workflow changes for a group of staff that was still adjusting to a fairly recent move to a new unit comprising almost all private rooms and a 5-fold increase in the physical space of the unit.

We were able to reassure those who raised concerns about the impact of lower oxygen saturations on brain and overall neurological development with data from studies on the saturation parameters mentioned earlier, as well as of even lower saturations.9-12

DATA POST INITIAL INTERVENTIONS

In mid-2008, we received our 2007 center-specific data. It had been approximately 1 year since we initiated efforts to reduce our rates of ROP, yet these data reflected only the first 6 months of our work, and we did not expect to see any major changes. In addition, we were aware that our efforts had been informal and were aimed at raising consciousness, reinforcing existing expectations, and encouraging and facilitating peer-to-peer feedback. At the same time, we wondered if the new unit might have had an impact on decreasing infant stress and oxygen requirements. The new data showed that ROP had decreased by more than 50%, a remarkable change in our minds7,13 (Table 2).

A MORE AGGRESSIVE APPROACH

Although our 2007 data showed a marked improvement, we felt that we should be working more aggressively and consistently at possibly further reducing our rates of ROP. In this case, more could be better. Since our informal efforts were associated with such remarkable improvements, we felt that a more formal approach might yield even better outcomes. A new multidisciplinary group of representatives from

<table>
<thead>
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<th>TABLE 1. Comparison of VON Data for 2006</th>
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<tr>
<td>Any ROP, %</td>
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</tr>
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<td>VON</td>
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<td>Massachusetts NICUs</td>
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<td>All US NICUs</td>
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</table>

Abbreviations: MGH, Massachusetts General Hospital; ROP, retinopathy of prematurity.4 Confidential report prepared for Massachusetts General Hospital by Vermont Oxford Network.7

Attachment NK 7 EO.e continued
nursing, respiratory care, and medicine was formed. This group, the ROP Reduction Group, established a number of goals (Table 3).

**INTERVENTIONS TO ACHIEVE GOALS**

To achieve these goals, we implemented several interventions. Table 4 summarizes actions, obstacles, and outcomes related to these goals.

**NURSING PRACTICE GUIDELINE**

A nursing practice guideline, “Nursing Care of the Infant at Risk for Developing Retinopathy of Prematurity,” was developed and approved by a multidisciplinary group. The evidence-based guideline defined infants at risk of developing ROP, maintenance-saturation parameters for these infants, and specific nursing practice interventions to address out-of-range saturations and care after a change in ventilatory support or oxygen concentration (Table 5). The guideline also reaffirmed an existing policy that all nasal cannulas be weaned by flow and not oxygen concentration. At that time, nasal cannula oxygen was weaned in no particular or consistent manner. The guideline standardized some elements of bedside nursing practice, as well as how nasal cannulas are weaned.

**STAFF EDUCATION**

Before implementing the new guideline, a series of in-services was offered to the nursing and respiratory care staff, aimed at improving staff’s knowledge related to all aspects of ROP. A pretest surveyed the staff’s baseline knowledge of several aspects of ROP. Inservices were held on all shifts, and a self-learning packet was developed for those unable to attend live in-services. The pathophysiology of ROP, variables that could lead to an increased incidence, the VON data, and new practice expectations included in the guideline were all reviewed in the educational offerings. Staff completed a posttest after inservice, and the test was a part of the self-learning packet. Overall, scores on the posttest were better than on the pretest.

**STANDARDIZATION OF BEDSIDE SET-UP**

Prior to the beginning of the inservices, 2 infants treated with low-flow oxygen nasal cannulas were found to be receiving more than the intended amount of flow. An investigation revealed that no 2 bedsides were set up the same way and that 6 different flowmeters were used in the NICU. Leadership from nursing, medicine, and respiratory care determined that standardization of the oxygen delivery equipment was essential. New flowmeters were purchased, and each headwall was standardized with the same 3 flowmeters: 25 to 250 cm³, 100 cm³ to 1 L with 100 cm³ increments, and 1 to 15 L, the standard flowmeter. Each flowmeter was installed in the same location and positioned for ease of reading. To remain consistent with the guideline’s expectation that nasal cannulas be weaned by flow and not oxygen concentration, oxygen blenders were dedicated to resuscitation bag use only.

**CREATING A PARTNERSHIP WITH RESPIRATORY THERAPY**

The work that the ROP Reduction Group and respiratory care leadership did to standardize bedside respiratory equipment provided an opportunity for many interdisciplinary discussions about the new guideline and oxygen delivery and monitoring in general. A decision was made to involve NICU-based respiratory care staff in the care of all infants receiving any type of oxygen therapy, including collaboration with NICU nurses in monitoring and maintaining oxygen saturations. Closer teamwork developed as a result of this change and it fostered opportunities for collaboration and learning.

These discussions led to guideline changes stipulating that deviations in set saturation parameters

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**TABLE 2. 2006 and 2007 VON ROP Data for Massachusetts General Hospital for Children (MGH/C)**

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
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<tr>
<td>Any ROP</td>
<td>43.2%</td>
<td>21.3%</td>
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<tr>
<td>Severe ROP</td>
<td>13.6%</td>
<td>4.3%</td>
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<tr>
<td>Surgical ROP</td>
<td>9.5%</td>
<td>3.4%</td>
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</table>

Abbreviation: ROP, retinopathy of prematurity.

*Confidential report prepared for Massachusetts General Hospital by Vermont Oxford Network.*

**TABLE 3. Goals of the Multidisciplinary Group**

- Reduce the overall rate of ROP.
- Further decrease the rate of ROP requiring surgical intervention to zero cases.
- Create a practice environment where infants at risk for ROP were managed consistently within their saturation parameters, with saturation limits set appropriately all of the time.
- Improve RN and RRT knowledge base regarding ROP prevention and prevention strategies.

Abbreviations: ROP, retinopathy of prematurity; RT, Respiratory Therapist.
required a physician’s or neonatal nurse practitioner’s order, that decisions to wean a nasal cannula by oxygen concentration needed the consent of the attending neonatologist and an order, and that repeated practice outside the guideline was considered a performance issue.

**NURSING ASSIGNMENTS**

In addition to the mandatory education, resource (charge) nurses were provided with additional information regarding assigning infants who were at high risk for ROP. They had to focus not only on patient acuity but also on the geographic proximity of patients, in order to make assignments more workable. Resource nurses noted “ROP protocol” on the assignment sheets to identify those at risk. Initially, the intention was to categorize these infants a 1:1 assignment. This was achieved only with the highest-acuity patients and was found to be unrealistic with the less acute.

**OUTCOMES DATA**

To our great satisfaction, the most recent VON data revealed an even greater decrease in all 3 categories of

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**TABLE 4. Interventions, Obstacles, and Outcomes for ROP Prevention Practice Changes: Overall Goal—Reduce the Rate of ROP Development**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Obstacles</th>
<th>Outcomes</th>
</tr>
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</table>
| Created standardized practice environment utilizing a nursing practice guideline | Failure to maintain oxygen saturation parameters of 86%-93%  
Failure to wean nasal cannulas by flow only | Patients at risk are cared for following the nursing practice guideline |
| Provided mandatory education for RN and RRT staff  | Belief that lower oxygen saturation parameters are harmful to the infant | Better understanding of ROP  
Greater appreciation for toxicity of oxygen  
Increased job satisfaction with knowledge of positive results |
| Standardized bedside oxygen delivery equipment set-up | Cost of new equipment  
Varied commitment of RRTs to assume new role  
Inconsistent utilization of this valuable resource by RNs  
Lack of a quick response to alarms | Oxygen delivery equipment is set up the same way at every bedside  
Equal commitment to maintaining desired oxygen saturation parameters |
| Facilitated RN/RRT partnership                     |                                                                           |                                                                           |
| Optimized nursing assignments by identifying patients at risk | Patient acuity vs geography within the unit  
Patient acuity not accurately reflected in classification scores | Improved practicality and workability of patient assignments  
Patient acuity more accurately captured |

**TABLE 5. Key Elements of Guideline**

| Reaffirmed ROP hemoglobin-oxygen saturation parameters of 86%-93% | | |
| Emphasized the need to reduce both hypoxic and hyperoxic episodes | | |
| Stated expectation of staff to remain at bedside after any escalation in respiratory support, including FiO₂, until infant stabilized | | |
| Stated expectation for staff member to remain at bedside for at least 5 minutes following any wean in respiratory support, including reduction in FiO₂ | | |
| Specific guidelines were created for adjusting FiO₂ in response to out-of-range saturations | | |

**Abbreviation:** ROP, retinopathy of prematurity.
ROP. The incidence of any ROP has dropped by an additional 72% and represents an 86% reduction over 2 years. The rate of severe ROP decreased by more than 50% between 2007 and 2008 and is now 85% less than it was in 2006. Similar changes in the rate of surgical ROP occurred7,13,14 (Table 6).

OUTCOMES, CHALLENGES, AND UNEXPECTED REALIZATIONS

The data speaks for itself, but as with any practice change, challenges were plentiful. Nurses had concerns about standardization of nasal cannula weaning by flow only and identified situations in which they thought a patient would benefit from weaning by oxygen concentration. They were asked to explain their rationale on the basis of their assessments, and their explanations revealed that some did not have a sound grasp of how to wean an infant from a nasal cannula. In most cases, it appeared that they were attempting to treat episodes of desaturation related to reflux and not a primary respiratory issue. Nasal cannula weaning is an “art,” dependent on many variables that differ from 1 infant to another. It was clear that what began as a need to focus on ROP had evolved into a need to focus on and improve practice related to oxygen delivery by nasal cannula.

We also needed to clarify oxygen concentration settings. For example, a setting of 100% for a cannula does not mean that the infant is receiving 100% oxygen. This was particularly challenging for parents, as most were aware of our goal of minimal oxygen use. Thus it was imperative that staff understood and could explain this concept. Many staff had a sound grasp of the many factors that determine how much oxygen actually reaches the infant. However, others had never considered the mechanics of nasal cannula oxygen delivery. We pointed out that the 100% oxygen that is present at the wall oxygen outlet mixes with room air in the oxygen delivery tubing, as well as in the nasopharynx of the infant. We also highlighted the impact of an intermittently open mouth, the usually loose fit of the cannula prongs, and variability in respiratory rate and tidal volumes. We realized that the way we document the amount of nasal cannula support as “100% nasal cannula at ‘x’ amount of flow” perpetuated this confusion.

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We realized that the way we document the amount of nasal cannula support as “100% nasal cannula at ‘x’ amount of flow” perpetuated this confusion. For those who still needed more of an explanation or asked for more information on the exact amount of oxygen that was received, the use of the Low Flow Oxygen FiO2 Calculator15 provided help. Table 7 shows this formula and provides an example of how this formula was used. We did not intend to use this formula with every infant on a low-flow cannula. In fact, it was used only with a few, but these examples demonstrated how the set concentration of oxygen and the concentration actually received by the patient differ.

It should also be noted that our institution has an acuity system that includes a section about the respiratory monitoring needs of patients. The educational offering included information on the need to score patients as more acute to reflect their monitoring needs. Audits of the acuity data revealed that staff did not consistently integrate this factor into their scoring practices. Staff continued to voice concerns about the rigor of the protocol, yet the workload was not reflected in their acuity scores.

SUMMARY

Over a 2-year period, a combination of efforts and practice changes resulted in a marked reduction of rates of ROP in all VON categories in our NICU. Efforts ranged from informal consciousness raising of...
nurse-sensitive aspects of ROP to more formal initiatives, including a practice guideline, education, standardization of practice related to oxygen administration, and greater collaboration between nurses and respiratory therapists.

We are deeply satisfied by the evident success of our efforts to create a practice environment in which the risk of ROP has been dramatically reduced through the concerted efforts of all team members and a variety of interventions. The challenge of maintaining these practice changes remains. The desired endpoint would be to have all the practice changes firmly integrated into care. With objective data provided by the VON and acknowledgment by staff of the profoundly positive impact of practice changes on their patients, the goal may be within reach.

As the culture of today’s health care continues to be driven by safety, it is entirely possible that neonatal care could someday be evaluated by a number of population-specific safety indicators. Retinopathy of prematurity would certainly be among those indicators by which our practice would be evaluated. Given the success that our unit has had in dramatically reducing the risk of ROP, we would be well positioned to be a leader in demonstrating how to enhance safety for this patient population.

Acknowledgements

We thank Margaret Doyle Settle, RN, and Dorothy Jones, EdD, RNC, ANP, FAAN, for recognizing the impact of this work and providing support for the writing of this article. We also thank Judith Mitiguy, MS, RN, for her expertise and responsiveness as we wrote this manuscript. In addition, we are grateful to our physician colleagues, Elizabeth Catlin, MD, and Jonathan Cronin, MD, for their insight and reflection. We acknowledge Mary Wyszynski, MS, RN, NNPC-BC, for her attention to detail as she collects our VON data. We also thank our staff whose questions and challenges enriched this process and whose practice changes will improve the outcomes of countless infants.

References

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**Proportion of Infants 22 to 29 Weeks Gestation Screened for Retinopathy of Prematurity (ROP)**

**Proportion of Infants 22 to 29 Weeks Gestation with Retinopathy of Prematurity (Stages 1-5)**

*VON benchmarks published annually. 2010 benchmarks in use, 2011 and 2012 benchmarks will be provided when available.*
An evidence-based practice project on the use of non-invasive mechanical modalities for VTE prophylaxis in the Surgical ICU

Investigators, Paula Restrepo, RN, staff nurse in the Ellison 4 Surgical ICU, and Deborah Jameson, RN, clinical librarian at Treadwell Library, were moved to undertake their study, “An Evidence-Based Practice Project on the Use of Non-Invasive Mechanical Modalities for Venous Thromboembolism (VTE) Prophylaxis in the Surgical ICU,” when they noticed variations in practice around the use of IPCs (intermittent pneumatic compression devices, or ‘boots’) and GCSs (graduated compression stockings or ‘TEDs’). Under the mentorship of nurse scientist, Diane Carroll, RN, they sought to:

- discover system barriers to VTE prophylaxis appropriate for system-improvement processes
- develop written guidelines and educational programs to define and disseminate a standard of care for proper use of non-invasive mechanical modalities (GCSs and IPCs)
- identify compliance rate of VTE prophylaxis with non-invasive mechanical modalities in SICU patients pre- and post-implementation of written guidelines

To discover barriers, Restrepo and Jameson met with 25 staff nurses from the Ellison 4 SICU and three physicians representing Anesthesia, Vascular, and Trauma. Some of the issues they found included: ill-fitting boots and TEDs, wrinkles in GCSs, IPC pumps not turned on, inconsistency in physician orders, outdated policies, and insufficient education for patients and families regarding optimal use of devices.

In order to establish guidelines for proper utilization, Restrepo and Jameson performed a comprehensive search of the literature, maintained a reference ‘library’ of the articles they found, and consulted with five international physician experts on VTE.

To understand compliance rates, they conducted an observational study from July of 2010 through February of 2012, observing patients twice a day for 21 days. They collected baseline data upon admission and checked on patients daily to monitor their use of IPCs and GCSs, ensuring appropriate application, and ensure IPC pumps were functioning properly.

Questions that arose were related to:
- the use of IPCs with existing DVTs
- the use of a combination of GCSs/IPCs
- the use of GCSs
- thigh versus knee IPCs
- the use of IPCs on only one limb
- the length of time IPCs should be used

What Restrepo and Jameson found as they investigated was a high level of variability and inconsistency in the understanding and use of IPCs and GCSs. They plan to audit again in one year and develop hospital-wide guidelines for use. In the meantime, nurses should:

- conduct accurate risk assessments
- monitor for signs and symptoms of VTE
- apply IPCs with attention to correct sizing and proper functioning
- monitor for skin issues, edema, and comfort
- ensure continuous use of IPCs, with breaks for bathing and assessment only

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