SUPPLEMENT ARTICLE


Judy Ohlinger, RNC, MSN; Anand Kantak, MD; Justin P. Lavin, Jr, MD; Ona Fofah, MD; Erik Hagen, MD; Gautham Suresh, MD; Louis P. Halamek, MD; Janice A. Schriefer, DrPH

*Neonatal Intensive Care Unit and Departments of Neonatology and Perinatology, Akron Children’s Hospital and Akron General Medical Center and Summa Health System, Akron, Ohio; Department of Neonatology, Rockford Memorial Hospital, Rockford, Illinois; Department of Neonatology, Children’s Hospitals and Clinics and United Hospital Birth Center, St Paul, Minnesota; Department of Neonatology, Medical University of South Carolina, Charleston, South Carolina; Center for Advanced Pediatric Education, Stanford University, Stanford, California; Vermont Oxford Network, Burlington, Vermont

The authors have indicated they have no financial relationships relevant to this article to disclose.

ABSTRACT

OBJECTIVE. The obstetric and neonatal exploratory focus group of the Vermont Oxford Network Neonatal Intensive Care Quality Improvement Collaborative 2002 set out to improve collaboration, communication, and coordination between maternal and neonatal caregivers in 3 areas: the pregnancy at 22 to 26 weeks, measurement of maternal outcomes that are linked with neonatal outcomes, and team performance during high-risk delivery. Antepartum and intrapartum maternal attributes and interventions also were considered important measurements to identify practice variations and their relationship to neonatal outcomes for ongoing obstetric and neonatal collaboration.

METHODS. Potentially better practices were developed on the basis of evidence in the literature, expert opinion, and internal analysis at the participating perinatal centers. The potentially better practices include development of local guidelines at each center for the care and counseling of pregnant women who are at risk for delivering at the margin of viability; communication strategies for obstetric and neonatology providers relating to high-risk pregnancy treatment plans; team communication and performance at high-risk deliveries; design of organizational structures and processes that facilitate obstetric and neonatal collaboration; and development of perinatal data to evaluate effects of perinatal practices on maternal, fetal, and neonatal outcomes.

RESULTS. As a result of the project, participating centers developed local guidelines for pregnancies between 22 and 26 weeks, created a cross-center maternal database that currently is being linked to neonatal outcomes, and completed a pilot study on video simulation of neonatal–perinatal team communication.

CONCLUSIONS. Increased understanding of practice variation in the management of care for infants who are at the margins of viability, locally developed guidelines, and a focus on improved team communication during delivery can be accomplished with a multicenter collaborative approach.

www.pediatrics.org/cgi/doi/10.1542/peds.2006-0913L
doi:10.1542/peds.2006-0913L

Key Words
perinatal, collaborative quality improvement, crew resource management, video simulation, team performance

Abbreviation
PBP—potentially better practice

Accepted for publication Jul 18, 2006
Address correspondence to Judy Ohlinger, RNC, MSN, Akron Children’s Hospital, Neonatal Intensive Care Unit, One Perkins Sq, Akron, OH 44308. E-mail: johlinger@chmca.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4205). Copyright © 2006 by the American Academy of Pediatrics
The Vermont Oxford Network established the Neonatal Intensive Care Quality Improvement Collaboratives with the goal of improving neonatal outcomes and safety. Historically, the collaboratives have been limited to neonatal caregivers. At the inception of the Neonatal Intensive Care Quality Improvement Collaborative 2002, an exploratory group with a combined obstetric and neonatal focus was formed with the addition of multiple obstetric caregivers. The belief was that neonatal outcomes could be improved further by initiation of improvement processes before birth. Increased maternal and neonatal caregiver collaboration, communication, coordination, cooperation, and continuity would facilitate these improvements. The group selected the name Wee Deliver.

The overarching purpose was to create a fertile organizational culture that would encourage and sustain quality improvement in perinatal care. Therefore, a high priority for the group was to develop and implement organizational and operational methods to foster inter- and intradisciplinary collaboration between obstetric and neonatology caregivers. In this article, we describe the process by which these centers evaluated and developed potentially better practices (PBPs) for perinatal and neonatal communication and collaboration (Table 1). Improving outcomes for both the infant and the family is the ultimate goal of this group.

**METHODS**

Wee Deliver is composed of 5 tertiary perinatal centers from different geographic locations in the United States: Akron Children’s Hospital and its partners, Akron General Medical Center and Summa Health System; Dartmouth Hitchcock Medical Center (Lebanon, NH); Providence St Vincent Medical Center (Portland, OR); and the family is the ultimate goal of this group. Children’s Hospitals and Clinics and its partner, the United Hospital Birth Center; and Rockford Memorial Hospital. Each center identified and organized a multidisciplinary project leadership team. Team membership includes physicians, bedside nurses, nurse practitioners, clinical nurse specialists, care managers, nurse managers, performance improvement coordinators, data managers, nurse educators, and outreach educators from both the obstetric and neonatal disciplines. Group communication occurs at face-to-face meetings twice a year, conference calls at least once a month, telephone calls and faxes as needed, and e-mail communication via a designated listserv. The group also was provided with an experienced facilitator. The personnel and other costs that are associated with these above activities are borne by each institution. Three centers, Akron, Dartmouth, and Providence St Vincent, started the exploratory group in April 2002. In January 2003, Children’s Hospitals and Clinics and Rockford Memorial Hospital joined the group.

The overall measurable aim of the group was to improve the collaboration of maternal and newborn caregivers. This group chose to concentrate on 2 areas in which obstetrics and neonatology interface frequently: (1) care of the pregnant woman who is at risk for delivering at the margin of viability (ie, 22–26 weeks’ gestation) and (2) management of team performance during high-risk delivery. The group proposed to achieve this by creating evidence-based PBPs. The group planned to evaluate results by using structure, process, and outcome measures.

Each participating institution performed its own internal structure and process analysis concerning pregnancy management as it pertained to obstetric and neonatal interactions, as well as the interactions between these caregivers and families. Each institution identified strengths, weaknesses, and opportunities for improvement. This step led the group to agree on measurements toward the overall aim. These measurements are discussed in Results. During this phase, participating institutions conducted a survey of obstetric and neonatal health care providers’ attitudes toward resuscitation of infants who are born at the threshold of viability and comfort with parental counseling.

At the first semiannual face-to-face meeting in April 2002, the first topic area of concentration was care of the pregnant woman who is at risk for delivering at the margin of viability. Margin of viability was defined as a gestation between 22 weeks, 0 days and 26 weeks, 7 days (22–26 weeks) on the basis of the best obstetric estimate. This topic was chosen because obstetric and neonatal management at this gestation is controversial. It is subject to large variation within and between the obstetric and neonatal disciplines, along with moral, ethical, and legal dilemmas. It was believed that this area would offer the best opportunity to create structures and

**TABLE 1** PBP Strength of Evidence Matrix

<table>
<thead>
<tr>
<th>PBP</th>
<th>Strength of Evidence</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Locally developed guidelines for perinivable patients and their families</td>
<td>Level 5</td>
<td>Refs 4–12</td>
</tr>
<tr>
<td>2. Documentation systems that reliably communicate high-risk pregnancy treatment plans among all obstetric and neonatal caregivers</td>
<td>Level 5</td>
<td>Refs 14–16</td>
</tr>
<tr>
<td>3. Design organizational structures and processes that promote collaboration among obstetric and neonatal services</td>
<td>Level 5</td>
<td>Ref 37</td>
</tr>
<tr>
<td>4. Implement processes to improve collaboration, performance, and communication during high-risk birth events using simulation</td>
<td>Level 5</td>
<td>Refs 30–36</td>
</tr>
<tr>
<td>5. Use a perinatal database that allows for evaluation of the effects of perinatal practices on maternal, fetal, and neonatal outcomes</td>
<td>Level 5</td>
<td>Ref 37</td>
</tr>
</tbody>
</table>

Level 5 indicates opinions of respected authorities, based on clinical evidence, descriptive studies, or reports of expert committees.
processes for present and future quality improvement projects and improvement in both staff and family satisfaction.

The group undertook a search for better practices. The first step was to look for a superior performing institution. No resource was identified to guide us to such a designated or self-proclaimed entity. The second step was a review of the literature. Position statements from the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics that were released at approximately that time were valuable in providing reassurance that the choice of topic was timely and very much needed, as were better practices that could delineate objectives for the management of these very high-risk pregnancies and deliveries.

The group reviewed a large body of literature to help in understanding national and international data on outcomes of pregnancies and neonates at 22 to 26 weeks’ gestation. In addition to outcomes data, the group reviewed articles that addressed caregiver attitudes regarding resuscitation at these gestational ages as well as differences in both obstetric and neonatal caregivers’ perceptions of outcomes versus actual outcomes.

There were a host of possibilities for where to focus the efforts of the group. The perinatal period was divided into predelivery, delivery, and postdelivery phases. The group focused its attention on the first 2 phases. While exploring national and international outcomes data, each center investigated its own outcomes at the local level. Similarities and differences within and between centers in outcomes and care recommendations were discovered and discussed. Variation exists in parent counseling practices, which were found to be based largely on the caregivers’ perceptions of outcomes rather than actual outcomes. There also were differences between parents’ and health care professionals’ attitudes toward the clinical treatment of infants at these gestations. Each team developed center-specific guidelines for the management of pregnancies at the margins of viability that reflected consideration of local laws, data, resources, and outcomes.

Management of team performance during high-risk delivery at any gestational age and ensuing newborn resuscitation and stabilization also were selected as a concentration area because it involves complex interactions between multiple disciplines. Improving team communication offers the opportunity for improved performance and outcomes. The goal is to create an optimal level of collaboration, coordination, cooperation, and continuity involving multiple disciplines in a highly complex system.

The group worked to improve team performance during the conduct of high-risk delivery and newborn resuscitation with special emphasis on the behavioral and communication skills of team members who already possess the necessary technical and cognitive skills. The group measured team performance using a simulation scenario, with the aim of achieving the highest score possible in team communication behaviors during a mock delivery room crisis. Use of simulation is a training tool for ongoing improvement in team performance as new delivery room crisis scenarios are introduced.

For arriving at this aim, the first step was a literature review for experience with assessment, best practices, and strategies for improvement of team performance and its measurement. An abundance of information was discovered in these areas in nonmedical fields, especially the aviation industry. The aviation model addresses structure and process improvement in conjunction with technical, cognitive, and behavioral training to achieve a consistently high level of team performance in high-risk situations. Simulations and continuing team performance measurements and feedback during and after these simulations are used to accomplish optimal team performance.

Crew resource management often is used to describe team training. In the field of medicine, the use of simulation scenarios has been successful for the training of personnel, particularly in anesthesiology and emergency medicine. In neonatology, simulations are used as training tools to improve team performance in neonatal resuscitation. It was decided that the group would focus on the behavioral aspects of communication within and between the many disciplines involved using real-time video and subsequent debriefing sessions.

The second step for each center was to complete an internal analysis to characterize existing structures and processes regarding communication surrounding high-risk delivery and newborn resuscitation. This step was to ensure that each center had structures and processes and to identify the strengths and weaknesses in their systems. The group developed scenarios and simulation-based training as the modality for improved team performance as the literature has indicated.

All staff who were identified in the structure and process analysis phase were required to view this simulation training and receive education and feedback on what constitutes excellent communication behaviors (Table 2). A tool was needed to measure simulations for “best score” to create the “gold standard” simulation scenario (Table 3). This same tool is used to teach and
assess the performance of future trainees and to track improvement during high-risk delivery and newborn resuscitation. Each center created its own training simulation on the basis of a scenario that was common to all 5 centers but using its own equipment, protocols, and personnel.

**RESULTS**

Early in this collaborative project, the group agreed on measures of improved maternal and newborn caregiver collaboration surrounding periviability and high-risk birth response:

- Perinatal and neonatal consultations completed and documented in a timely manner and kept current and accessible throughout hospitalization
- Adherence to center-specific obstetric and neonatal clinical care guidelines
- Uniform, evidence-based, center-specific information on treatment options and outcomes that are presented to families by all caregivers
- Increased family and caregiver satisfaction with care processes, education, interventions, and shared decision-making; parent satisfaction with counseling; provider satisfaction with consultation and counseling; and provider satisfaction with high-risk delivery response and team performance
- Expanded collection, analysis, and sharing of data for all pregnancies that present to the perinatal unit at 20 to 32 weeks’ gestation, including infants who are not admitted to the NICU

The group has reviewed, evaluated, summarized, and shared hundreds of articles. Each center has established structures and processes for accomplishing their work locally, as well as with the other participating institutions. Individually, each has completed the investigation and understanding of its internal care and communication structures and processes.

Several subgroups, with representatives from each institution, were formed to work on the development, implementation, and testing of specific aspects of the PBPs and the measures of improvement. One has worked on the tools to assess both parent and provider satisfaction. Another worked on assessment tools for parent and provider communication and decision-making with care of the pregnant woman who is at risk for delivering at the margin of viability (ie, 22–26 weeks’ gestation).17

A third group formed to identify and investigate benchmark sites and experts in high-risk delivery team performance, resulting in Dr Halamek’s becoming the expert for high-risk delivery team performance. A fourth group developed the simulation scenarios and team behavioral performance assessment (Table 3) tools for high-risk birth events. The fifth, which has worked together since the inception of the collaborative, has developed a perinatal database for pregnancies of 20 to 32 weeks’ gestation that are admitted to each center’s respective perinatal unit and is currently testing and refining this database.

**DISCUSSION**

The exploratory group extended the process of improving neonatal outcomes and safety to the antepartum, intrapartum, and immediate postpartum periods in collaboration with obstetricians and related caregivers. The focus is on consistent, continuous, reliable communication within and between the neonatal and obstetric disciplines. Within the predelivery phase, the focus is on the period that is defined as 22 through 25 weeks’ gestation. Pregnancy complications that arise during these weeks often give rise to a great deal of controversy, dissatisfaction, litigation, and uncertainty.

The work focused on describing the feelings and frustrations that professionals experience when faced with decision-making, their understanding of current local and national data, and comfort levels when counseling parents. The group studied the experiences of the family as they interact with a multitude of care providers when pregnancy is threatened. Improving the accuracy and the consistency of the information provided should increase satisfaction with the decision-making process and the experience of care even though the outcome of the pregnancy may not be a happy one.

In the time immediately surrounding the birth of a high-risk infant, the communication interface among obstetric, perinatal, and neonatal staff is very important. Specifically, this is the time from when the decision is made to deliver the infant to the time when the infant is stabilized. This interface is complex and challenging in terms of delivery notification, communication of vital information to the right people in a timely manner, and

---

**TABLE 2** Staff Education Pocket Card for Improved Communication During Delivery Room Crisis (From Dartmouth)

<table>
<thead>
<tr>
<th>Assertion: Under time pressure, it can be difficult to obtain attention fully and to communicate effectively. Assertion is when individuals persist in speaking up to ensure that there is shared understanding and a resolution of a situation of concern (eg, delivery room crisis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steps to take for improved communication in a deliveryroom emergency</td>
</tr>
<tr>
<td>Get the person’s attention</td>
</tr>
<tr>
<td>Express your concern</td>
</tr>
<tr>
<td>State the problem</td>
</tr>
<tr>
<td>Recommend action</td>
</tr>
<tr>
<td>Achieve a decision</td>
</tr>
<tr>
<td>Use communication ground rule</td>
</tr>
<tr>
<td>Make eye contact</td>
</tr>
<tr>
<td>Listen to understand</td>
</tr>
<tr>
<td>Repeat back what the person says</td>
</tr>
<tr>
<td>Call people by their first name</td>
</tr>
</tbody>
</table>

**Steps to take for improved communication in a delivery room emergency**

- Get the person’s attention
- Express your concern
- State the problem
- Recommend action
- Achieve a decision

**Use communication ground rule**

- Make eye contact
- Listen to understand
- Repeat back what the person says
- Call people by their first name
response expectations. Team performance in emergent, high-risk delivery scenarios involve many individuals from various specialties. The team members come together to perform complex, critical tasks for a brief period when a high degree of coordination and communication is required.

CONCLUSIONS
There is tremendous opportunity to improve the experience of families and care providers surrounding high-risk pregnancy and birth. This project has provided the opportunity to design structures and processes that enable neonatal caregivers to become involved in care of the family and the fetus earlier and more consistently and for maternal caregivers to understand and impact of the results of their efforts and interventions on neonatal outcomes. The group efforts aimed at operational and organizational improvements with embedded elements of clinical improvements.

REFERENCES

TABLE 3 Simulation Scoring Sheet

<table>
<thead>
<tr>
<th>Performance Marker</th>
<th>1 (Poor)</th>
<th>2 (Acceptable)</th>
<th>3 (Excellent)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification of the event</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Declaration of emergency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statement of the situation (S)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statement of the background (B)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy of the assessment (A)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Request for recommended action (R)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy of the repeat back</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appropriateness of the request for help</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linguistic clarity of the request</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direction of requests to specific individuals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Double checks data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reports data to the team</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensures that team members are present</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verifies that arriving team members have accurate information</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notifies surgeon/neonatology/anesthesiology/nursing of possible problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall crisis management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Judy Ohlinger, Anand Kantak, Justin P. Lavin, Jr, Ona Fofah, Erik Hagen, Gautham Suresh, Louis P. Halamek and Janice A. Schriefer
*Pediatrics* 2006;118;S147
DOI: 10.1542/peds.2006-0913L

**Updated Information & Services**
including high resolution figures, can be found at:
http://pediatrics.aappublications.org/content/118/Supplement_2/S147

**References**
This article cites 33 articles, 7 of which you can access for free at:
http://pediatrics.aappublications.org/content/118/Supplement_2/S147.full#ref-list-1

**Subspecialty Collections**
This article, along with others on similar topics, appears in the following collection(s):
*Fetus/Newborn Infant*
http://classic.pediatrics.aappublications.org/cgi/collection/fetus:newborn_infant_sub

**Permissions & Licensing**
Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:
https://shop.aap.org/licensing-permissions/

**Reprints**
Information about ordering reprints can be found online:
http://classic.pediatrics.aappublications.org/content/reprints

Pediatrics is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since . Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2006 by the American Academy of Pediatrics. All rights reserved. Print ISSN: .

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™
Judy Ohlinger, Anand Kantak, Justin P. Lavin, Jr, Ona Fofah, Erik Hagen, Gautham Suresh, Louis P. Halamek and Janice A. Schriefer
Pediatrics 2006;118;S147
DOI: 10.1542/peds.2006-0913L

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://pediatrics.aappublications.org/content/118/Supplement_2/S147