Attribution Non-Commercial Share Alike

This document is provided by the Vermont Oxford Network under the terms of a Creative Commons Attribution, Non-Commercial, Share Alike license. http://creativecommons.org/licenses/by-nc-sa/3.0/

You are free:

- to Share — to copy, distribute and transmit the work
- to Remix — to adapt the work

Under the following conditions:

- Attribution — You must attribute the work in the manner specified by the author or licensor (but not in any way that suggests that they endorse you or your use of the work).
- Non-Commercial — You may not use this work for commercial purposes.
- Share Alike — If you alter, transform, or build upon this work, you may distribute the resulting work only under the same or similar license to this one.

With the understanding that:

- Waiver — Any of the above conditions can be waived if you get permission from the copyright holder.
- Other Rights — In no way are any of the following rights affected by the license:
  - Your fair dealing or fair use rights;
  - The author's moral rights;
  - Rights other persons may have either in the work itself or in how the work is used, such as publicity or privacy rights.

Notice — For any reuse or distribution, you must make clear to others the license terms of this work. The best way to do this is with a link to http://creativecommons.org/licenses/by-nc-sa/3.0/

When providing attribution to this book, please use the following citation:


Attribution citations for individual chapters are available at the end of each chapter.
NICQ Participating Centers 2007

Advocate Lutheran General Hospital — Park Ridge, IL
Akron Children’s Hospital — Akron, OH;
Baptist Children’s Hospital — Miami, FL
Baptist Memorial Hospital for Women — Memphis, TN
Barbara Bush Children’s Hospital at Maine Medical Center — Portland, ME
Benefis Healthcare — Great Falls, MT
Brenner Children’s Hospital at Wake Forest — Winston—Salem, NC
Carle Foundation Hospital — Urbana, IL
Central Mississippi Medical Center — Jackson, MS
Children’s Hospital & Clinics; Minneapolis — Minneapolis, MN
Children’s Hospital & Clinics; St Paul — St Paul, MN
Children’s Hospital at Bronson Methodist Hospital — Kalamazoo, MI
Children’s Hospital Central California — Madera, CA
Children’s Hospital of Illinois at St Francis (CHOI) — Peoria, IL
Children’s Hospital of Orange County — Orange, CA
Children’s Mercy Hospitals and Clinics — Kansas City, MO
Columbus Regional Medical Center — Columbus, GA
Dartmouth-Hitchcock Medical Center — Lebanon, NH
Exempla St Joseph Hospital — Denver, CO
Hackensack University Medical Center — Hackensack, NJ
Helen DeVeos Children’s Hospital — Grand Rapids, MI
Inova Fairfax Hospital for Children — Falls Church, VA
Jackson-Madison County General Hospital — Jackson, TN
Janet Weis Children’s Hospital at Geisinger Medical Center — Danville, PA
Joe DiMaggio Children’s Hospital — Hollywood, FL
Lucile Packard Children’s Hospital — Palo Alto, CA
Medical University of South Carolina — Charleston, SC
Miami Valley Hospital — Dayton, OH
Mission Children’s Hospital — Asheville, NC
Mississippi Baptist Medical Center — Jackson, MS
Nationwide Children’s Hospital — Columbus, OH
New Hanover Regional Medical Center — Wilmington, NC
Providence St Vincent Medical Center — Portland, OR
Rockford Health System — Rockford, IL
Salem Hospital — Salem, OR
Salinas Valley Memorial Hospital — Salinas, CA
Saint Barnabas Medical Center — Livingston, NJ
Saint John’s Mercy Medical Center — St Louis, MO
Sunnybrook Health Sciences Centre — Toronto, Ontario, Canada
The Children’s Hospital at Providence — Anchorage, AK
University of Michigan: Mott Children’s Hospital; Holden NICU — Ann Arbor, MI
NICQ 2007: Improvement in Action

University of Minnesota Amplatz Children’s Hospital — Minneapolis, MN
Vermont Children’s Hospital — Burlington, VT
Wesley Medical Center — Wichita, KS
Woman’s Hospital — Baton Rouge, LA
Yakima Valley Memorial Hospital — Yakima, WA

NICQ 2007 Faculty and Advisory Board

NICQ 2007 Collaborative Leaders
Jeffrey D. Horbar, MD
Marjorie Godfrey, MS, RN
James Handyside, BSc
Kathleen Iannacchino, MS, RN

NICQ 2007 Coordinator
Kathy Leahy, RN, BSN, NNP

NICQ 2007 Facilitators
Nancy L. Jacklow
Martha Kathryn Key, Ph.D.
Hannah King, MPH
Karen McKinley, RN, MBA
June Paquette, RN, BS, MPA
Jan “J” Schriever MSN, MBA, DrPH
Terry Wilson-Malam, BA

NICQ 2007 Advisory Board
Betsi Anderson, RN, BSN, CPHQ
Amy Atwater, RN, BSN
Joanna Celenza, MA, MBA (Parent Advisor)
Cliff Richardson, APRN, NNP
William Rhine, MD
Gautham Suresh, MD
About the Authors

Chapter 1: Advancing Patient- and Family-Centered Care

Marie R. Abraham, MA  
Senior Policy and Program Specialist, Institute for Family-Centered Care

Joanna F. Celenza  
March of Dimes/CHaD ICN Family Support Specialist at the Children’s Hospital at Dartmouth-Hitchcock Medical Center

Jim Conway, MS  
Senior Vice President, Institute for Healthcare Improvement  
Adjunct Faculty, Harvard School of Public Health  
Board Chair, Partnership for Healthcare Excellence

Chapter 2: System Safety in the NICU

James Handyside, BSc  
Principal Consultant, Improvision Healthcare  
Senior Associate Consultant, HumanSystems Inc.
Chapter 3: Effectiveness in Healthcare

Robert H. Pfister, MD
Assistant Professor of Pediatrics, University of Vermont
Attending Neonatologist, Vermont Children's Hospital

Gautham Suresh, MD, DM, MS
Associate Professor of Pediatrics, Section of Neonatology, Children's Hospital at Dartmouth-Hitchcock Medical Center

Chapter 4: Equitable Care in the NICU

Stephaine Hale Walker, MD, MPH
Assistant Professor of Pediatrics, Vanderbilt University Medical Center
Neonatologist, Monroe Carell Jr. Children's Hospital at Vanderbilt

Chapter 5: Improving Efficiency

Diane C. Frndak, PhD, MBA, PA-C
Vice President of Organizational Excellence West Penn Allegheny Health System
Chapter 6: Timely Care Delivery

Karen E. McKinley, RN, MBA
Vice President, Division of Quality and Safety, Geisinger Health System

Chapter 7: First Do No Harm: Environmental Responsibility in the NICU

Nancy Dickeman, MA
Environmental Health and Sustainable Healthcare Consultant
Washington Physicians for Social Responsibility

Michelle Gottlieb, MEM
Health Care Without Harm
Steering Committee member and co-coordinator of the Healthy Food in Health Care Initiative
NICQ 2007: Improvement in Action

Chapter 8: Measure What Matters

William H. Edwards, MD
Professor and Vice Chair of Pediatrics, Children's Hospital at Dartmouth-Hitchcock Medical Center

Eugene C. Nelson, DSc, MPH
Professor, Community and Family Medicine, The Dartmouth Institute for Health Policy and Clinical Practice, Center for Leadership and Improvement, Dartmouth-Hitchcock Health and Dartmouth Medical School
# Table of Contents

## Introduction 1

- Background .......................................................................................................................... 1
- About This Book .................................................................................................................. 1
- Acknowledgements ............................................................................................................. 2
- References ............................................................................................................................. 2

## Chapter 1 Advancing Patient- and Family-Centered Newborn Intensive Care ... 1-1

- Getting to PFCC: What Will It Take? ................................................................................. 1-2
- Publicly Verifiable PFCC ..................................................................................................... 1-3
- Establishing an Effective Team to Improve PFCC ............................................................ 1-4
- Improving PFCC in the NICU ............................................................................................ 1-4
- The Vermont Oxford Network Experience ....................................................................... 1-6
  - Table 1.1 IFCC Tool: Framework for Family Involvement in Quality Improvement ................................................................................................................. 1-7
  - Figure 1.1 How’s Your Baby Survey ............................................................................. 1-8
- Resourcing the Journey to Patient- and Family-Centered Care ...................................... 1-8
- Summary and Next Steps .................................................................................................... 1-9
- References .............................................................................................................................. 1-9

## Chapter 2 System Safety in the NICU ............................................................................. 2-1

- What Is System Safety? ........................................................................................................ 2-1
  - Figure 2.1 Safety Precedence Sequence ........................................................................ 2-2
- Hazard Identification and Definition in Neonatal Care .................................................. 2-3
  - Figure 2.2 Hazard Management Process ...................................................................... 2-3
  - Figure 2.3 Hazard Management Worksheet ................................................................ 2-4
- Risk and Safety Resource Application ........................................................................... 2-5
  - Figure 2.4 Risk Scoring Matrix .................................................................................... 2-5
- Probability of Occurrence ................................................................................................ 2-6
- Severity of Harm ............................................................................................................... 2-6
- Hazard Control ..................................................................................................................... 2-6
  - Figure 2.5 Hazard Control and Barrier Evaluation Worksheet ..................................... 2-7
- Eliminating Hazards .......................................................................................................... 2-7
- Implementing the Safety Precedence Sequence ................................................................ 2-8
- Setting Up Barriers to Minimize Harm ............................................................................ 2-8
  - Figure 2.6 The Bow-Tie Model .................................................................................... 2-9
- Error Proofing ..................................................................................................................... 2-9
- Using Human Factors Science ......................................................................................... 2-9
- The Future: Collaborative System Safety Developments ................................................ 2-9
- Hazard Index ....................................................................................................................... 2-10
- Alarms and Monitoring ...................................................................................................... 2-10
- Security ............................................................................................................................... 2-10
Chapter 5  Improving Efficiency ................................................................. 5-1
Definitions of Efficiency and Types of Waste ........................................ 5-1
Hidden Wastes: Workarounds and Faux Problem Solving ..................... 5-3
Starting at the Front Line with Problem Solving ................................... 5-4
Efficiency Problems and Front-Line Solutions ...................................... 5-5
Efficiency Aims and Measures ............................................................... 5-7
  Table 5.1 NICU Efficiency Aims and Measures ................................... 5-7
Conclusion ............................................................................................ 5-8
References........................................................................................ 5-8

Chapter 6  Timely Care Delivery ............................................................... 6-1
Timeliness in Context of the NICU ........................................................ 6-1
Aims and Measures for Improving Timeliness ....................................... 6-2
  Table 6.1 Sample Timeliness Aims and Measures for NICQ 2007 ........ 6-3
The Case for Timeliness ....................................................................... 6-4
Case Study ........................................................................................ 6-5
  Background ..................................................................................... 6-5
  Methods ......................................................................................... 6-5
  Results and Discussion .................................................................. 6-6
Conclusion ........................................................................................ 6-6
References........................................................................................ 6-6

Chapter 7  First Do No Harm: Environmental Responsibility in the NICU .... 7-1
Environmental Contamination in Hospitals: A Review of the Issues ...... 7-1
  Waste ............................................................................................ 7-2
  Climate Change—Healthcare’s Opportunity for Leadership ............... 7-2
  Food Systems and Climate Change .................................................. 7-3
  Cleaning and Disinfection ............................................................... 7-4
  Building Materials ......................................................................... 7-4
  DEHP: Exposure Concerns and Steps for Action ............................... 7-5
  Resources and Action on DEHP Phase Out ...................................... 7-7
Sustainability Goals and Objectives ...................................................... 7-7
Seattle Children’s: A Case Study for Greening the NICU and Pediatric Hospital .... 7-8
  First Steps: Excellence in Care and Environmental Health Commitment .... 7-8
  The Clean, Green Initiative ............................................................. 7-9
  Comprehensive Excellence in Delivering Care ................................... 7-10
The Future of Healthcare Sustainability ............................................... 7-11
References........................................................................................ 7-12
Key Organizational Resources on Sustainability in Healthcare ........... 7-15

Chapter 8  Measure What Matters ............................................................ 8-1
Figure 8.1 Quality Improvement in Healthcare ....................................... 8-1
The Compass and the Scorecard .......................................................... 8-2
  Table 8.1 The Value Compass and the Balanced Scorecard ............... 8-3
  The Value Compass ..................................................................... 8-4
NICQ 2007: Improvement in Action

Figure 8.2 Clinical Value Compass Framework ........................................................ 8-4
Figure 8.3 MUSC Measures for Improvement Chart .............................................. 8-5
Figure 8.4 Value Compass Example: MUSC .......................................................... 8-6
Figure 8.5 Charting Trends from the Value Compass Framework ....................... 8-7
Figure 8.6 Compass Display of Outcomes and Value: Herniated Disks ............... 8-9
Figure 8.7 Compass Display of Outcomes and Value: Stenosis ......................... 8-10
The Balanced Scorecard .......................................................................................... 8-10
Figure 8.8 Balanced Scorecard Framework ......................................................... 8-11
Figure 8.9 Balanced Scorecard Example: MUSC .................................................. 8-12
Cascades and Dashboards ...................................................................................... 8-13
The Cascade .......................................................................................................... 8-13
Figure 8.10 Cascading Metrics ............................................................................. 8-14
Figure 8.11 Cascade Example: Micro, Meso, and Marcosystems at MUSC ........... 8-15
The Dashboard ........................................................................................................ 8-15
Figure 8.12 Dashboard Example: Baptist Children’s Hospital ............................... 8-17
Figure 8.13 Dashboard Example: Sunnybrook ...................................................... 8-18
The Measure What Matters Worksheet ................................................................. 8-18
Figure 8.14 MWM Worksheet: Part 1 ................................................................. 8-20
Figure 8.15 MWM Worksheet: Part 2 ................................................................. 8-20
Figure 8.16 MWM Worksheet: Part 3 ................................................................. 8-21
Examples: Using the MWM Worksheet in VON NICUs ........................................ 8-21
Figure 8.17 Sample Layout: Measures for Improvement Data Wall ................. 8-22
Conclusion ............................................................................................................. 8-22
References ........................................................................................................... 8-23
Introduction

The Vermont Oxford Network, a nonprofit organization with over 800 member hospitals around the world, is dedicated to improving the quality and safety of medical care for newborn infants and their families through a coordinated program of research, education, and quality improvement. Since 1995, the Network has sponsored a series of intensive quality improvement collaboratives in which multidisciplinary teams of healthcare professionals and families work together under the guidance of expert faculty to identify, test, and implement potentially better practices designed to improve the quality of NICU care.

BACKGROUND

NICQ 2007 was the fifth in this series of improvement collaboratives. Forty six teams worked together for 2 years. Their improvement work was guided by the six domains identified in Crossing the Quality Chasm, the landmark report from the Institute of Medicine. These six domains include: patient and family-centered, safe, effective, timely, efficient, and equitable. The Vermont Oxford Network added a seventh theme, social and environmental responsibility, a domain that we believe must be integrated into our daily work. These seven domains are represented in the graphic above, which was adapted from Battles. Importantly, it positions the patient and family at the center, with the other domains for improvement surrounding this crucial core. We are proud to have engaged parents of NICU patients as working members of our improvement teams and believe that it is a key element of our work’s success.

ABOUT THIS BOOK

The chapters in this book address the seven domains for improvement. Each chapter was written by an expert invited to provide background about the domain and to guide improvement in NICU care. Chapters are illustrated with improvement stories from teams that participated in the NICQ 2007 collaborative, among others. We hope that their stories will guide and inspire other NICU teams to make dramatic improvements for the patients and families they serve.

Chapter 8 addresses a cornerstone of improvement and the linchpin of membership in Vermont Oxford Network: measurement. The use of data is vital to guide change and verify progress toward achieving aims. It is not enough to measure the outcomes at the level of patient and family, although this is the true guiding light for improvement. In addition, it is crucial to apply balanced measures that include process variables and other system indicators. NICQ improvement teams developed and shared tools such as balanced scorecards and value compasses for this kind of guidance, feedback, and learning.
NICQ 2007: Improvement in Action

The Vermont Oxford Network is pleased to provide NICQ 2007: Improvement in Action under a Creative Commons, Share Alike, Non-Commercial License. (For information about the license, see: http://creativecommons.org/licenses/by-nc-sa/3.0/)

Please feel free to use, modify, and distribute this resource as long as it, or any derivative material, is not used for a commercial purposes. Please acknowledge the Vermont Oxford Network and the individual chapter authors, and share the material and any derivatives you create under the same Creative Commons terms.

ACKNOWLEDGEMENTS
We would like to thank the participating teams in NICQ 2007 for their dedication to improvement and for sharing their work. We also express our gratitude to the authors and to our editor, Geta Carlson, for creating and editing this valuable resource.

Jeffrey Horbar
James Handyside
Kathy Leahy

REFERENCES

Chapter 1  Advancing Patient- and Family-Centered Newborn Intensive Care

James B. Conway, MS
Senior Vice President, Institute for Healthcare Improvement

Joanna Celenza, March of Dimes/CHaD ICN Family Support Specialist,
Children’s Hospital at Dartmouth at Dartmouth-Hitchcock Medical Center

Marie R. Abraham, MA
Senior Policy and Program Specialist, Institute for Family-Centered Care

There is a growing consensus that patient- and family-centered care (PFCC) is an essential dimension of excellence in healthcare and of healthcare quality improvement. Numerous benefits of PFCC have been reported, including decreased length of stay, enhanced parent-infant attachment and bonding, better mental health outcomes, better allocation of resources, decreased likelihood of lawsuits, greater patient and family satisfaction, and better staff satisfaction.1-12

Given these benefits, the expectation that healthcare delivery should be patient- and family-centered continues to grow at the policy level, within the healthcare provider community, and among the general public. Leading healthcare organizations, including the Institute of Medicine, the Agency for Healthcare Research and Quality, the World Health Organization, the Joint Commission, the National Quality

Patient- and Family-Centered Care

As defined by the Institute for Family-Centered Care (IFCC), patient- and family-centered care places an emphasis on collaborating with patients and families of all ages, at all levels of care, and in all health care settings. Further, it acknowledges that families, however they are defined, are essential to patients’ health and well-being and are allies for quality and safety within the health care system. The core concepts of patient- and family-centered care are:

Dignity and respect. Health care practitioners listen to and honor patient and family perspectives and choices. Patient and family knowledge, values, beliefs and cultural backgrounds are incorporated into the planning and delivery of care.

Information sharing. Health care practitioners communicate and share complete and unbiased information with patients and families in ways that are affirming and useful. Patients and families receive timely, complete and accurate information in order to effectively participate in care and decision making.

Participation. Patients and families are encouraged and supported in participating in care and decision making at the level they choose.

Collaboration. Patients, families, health care practitioners, and hospital leaders collaborate in policy and program development, implementation and evaluation; in health care facility design; and in professional education, as well as in the delivery of care.16
NICQ 2007: Improvement in Action

Forum, the Institute for Healthcare Improvement (IHI), and the American Academy of Pediatrics, strongly voice support for PFCC. These organizations also recognize that involving patients and families in system redesign and improvement initiatives is critical to success.

Over the last several decades, maternal and child health and newborn intensive care have taken a leadership role in the PFCC movement, laying the groundwork for a change that now informs all clinical areas. While we celebrate the gains, there is much more to do. In newborn intensive care, we are still a long way from delivering PFCC to every infant and family, 100 percent of the time, in every NICU.

Opportunities for learning and improvement are numerous. Effective plans for improvement initiatives can be developed by involving all who have experience in newborn intensive care. This includes clinicians and staff from across disciplines, but most importantly, these initiatives must include family members as partners in facility design, policy review, program development and implementation, and staff education.

Getting to PFCC: What Will It Take?

When the Centers for Medicare and Medicaid Services chose to post patient experience rankings for hospitalized adult patients, IHI and many other organizations were peppered with questions on how to achieve an exceptional patient care experience. The questions centered on what things needed to be done and how these things fit together. In order to respond to these questions, IHI led a research and development project to identify key drivers (that is, the system components) that have a positive effect on the care experience. Patients, family members, clinicians, and administrative content experts across healthcare participated in the project. They determined that the key drivers are:

- Governance and executive leaders demonstrate that everything in the culture is focused on patient- and family-centered care and is practiced everywhere in the hospital.
- The hearts and minds of staff and providers are fully engaged.
- Every care interaction is anchored in a respectful partnership anticipating and responding to patient and family needs.
- Hospital systems deliver reliable quality care 24/7.
- The care team instills confidence by providing collaborative, evidence-based care.

Conclusions drawn from this project support the concept that patient- and family-centered care is inextricably linked with quality and evidence-based care. The challenge then becomes how to hardwire the components necessary for a unit or hospital to begin or expand PFCC. A natural place to start is by assessing the current status of integration of PFCC.
Chapter 1. Advancing Patient- and Family-Centered Care

Publicly Verifiable PFCC

When health professionals are asked if their practice is patient- and family-centered, the typical response is “Yes.” It is something they value but when questioned what the elements are, answers come up short. A number of organizations have developed self-assessment tools including Family Voices, the Institute for Family-Centered Care, Planetree, IHI, the National Initiative for Children’s Healthcare Quality (NICHQ), and the American Hospital Association. These tools explore a range of publicly verifiable elements of patient- and family-centered care, asking whether patients and families:

- Participate as key members of the care team (and are not viewed as visitors by staff and clinicians)?
- Have access to the paper and electronic record?
- Have access to the most accurate clinical information by participating in rounds and change of shift report?
- Receive education and ongoing communications at appropriate literacy levels and in the language spoken at home?
- Serve on governing board and hospital strategic, operating, quality, or facility design committees?
- Participate on patient and family advisory councils?
- Assist in personnel selection and orientation processes?
- Serve as educators for students, trainees, clinicians, and staff?

Experience has taught us that these self-assessment tools are most effective when they are completed by a team that includes patients and family members and staff from various organizational levels and disciplines. The question “how do things work here” gets answered very differently based on where you work. Healthcare historically has focused much more on working within silos as opposed to in teams. Often direct-care staff have differing perspectives of processes from those of managers. Patients and families, in sharing their care experiences with the assessment team, highlight the difference between organizational values and actual practice. It’s particularly important that the team include management as well as direct-care staff. When the team completes self-assessments together, there is often striking use of expressions such as “I thought we started…” “Don’t we…?” “When did we stop…?” Leadership, in particular, has made statements like the following: “If you asked me before the self-assessment process, I would have said absolutely—we are patient- and family-centered. After this process, I see we have barely begun.” Or “I thought of this as a value and not a lot of things.”

We learn through this type of evaluation that the statements highlighting commitment to PFCC in organizational core values and marketing materials do not automatically lead to hard-wiring specific policies and practices across the organization. Once a thorough self-assessment has been completed, strategic priorities for change can easily be determined.
Establishing an Effective Team to Improve PFCC

The experience of organizations such as the Vermont Oxford Network (VON), IHI, NICHQ, and other organizations dedicated to healthcare quality and safety tell us that the most effective improvement teams are made up of representatives who have knowledge about the area of focus. Typically, teams strive for inclusiveness and yet often exclude a key constituency – patients and families. However, if the aim is to advance PFCC or improve any aspect of the care experience, patients and families must be active participants in improvement initiatives. Their perspective of the experience of care is vital.

In observing organizations where there is a struggle with this approach, the model is typically just the action of a few clinical leaders who are committed to patient- and family-centered care who are allowed to implement models as long as no one voices an objection. Administrators and clinicians often struggle with issues of privacy, boundaries, liability, cost, and losing control. At times of enormous demands and constraints, staff worry that there will be a further burden imposed if families are at the table. Each of these concerns is real and underscores that you just don’t “throw” parents and staff into partnerships. It won’t work for the staff or the parents. Families and staff require preparation and training to build the knowledge, skills, and trust that are essential to effective partnerships.

Despite the concerns of staff, we have seen NICUs where parent collaboration is effectively executed. At the root is the clear expectation from unit and organizational clinical and administrative leadership that this is not an “if” discussion but a “when and how.” Ongoing collaboration is not being put to a vote or left to a few clinicians to implement in isolation. Instead the focus is on how it can be implemented in a way that is respectful of families, respectful of staff, and informs processes to most effectively achieve goals. Integration of families in quality and redesign initiatives is conducted in a thoughtful, sensitive, and strategic manner that matches the strengths of parent advisors with the needs of the team. Considerable resources and examples exist to guide organizations in this effort.24–28

Improving PFCC in the NICU

Families are often unprepared for the NICU journey, and struggle to understand this intimidating world of equipment, monitors, and staff caring for their baby. Many, if not most, of the approximately half million premature and critically ill infants born each year (and their families) have experienced care and caring anchored in patient- and family-centered tenets. Yet parents often express concern that they are treated as outsiders in the care of their own infant. Examples include not being a part of critical clinical decision making, not being communicated to in a language or at a level they understand, and not feeling competent and confident to effectively care for their child when they go home.
Chapter 1. Advancing Patient- and Family-Centered Care

However, by engaging families to participate in care and decision making—for example, by including them on multidisciplinary rounds and nurse change of shift reports—NICU staff can help parents begin to feel more like parents and like active members of the care team. Instead of being passive observers watching the physicians and staff care for their infant, parents can be included at their specific comfort level and encouraged to participate in the plan of care and any decisions related to their infant. This active engagement and participation provides a sense of purpose for the family in their baby’s recovery. Additionally, if parents’ informational needs, observations of their infant, and their concerns are acknowledged and addressed by the care team, this too can build their confidence and competence in caring for their baby, especially as they prepare to transition home.

Empowering families to be part of the care team and truly partnering with them throughout their NICU journey can lead to continued partnerships after their infant goes home. Families often express a profound sense of gratitude for the care received and wish to somehow give back to those who provided care for their babies and themselves during a very vulnerable period in their lives. Some NICUs and organizations have responded by establishing parent/family advisory committees. Parents of former patients have been invited to sit on committees dealing with facility design, not just to react to completed designs, but to be full members of the design team from the start. There are now a growing number of neonatal units and organizations where no clinical space can be designed without having family members as part of the design team. Changes suggested by parents include recommendations for noise control, lighting, privacy, sleeping chairs, and room design.

In other organizations, former family members are invited to be part of quality improvement initiatives, sitting on teams, providing immediate reaction to staff around tests of change. At the leading edge are those organizations where parents are full partners in all aspects of improvement and system redesign. In these organizations, parents collaborate with providers to develop policies and strategies. These include how to prepare and support parents to participate in rounds and nursing shift report; how to adapt informed consent documentation and processes so that families have full and understandable information, and how to communicate difficult information or disclose a medical error. These recommended changes often include nuances that only the unique perspective of a family member brings.

One parent whose perspective has been making a significant difference in healthcare improvement is Sorrell King. In 2001, her 18-month old daughter, Josie, died due to medical errors. The King family established a foundation and Sorrell has been working with hospitals and healthcare organizations across the nation to build safer systems and processes. In addition to the presentations she gives to healthcare professionals throughout the U.S., Sorrell has been involved in helping hospitals establish a formal process for families to call a rapid response team if they believe their loved one’s
condition is deteriorating. She has also been assisting researchers in developing a toolkit to train physicians in how to disclose medical errors.30

**The Vermont Oxford Network Experience**

The Vermont Oxford Network began involving families on quality improvement teams in 1998. In the NICQ 2000 collaborative, twelve teams (self-named the We Are Family topic group) focused on PFCC. They involved families in on-site visits to exemplary hospitals, at the face-to-face collaborative meetings, in ongoing improvement work within their individual units, and in the work of identifying potentially better practices and developing tools to measure PFCC. After experiencing the benefits of involving families in this work, many of these teams increased opportunities for families to partner with them in providing PFCC within their individual units. Many units established family advisory councils, created parent-led peer support programs, included families as faculty for staff and trainees, and involved families in revising parent educational and support resources. 28, 31

In the NICQ 2002 collaborative, three teams chose to build on the work of the We Are Family topic group. They enlisted families in creating and testing a Family-Centered Care Map (http://www.fccmap.org/index.htm), an interactive web-based tool designed to promote the delivery of family-centered newborn intensive care. This tool pinpoints specific strategies and programs that clinicians and staff, family advisors, and peer support personnel can test out to improve the delivery of patient- and family-centered newborn intensive care. During this collaborative, VON leadership hired a family member to serve as a consultant to the collaborative. 25, 32

In the NICQ 2007 collaborative, one of the major focus areas was engaging families as members of the quality improvement teams. In alignment with its goals for partnering with families and to model this approach, VON leadership appointed a family member to the Advisory Board for this collaborative. Participating teams were encouraged to collaborate with families in their improvement work during the face-to-face meetings as well as the work between meetings. Teams used a tool developed by the Institute for Family-Centered Care and a family advisor to measure their success in engaging families in quality improvement (see Table 1.1). 33
Table 1.1 IFCC Tool: Framework for Family Involvement in Quality Improvement

<table>
<thead>
<tr>
<th>Level</th>
<th>How Families Participate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level I</td>
<td>Families complete surveys or engage in other evaluative activities as respondents (for example, focus groups).</td>
</tr>
<tr>
<td>Level II</td>
<td>Family advisory councils serve as a resource to the quality improvement team (for example, review projects, documents).</td>
</tr>
<tr>
<td>Level III</td>
<td>Families participate as occasional reviewers and consultants during an improvement project.</td>
</tr>
<tr>
<td>Level IV</td>
<td>Families participate as active members of improvement teams and/or may serve on unit-based task forces and committees and faculty for staff and clinician education.</td>
</tr>
<tr>
<td>Level V</td>
<td>Families are co-leaders of improvement initiatives.</td>
</tr>
</tbody>
</table>

One of NICQ 2007’s aims was to increase the level of involvement of families as members of the improvement teams. Utilizing the IFCC framework, baseline measurements were taken at the beginning of the collaborative and compared to individual and benchmark results at the end of the two-year collaborative. By the end of the two year project, 71 percent of the teams showed improvement and/or achieved the highest level of partnering with families. Of the participating centers, 19 percent ended the collaborative with a self-reported level IV score in the IFCC framework.

Another aim of the collaborative was to have 100 percent of the teams bring at least one parent to one of the four face-to-face meetings. By the end of the collaborative, 80 percent of the teams had done so, and 54 percent of the teams had a parent representative attend more than one meeting, an indicator of commitment and sustainability of partnerships with families in this work.

In addition to observing the changes in level of family involvement in the improvement process, many units in the collaborative voluntarily began to measure families’ perspectives and share this data within the collaborative. One of the useful tools emerging from the NICQ 2000 We Are Family group is an online survey called How’s Your Baby (Figure 1.1).
The survey tool was developed and tested by members of the NICQ collaborative, including parents. How’s Your Baby is currently being used by over 40 centers from the Vermont Oxford Network as a way to measure parents’ perception of quality of care, as well as their assessment of their overall experience. The survey provides useful data about family-centered care practices and how well these goals are being met. The information allows centers to identify areas of improvement, such as transition planning, facilitation of skin-to-skin care, and lactation support, among others. In addition to providing NICUs with information about their performance, the survey information is used in benchmarking with other VON centers.34

Resourcing the Journey to Patient- and Family-Centered Care

As organizations and departments begin or expand their journey in patient- and family-centered care, they report that it takes time, talent, space, money, and other resources. Staff as well as patients and families need time for training and support to position themselves for success. There is the challenge of finding the time for respectful listening and relationship building. Improvement and other collaborative meetings often require staff to stay extended hours or come in off-shift. Family advisors may need funds for parking, meals, childcare, or their time to attend these meetings. Support staff and administrative resources are needed to follow up on the new initiatives.

For too long, funding of these activities has not been a part of operating budgets. NICUs have raised all funds from grateful families, other donors, and grants. Some NICUs have
established paid positions for family leaders to coordinate PFCC initiatives, yet often long-term funding for these positions is precarious. With previously referenced evidence from newborn intensive care and other clinical areas demonstrating the positive impact of patient- and family-centered care on quality, safety, efficiency, and effectiveness, it’s time to have general fund budget allocations join in funding these allocations to ensure continuity and sustainability of these efforts.26

Summary and Next Steps

Newborn intensive care units, their staff, families, and the organizations and associations supporting them have had a significant impact on advancing PFCC in their units and across the hospital. For over 10 years, participants in VON collaboratives—VON leaders and faculty, clinical leaders, clinicians, staff, and family representatives—brought their frustration, passion, caring, honesty, and energy to complete the job. VON has stood as an exemplar for how to establish and maintain a commitment to partnering with families in the care of premature and critically ill infants, as well as how to partner with families in quality improvement and system redesign. It is time to bring patient-and family-centered care to every patient and every family in the NICU and to have the NICU stand as a model and leader to guide efforts in the overall healthcare environment. We owe it to the patients, families, and staff who we are here to serve.

References


Chapter 1. Advancing Patient- and Family-Centered Care


The Vermont Oxford Network is pleased to provide NICQ 2007: Improvement in Action under a Creative Commons, Share Alike, Non-Commercial License. (For information about the license, see: http://creativecommons.org/licenses/by-nc-sa/3.0/.)

When providing attribution to this chapter, please use the following citation:

Chapter 2 System Safety in the NICU

James Handyside, BSc  
Principal Consultant, Improvision Healthcare  
Senior Associate Consultant, HumanSystems Inc.

A neonatal intensive care unit is similar in important ways to so called “first-time safe” systems in high-risk enterprises like nuclear power and aviation. All such first-time safe systems are complex, and they include hazards that require identification and control in order to minimize harm. The adaptation and application of safety methods and tools used in other industries is regarded as a worthy approach to improving safety in healthcare systems. Since 2005, NICQ collaborative teams have been working with the application of system safety methods as a means to identify and control hazards and thereby improve patient safety.

Studies of NICU incident reporting systems identify a wide range of errors, adverse events, and risks. Comparing the findings from these systems is problematic since different reporting and analysis methods were used to collect and classify incident information. The NEOSAFE report presents a more in-depth analysis of incidents and may be more inclusive of the kinds of hazards in NICUs, but is limited to experience in eight NICUs in the Netherlands. What is clear is this: there is considerable opportunity for improvement.

What Is System Safety?

System safety is a management approach to maintaining and improving safety that is comprehensive and thorough. It involves a philosophy that strives to reduce the risk of harm to a level that is “as low as reasonably achievable,” recognizing that resources to prevent harm are limited. A variety of management and engineering tools are used to identity, define, and control hazards in a systematic manner, focusing on system components and how they work together.

One of these tools is the system safety precedence sequence, shown in Figure 2.1. The system safety precedence sequence is based on reliability analysis and sets out a hierarchy of general hazard control strategies. Obviously the most reliable hazard control involves the elimination of the hazard, but it is not uncommon to neglect such an opportunity. The conscious use of the precedence sequence enables improvement teams to work with higher levels of reliability and to move away from the reliance on more training and education. This does not mean that provider knowledge is unimportant or that it should it be neglected, but rather points out the fallibility of hazard control that relies exclusively on this approach.
System safety also includes careful consideration of risk that attempts to quantify it subjectively, or empirically when possible, to inform decisions about resource application in control of hazards. The approach also strives to include safety consideration at all phases of a system’s life cycle; it is not a discrete activity that occurs only when a problem is identified or experienced, although it includes sophisticated incident investigation methods.  

A key principle of system safety is that safety is a line management responsibility. For the NICU, this means that the responsibility for safety should not be referred to a safety officer, specialist, or team. It is the responsibility of all—from the front line of care to unit leadership. Safety is a key result area like other performance goals (for example, fiscal responsibility).

Proactive methods of system safety direct attention to the identification and control of hazards before an event occurs. With limited resources and safety expertise in a busy NICU, this is challenging. However, every change provides an opportunity to consider hazards and improve safety. Participants in the NICQ collaboratives have been committed to making system safety a consideration in all change. The goal has been to identify, analyze, and improve hazard control as a parallel activity to all improvement activity.
Hazard Identification and Definition in Neonatal Care

Patient safety in the NICU presents a formidable challenge because of the complexity of care provided, the reliance on technology, and the vulnerability of the patients, mainly preterm infants, who have very limited tolerance for error. Given this challenge, an approach to safety improvement that engages some of the specific methods and tools of system safety is appropriate. The NICQ projects have provided an opportunity to apply system safety tools across multiple units. As a result, the collaboratives have been able to learn and share findings, engaging in a wide scope of improvement efforts across many different hazards (see the Hazard Index at the end of this chapter).

An effective hazard management process guides improvement activity from hazard identification through to control monitoring, as shown in Figure 2.2.

**Figure 2.2 Hazard Management Process**

Hazards are identified through a variety of methods, and it is important to have the means for taking preventive action when a hazard becomes known. Hazards can be identified by sources external to the NICU—for example, through The Joint Commission, through networks and associations such as the Vermont Oxford Network’s NICQ projects, and through literature, especially the growing body of literature concerned with patient safety. While a typical response to learning about hazards in other units is often “that would never happen here,” a much more useful response is to examine the system at play in one’s own unit. This can be as simple as clearly defining the hazard, examining the control measures in place, and assessing effectiveness by reviewing near misses or through observation and conversation with providers and/or parents.
Vigilance and review of local experience, including incidents and near misses (or “free lessons,” as they are sometimes called) are other sources of hazard identification. When an incident occurs, the associated hazard or hazards should be defined in a way that helps an improvement team consider various mechanisms, not just the exact mechanism associated with a particular event. This affords more thorough and proactive review and more effective ameliorative action.

For instance, if an event occurred in which a test delay caused a clinically significant treatment delay and it involved the mechanism of missing patient information on a specimen, it would be prudent to generalize the hazard to also include a mechanism in which the patient identifier on a specimen was incorrect. Although this is a different hazard, a review of specimen labeling processes presents an opportunity to address more than one specific hazard in a proactive manner.

Participating NICQ teams were guided to undertake preliminary hazard analysis and share findings and improvement activity. The Hazard Management Worksheet, shown in Figure 2.3, was used in this analysis to guide hazard definition, risk scoring, control review, and control improvement.

**Figure 2.3 Hazard Management Worksheet**

<table>
<thead>
<tr>
<th>Hazard Description:</th>
<th>Safety Controls:</th>
<th>Revised Controls:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin Breakdown / Nasal Septum Erosion due to Pressure from CPAP Prongs</td>
<td>Prongs and application technique</td>
<td>Eliminated all choices for equipment and application technique</td>
</tr>
<tr>
<td></td>
<td>Education for nursing and respiratory staff</td>
<td>Validated competency for application technique</td>
</tr>
<tr>
<td></td>
<td>Poster and fact sheet on application and maintenance</td>
<td>Application process review on morning rounds</td>
</tr>
<tr>
<td></td>
<td>Standard team of respiratory therapists</td>
<td>On-the-one remediation for application techniques</td>
</tr>
<tr>
<td></td>
<td>Protocol on application and maintenance</td>
<td>Continue tracking of nasal septum erosion associated with NCPAP</td>
</tr>
<tr>
<td></td>
<td>NCPAP equipment bin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Simplified application and use of suture strips on prongs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ongoing monitoring of nasal septum erosion</td>
<td></td>
</tr>
</tbody>
</table>

A hazard definition includes three parts: source, mechanism, and harm. This is not a rigid structure, however. What’s more, hazards are often referred to in a truncated form for ease of communication or because information can be inferred.
Writing a hazard definition is a powerful exercise; each component offers different clues on how to make improvement as well as on the associated risk. To see the value of highlighting the component parts of a hazard definition, consider a hazard defined simply as mislabeled specimens. But if you rewrite this definition as Blood specimen (source) not labeled or labeled incorrectly (two mechanisms) resulting in delays or errors in care (potential harm), you get more information and enable a more thorough and comprehensive preventive response. Similarly, a hazard defined as weight dosing might be better defined as: Inaccurate or out-of-date patient weight (mechanism) leading to medication dose (source) calculation error (potential harm). For more examples of hazard definitions, see the Hazard Index at the end of this chapter.

**Risk and Safety Resource Application**

The concept of risk is not new to clinical decision making. For example, it’s involved in consideration of treatments with either uncertain or potentially adverse effects. A more formal consideration of risk as part of safety improvement is an extension of this kind of thinking.

A simplified risk scoring matrix was developed based on system safety tools as part of the NICQ 2005 collaborative (Figure 2.4). This tool enables teams to consider risk, which is a product of severity and probability, in a subjective manner in order to create a score on which to base further action and consider the potential effect of improvement action. A variation of the tool was used by Snijders and applied in a similar manner.

**Figure 2.4 Risk Scoring Matrix**

<table>
<thead>
<tr>
<th>Severity of Harm</th>
<th>Probability of Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F. Impossible</td>
</tr>
<tr>
<td>I. Death</td>
<td></td>
</tr>
<tr>
<td>II. Serious</td>
<td></td>
</tr>
<tr>
<td>III. Minor</td>
<td></td>
</tr>
<tr>
<td>IV. No Harm</td>
<td></td>
</tr>
</tbody>
</table>

1. Take immediate action to reduce risk
2. Monitor closely, seek additional controls
3. Control adequate, monitor change
**Probability of Occurrence**
The probability that a hazard will occur is a system characteristic based on several factors—generally, mechanism and exposure. The mechanism informs teams about how to make changes in their systems, while exposure brings into play considerations such as how frequently a process is performed. For instance, if breast milk is stored in a central location, the selection of the correct breast milk will be a step that is repeated for each feeding. Exposure to the possibility of this mechanism resulting in a breast milk error can be reduced or eliminated by storing the patient’s milk in their room or at their bedside. While this is not possible for many units, those moving to single-patient rooms have the opportunity to implement such a countermeasure to reduce exposure.

**Severity of Harm**
The severity associated with hazards involves other considerations such as the patient’s underlying condition but also factors that may be amenable to change. For instance, actions to reduce the magnitude of a source of potential harm—for example, limiting the availability of concentrated drugs—has the potential to reduce severity, as do actions that recognize and respond quickly and effectively when an event occurs.

NICQ teams included a consideration of the risk score as part of their work with the Hazard Management Worksheet. The example provided in Figure 2.3 illustrates how one team scored the risk of skin breakdown or nasal septum erosion due to pressure from CPAP prongs, scoring the risk both before and after changing their practices and instituting new hazard controls. This is a subjective, team-based assessment that has the shortcomings that come with this kind of assessment; however, by paying attention to the components of risk, teams are provided with more options for improvement. Furthermore, in the absence of any formal consideration of risk, a team’s actions are based on tacit assumptions. Formal consideration of risk creates change by contributing to the shared understanding and agreement on how to apply limited safety resources. Risk scoring is an iterative process that ought to occur following a review of current hazard control as well as during and after changes to improve control.

**Hazard Control**
“How do you know what you’re doing to control hazards is good enough?” This is a great question and one that led to the development of a worksheet to aid review of hazards and controls (see Figure 2.5). The items on the worksheet provide a reminder of key prevention principles and methods to support a team’s review of a hazard and to help them answer that question. Of course, there is no magic answer and it is best to consider this an open question, but the worksheet enables an enumeration of how many controls are in place (to provide redundancy) and whether specific and more reliable methods have been deployed.
Figure 2.5 Hazard Control and Barrier Evaluation Worksheet

While the worksheet directs users to more detailed references on the NICQpedia website, the following sections briefly describe what each part of the worksheet addresses.

**Eliminating Hazards**
The first consideration for all hazards should be: Can the hazard be eliminated and done so safely, without introducing more risk? A good example of this is review and consideration of the use of heparin for line flushes and line maintenance care following
NICQ 2007: Improvement in Action

tragic outcomes. If normal saline can safety be substituted, the hazard of heparin overdose may be effectively eliminated. The point to having this on a worksheet is to challenge thinking and ensure this dramatic improvement potential is not overlooked but carefully considered.

IMPLEMENTING THE SAFETY PRECEDENCE SEQUENCE

The worksheet includes a shortened version of the safety precedence sequence shown in Figure 2.1. A review team must challenge the prevailing reaction, which is to simply introduce more education or a new policy or enforcement. These responses may appear inexpensive and easy to implement, but they are often founded on the false premise that people can achieve perfection. The resulting hazard control is often difficult to sustain and can add administrative burden or waste time, often leading to workarounds. While it is not inappropriate to attend to education and awareness, an improvement team needs to understand the fallibility of relying primarily on this kind of control. In his classic human factors book, The Design of Everyday Things, Donald Norman differentiates between “knowledge in the head” versus “knowledge in the world.” Education requires a provider to remember and act on knowledge. When hazard control is more salient — “you can take a picture of it” — there is less reliance on the fallibility of human performance. As John Grout says in Mistake-Proofing the Design of Health Care Processes: “Putting knowledge in the world is an attractive alternative to trying to force more knowledge into the head. Knowledge can be put in the world by providing cues about what to do. This is accomplished by embedding the details of correct actions into the physical attributes of the process. In health care, for example, mental energies that were used to generate precise action and monitor compliance with procedures stored in memory are now freed to focus on those critical, non-routine deliberations required for the best possible patient care.”

SETTING UP BARRIERS TO MINIMIZE HARM

When making improvements in safety, it is important to address not just the prevention of events and occurrences, but also the response should the hazard controls fail. The concept of barriers and safety was popularized by James Reason in his so-called “swiss-cheese” model. Energy-barrier analysis is a system safety technique that uses the same principle: that blocking the progression of an untoward event with physical or procedural barriers is key to prevention. If the most important objective of safety is to prevent or minimize harm to the patient, we fall short if we do not consider countermeasures that mitigate the severity of harm when an error occurs.

Another system safety metaphor that uses the barrier concept is the bow-tie model shown in Figure 2.6. This model directs us to deploy countermeasures that acknowledge that adverse events will happen. These countermeasures need to both detect such an event and limit the level of harm experienced as a result. An example of this is naloxone hydrochloride (narcan) for narcotic overdose. Control of the narcotic overdose hazard is not just about prevention - it includes a response countermeasure.
that will limit harm. It’s a simple concept that is sometimes overlooked; the worksheet directs a reviewer’s attention to consider this as part of safety improvement.

**Figure 2.6 The Bow-Tie Model**

![Bow-Tie Model Diagram]

**ERROR PROOFING**

Error-proofing or mistake-proofing is an approach that has been adapted from a manufacturing quality improvement methodology. It aims either to make errors impossible or to make them visible so a process is interrupted for correction before any adverse outcome occurs. This method is called Poka Yoke and originally developed by Toyota, whose improvement philosophy and methods have recently been employed successfully in several healthcare systems. 11, 15, 16

**USING HUMAN FACTORS SCIENCE**

Human factors principles in the worksheet refer to the NICU Human Factors Checklist series. 17 This was developed to guide changes based on human factors science and to educate NICQ participants, fostering a culture that focuses on system reliability. The approach taken with the series was to engage front-line teams in review and evaluation of their systems. The term “checklist” was applied in this instance to mean a self-assessment tool for the proactive evaluation of system characteristics, and not, as is frequently used in safety procedures, to mean a list to guide you in following procedures or real-time inspections of work factors.

**The Future: Collaborative System Safety Developments**

The application of system safety methods provides an opportunity for continued collaboration to improve safety in the NICU. In particular, an index of hazards and
NICQ 2007: Improvement in Action

controls, along with safety experience, can form a common reference point for improvement. The context of each NICU varies, but shared experience affords a larger realm in which to learn about often rare events. The pool of knowledge that stems from such experience is larger and this can accelerate improvement and avert tragic outcomes for infants and families. NICQpedia is a development that affords such opportunities on a global scale.

Hazard Index

The lists in this section call attention to hazards associated with neonatal care and were compiled as part of the NICQ 2005 and 2007 collaboratives. These lists provide cautionary samples; they do not represent all possible hazards. In each list, sources are denoted as follows:

(1) On Safety Conference Calls February 2008
(2) List submitted at NICQ 2007 Cambridge
(3) Prework for NICQ 2007 Chicago
(4) NICQ 2005 Portland Posters

Alarms and Monitoring

- Alarm response (1)
- O₂ saturation range monitoring / maintenance failure: outside ordered profile (2)
- Delay in response to saturation alarms (2)
- Delays in alarm response (2)
- Alarm fatigue (excess and noncritical alarms) with Guardrail™ use for TPN (3)
- Inadvertent contact with touch screen resulting in standby or disabled monitor (3)
- Faulty or disconnected alarms and delayed response hypoxia/bradycardia (4)

Security

- Unit access security failure (abduction and other threats) (3)

Discharge and Transfer

- Insufficient or inadequate family instruction and teaching; medication error post discharge (3)
- NICU to Special Care Nursery handoff communication failure (3)

Testing, Assessment, and Diagnosis

- Mislabeled specimens (1)
- Point of care testing redraws, delays and spills (2)
- Missed or delayed ROP exam (2)
- Failure to report critical lab value such as a critical electrolyte imbalance (4)
- Unrecognized fetal heart rate abnormality (4)
- Inappropriate blood sample labeling; delay, redraw and/or inappropriate treatment (4)

Infection Prevention

- UVC lines in place beyond change date (2)
Chapter 2. System Safety in the NICU

- Extended use of lines/catheters and potential for BSI (2)
- Inconsistent PICC care and maintenance (2)
- IV line access procedure errors (infection hazards) (2)
- Improper Hep B administration (2)
- Contamination of central line; omission of preventive procedural steps (3)
- Contamination of IV fluids PIV fluids to new PICC line (4)

**Identification**
- Bedside patient ID (1)
- Procedure time out (1)
- Administration of incorrect unit of blood to patient (2)
- Patient identification errors and delays in blood gas testing procedure (3)
- Wrong patient, site, side, or procedure occurrence (4)
- Inappropriate positioning or dislodging of central venous catheters (4)

**Hemorrhage and Injury**
- Hemorrhage from severed line(s) (4)
- Hemorrhage from umbilical arterial catheter; no dead end on stopcock (4)
- Laceration from exposed scalpel blade (4)

**Medication**
- Heparin overdose (1)
- Weight dosing (1)
- IV rate error (1)
- Erroneous barcodes (1)
- IV infiltration, extravasation resulting from perforation of vessel wall or dislodged needle (2)
- IV lipid over infusion (too fast) (2)
- Untimely, delayed, or missing discharge prescription (2)
- Dosing errors on discharge prescription (2)
- IV pump failure (2)
- Syringe design and labeling deficiency resulting in IV dose given orally (3)
- Medication dispensing and administration errors (for example, dopamine-doxapram mixup) (3)
- Multidose lidocaine vials confused for saline in procedure (3)
- Reversal of HAL and IL rates when bags hung with multichannel pump (3)
- Inappropriate morphine dose calculation (4)
- Delay in communication of antibiotic treatment; sepsis (4)
- Absent or inappropriate syringe labels (4)
- Delay in delivery of medication (pressors); prolonged hypotension (4)
- Wrong rate of infusion programmed into IV pump (4)
- Error in TPN drug doses (4)
NICQ 2007: Improvement in Action

**Nutrition**
- TPN contaminants (1)
- Feeding guidelines (1)
- TPN order communication delay or error (2)
- TPN volume maximum not controlled when switching from umbilical to PICC line (2)
- Confusing order for feeding readiness score with order for cue-based feeding (2)
- Breast milk administration errors (wrong patient) (2)
- TPN administration process hazards (2)
- Inappropriate addition of supplements to breast milk; inadequate nutrition or bowel injury (4)
- Incorrect placement of NG tube (4)
- Administration of overheated of breast milk (4)

**Respiratory**
- Condensation in breathing circuit with high-flow nasal canula (3)
- CPAP prongs leading to nasal septum erosion or necrosis (3)
- Improper assembly of CPAP; obstruction of air flow to infant (3)
- Accidental extubation (4)
- Lung injury/disease - use of NeoPuff (4)

**Admission**
- Admission hypothermia (1) (3)
- Communication failure re: high-risk OB patient and consequent delay or inappropriate infant care (2)
- Admission process delays (temperature control, respiratory care, IV access, labs) (2)

**Movement and Transport**
- Transport incubator movement injury (facility to helicopter and in/out of ambulance or helicopter (2)
- Patient falling hazards (4)

**Resuscitation**
- Error in resuscitation procedure sequence (for example, compression before PPV) (3)

**Environment**
- Inappropriate light exposure to infants (3)

**References**
NICQ 2007: Improvement in Action

The Vermont Oxford Network is pleased to provide NICQ 2007: Improvement in Action under a Creative Commons, Share Alike, Non-Commercial License. (For information about the license, see: http://creativecommons.org/licenses/by-nc-sa/3.0/.)

When providing attribution to this chapter, please use the following citation:

Chapter 3 Effectiveness in Healthcare

Robert H. Pfister, MD
Assistant Professor of Pediatrics, University of Vermont
Attending Neonatologist, Vermont Children’s Hospital

Gautham Suresh, MD, DM, MS
Associate Professor of Pediatrics, Section of Neonatology, Children's Hospital at Dartmouth-Hitchcock Medical Center

“In theory, theory and practice are the same…
In practice, they are not.” - Albert Einstein

Effective healthcare is one of the six aims for improvement proposed in the landmark report from the Institute of Medicine, Crossing the Quality Chasm. Effectiveness in healthcare is defined as “the provision of services based on scientific knowledge to all who could benefit, and refraining from providing services to those not likely to benefit (avoiding underuse and overuse, respectively).”¹ The scientific knowledge and the estimation of benefits (and risks) are ideally derived from valid, unbiased, and generalizable research, and constitute the evidence that should inform all decisions about healthcare interventions and services. Thus, effective healthcare is closely related to evidence-based medicine, which is defined “as integrating the best research evidence with clinical expertise and patient values to achieve the best possible patient management.”²

About Evidence-Based Medicine

Our starting point is a look at some of the important issues in evidence-based medicine: how evidence-based medicine is applied, study designs and how the quality of evidence is evaluated, and the difference between efficacy in trials and effectiveness in practice.

Applying Evidence-Based Medicine: Some Basics

When systematic efforts are made to improve the quality of healthcare, there are two broad levels where the principles of evidence-based medicine can be applied:

- In the creation of policies and guidelines at an institutional, organizational, or national level (evidence-based healthcare)
- In the care of individual patients by clinicians, to assist the clinicians, patients and the families of patients in making the best selection among various treatment options (evidence-based practice).³

Evidence-based practice is based on five steps:

1. Forming answerable questions
2. Searching for the best evidence
3. Critically appraising the evidence
4. Applying the evidence in practice
5. Evaluating one’s performance

The medical evidence available to support healthcare decisions can be derived from scientific research of various types or expert opinion, and is often classified into different levels, creating a hierarchy of evidence. While many different systems of hierarchically classifying the evidence exist, all of them rank the evidence according to the degree of confidence that can be placed in its validity—that is, its ability to indicate the truth. High levels of evidence are more likely to yield a true estimate of the effects of an intervention such as a medication or a diagnostic test and lower levels less likely to do so. In such hierarchies, expert opinion, which was historically considered to be the best source of evidence, is relegated to the lowest level. The study design type generally ranks very high as a determinant of confidence levels. The pinnacle of the hierarchy is now occupied by systematic reviews of multiple well-designed randomized, controlled trials. Of the many existing schemes of classifying evidence, the Vermont Oxford Network had adopted the Muir Gray classification, which is provided in Table 3.1.

Table 3.1 Muir Gray Evidence Classification Scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1—highest-quality evidence</td>
<td>Systematic review of multiple well-designed randomized controlled trials</td>
</tr>
<tr>
<td>Level 2</td>
<td>Properly designed randomized controlled trial of appropriate size</td>
</tr>
<tr>
<td>Level 3</td>
<td>Well-designed trials without randomization</td>
</tr>
<tr>
<td>Level 4</td>
<td>Well-designed non-experimental studies</td>
</tr>
<tr>
<td>Level 5—lowest-quality evidence</td>
<td>Opinions of respected authorities (based on clinical evidence, descriptive studies, or reports of expert committees)</td>
</tr>
</tbody>
</table>

Eliminating Chance, Bias, and Confounding Factors

This hierarchy and other similar ones are founded on the basis that the findings of scientific research can be erroneous if factors such as chance, bias, and confounding factors influence the conduct of the study, measurement of the outcomes, or interpretation of the results.

Study designs that eliminate chance, bias, and confounding factors should therefore invoke more confidence in the veracity of the study’s results. The randomized controlled trial (RCT) is an example of such a design for studies of therapeutic interventions. RCTs involve the random allocation of different interventions, treatments, or conditions to separately followed cohorts of patients.
A major strength of this type of trial over observational studies is the ability to assign causality. Adequate number of patients in a study, also called adequate power, helps to ensure that errors due to random chance are eliminated in a RCT.

Although chance is caused by random variation, bias is caused by systematic variation. A systematic error in the way we select our patients, measure our outcomes, or analyze our data will lead to results that are inaccurate. Blinding of participants, random selection of participants, random allocation of interventions, and the use of intention-to-treat analysis are all techniques used in RCTs to reduce the possibility of bias.

Lastly, randomization and stratification are both techniques used in RCTs to help reduce the effect of both known and unknown confounders. A confounder is a factor that is prognostically linked to the outcome of interest and is unevenly distributed between the study groups. Whereas bias involves error in the measurement of a variable, confounding involves error in the interpretation of what may be an accurate measurement. A classic example of confounding is to interpret the finding that people who carry matches are more likely to develop lung cancer as evidence of an association between carrying matches and lung cancer. Smoking is the confounding factor in this relationship: smokers are more likely to carry matches and they are also more likely to develop lung cancer.

A factor is not a confounder if it lies on the causal pathway between the variables of interest. Using the same example, smoking would not be a confounder if all people who carried matches smoked or if all (any) smoking led to lung cancer.

Stratification ensures that only populations with similar levels of a potential confounder are compared. Again, using our example with smoking as a confounder, by ensuring that each group has similar numbers of smokers (“stratifying on smoking”), the confounding effect of smokers is removed. One major problem is that confounding variables are not always known or measurable. Hence, randomization with sufficient power is often the best solution, so that all confounding variables (known and unknown) will be equally distributed across all study groups.

**Systematic Reviews of Multiple RCTs**

Systematic reviews of multiple RCTs constitute the highest level in the hierarchy of evidence because they provide the most comprehensive view of the existing evidence on a given topic. Although policy and individual patient decisions are often made using RCTs, it’s important to seek well-designed, systematic reviews of RCTs to inform policy decisions.

The process for creating a systematic review—which is different from conventional review articles—involves the following basic steps:
1. Perform a systematic search to identify relevant published studies and, if possible, relevant unpublished studies.

2. Critically appraise each eligible study for methodological flaws using explicit, predefined criteria.

3. Extract the results of each eligible study in a standardized manner.

4. When possible, pool the results of all included studies using a statistical technique called *meta-analysis* to derive a pooled estimate of the effects (benefits and risks) of an intervention.

Meta-analysis is a statistical technique to combine the results of multiple studies that address similar research hypotheses. A major advantage of meta-analysis is the higher statistical power derived from the increased number of subjects from the multiple included studies. This greater statistical power enables a more precise estimation of a given treatment effect.

Meta-analysis may also uncover and control for significant variation between studies. It allows investigation of the effect on the results of specific characteristics of the included studies. For example, exclusion of nonblinded studies may change the overall result of the meta-analysis. Within a meta-analysis, it is also possible to explore for the effects of a given intervention on subgroups of patients: for example, does surfactant have a different effect on late preterm infants compared with very-low birth weight infants?

A weakness of systematic reviews is that certain faults within the original studies may tarnish the integrity of their compilation. Sources of bias may not be adequately controlled within the original RCTs. It is therefore crucial that only methodologically sound studies should be included in a systematic review.

A second potential weakness of systematic reviews is the predominant inclusion of published studies. Studies that show negative or nonstatistically significant results are often not published (the phenomenon of publication bias). Therefore, the exclusion of such “negative” studies from a systematic review of an intervention may falsely increase or inflate estimates of the effects of the intervention.

In addition to these innate weaknesses related to the methods of a systematic review, some published systematic reviews—particularly those sponsored by industry—may have serious methodological flaws and unclear biases. Systematic reviews that are rigorously conducted and that are therefore less prone to methodological flaws can be found in the Database of Systematic Reviews maintained by the Cochrane Collaboration.
The Cochrane Collaboration’s Database of Systematic Reviews

Named after the British epidemiologist and champion of the RCT, Archie Cochrane, the Cochrane Collaboration creates, maintains, and updates systematic reviews of relevant healthcare interventions and promotes the acquisition of new evidence for effective healthcare. The Cochrane Collaboration is an unaffiliated, unbiased, international organization, dedicated to making up-to-date, accurate information about the effects of healthcare readily available worldwide.

Cochrane Reviews are prepared systematically and are framed around a similar structure. This structure includes a brief description of the main elements of the question under consideration (types of studies, participants, interventions, and outcomes), a comprehensive search strategy (including unpublished and non-English records), a detailed methods section (describing how studies eligible for inclusion in the review were selected and how their quality was assessed), meta-analytic results, and a thorough discussion including a clear interpretation of the results. The reviews are designed to be clear and easy to understand for nonexperts. Accordingly, each review includes an extensive background describing where the review fits into existing literature, a structured abstract accessible in the medical bibliographic database MEDLINE, and a plain language summary aimed at the non-healthcare professional.

A clear strength of the Cochrane Reviews is that they are designed to be periodically updatable. In 2007, a cross-sectional study of the Cochrane Systematic Reviews was performed. This study randomly selected and analyzed 1016 completed systematic reviews published across all 50 Cochrane Collaborative Review Groups. The authors reported that although 44 percent of the reviews were positive, of these, only 1 percent recommended no further research. Likewise, among the 7 percent of the reviews that concluded that the interventions were likely to be harmful, 5 percent recommended additional studies. Accordingly, authors of individual reviews and the collaborative editorial team update their reviews to assimilate newly completed or published studies, review the quality of the review, and adjust the conclusions as appropriate.

Efficacy Versus Effectiveness

Randomized trials and systematic reviews of such trials provide the best estimate of the effects of an intervention or its efficacy. Efficacy describes the effects of an intervention under ideal conditions—for example, in a laboratory setting or within the protocol of a randomized, controlled trial. However, when an intervention whose efficacy is proven in research studies is used in clinical practice, its actual effects may differ from those seen in the original research. Effectiveness is the extent to which a specific intervention does what it is intended to do for a defined population in actual practice. Efficacy is high on internal validity but at the expense of generalizability; effectiveness is high on external validity but at the expense of careful controls.
An example of proven efficacy is that pulmonary surfactant decreases the risk of pneumothorax and mortality in premature infants with respiratory distress syndrome (RDS). However, to prove that surfactant is also effective, one must determine the following:

- Which are the right patients?
- What is the best dose?
- Which commercially available surfactant preparation should be used?
- Who should administer the treatment?
- What is the optimal timing?
- Is re-treatment beneficial?

Although ideally high-level evidence should be the foundation of effective healthcare decisions, such evidence is often sparse or nonexistent for many healthcare interventions. Even if available, such evidence might not be entirely generalizable to a particular clinical context, or a given patient, or set of patients. In such a situation, if we require only the highest level of evidence in every situation, we may deny patients the benefit of potentially valuable and cost-effective treatments. Dr. Sackett, a pioneer of evidence-based medicine, recognized this when he stated: "Evidence-based medicine is not restricted to randomized trials and meta-analyses. It involves tracking down the best external evidence with which to answer our clinical questions.....if no randomized trial has been carried out for our patient’s predicament, we follow the trail to the next best external evidence and work from there."\(^\text{11}\)

Sackett’s statement suggests that clinicians, patients, and policy-makers should make decisions using the highest-level of evidence available to them in any given situation. Many clinical questions will not have answers based on high-level supporting evidence, and true effectiveness will often not be established. Accordingly, implementation of less proven forms of evidence requires careful monitoring, local customization, and testing. High-quality evidence can inform, but can never replace, individual clinical judgment, including decisions about whether the evidence applies to the individual patient at all and how it should be integrated into a given clinical situation.

The Gap Between Evidence and Practice

Despite the growing development and availability of the medical knowledge base, evidence is unevenly applied to clinical practice. There is a significant delay, estimated at 15 to 20 years, between the discovery of and the incorporation of effective healthcare evidence into routine care.\(^\text{1}\)

Examples of this gap are abundant in the medical literature on interventions for adult patients. For example, despite the fact that over 30 RCTs and meta-analyses demonstrated benefit from the utility of thrombolytic therapy in treating myocardial infarction, adoption of this practice was not uniform until the 1990s.\(^\text{12}\) A second, well-
known example from adult medicine relates to infections in the intensive care unit setting. Despite the fact that there are well-known methods of limiting catheter-related bloodstream infections, one report observed that prior to an intensive quality improvement intervention, only 62 percent of physicians followed routine infection control guidelines.

This gap between the evidence and clinical practice exists in the field of perinatal medicine as well. For example, for many years, in spite of good evidence for the benefits of antenatal corticosteroid administration to pregnant women at risk of preterm delivery, obstetricians did not routinely use this medication in eligible women. In 1992, Crowley et al published a convincing meta-analysis demonstrating that the use of antenatal corticosteroids in mothers at risk of preterm delivery promoted lung maturity in preterm infants, and resulted in overall reduction in neonatal deaths, cerebral hemorrhage, and necrotizing enterocolitis. On the weight of this meta-analysis and its RCT components, in 1994 the NIH released a statement supporting the routine use of corticosteroids, “... indicated for women at risk of premature delivery with few exceptions.”

Although the NIH’s statement resulted in an increased rate of usage of antenatal corticosteroids, considerable variability continues to exist. As recently as 2004, among the 504 NICUs in the Vermont Oxford Network (VON) database, maternal antenatal steroid administration was performed in only 54 percent of the cases in the worst quartile compared to 79 percent in the best-performing quartile.

Another example of the gap between evidence and practice in perinatal medicine is related to the use of surfactant therapy in preterm infants. Despite a Cochrane Review demonstrating clear benefit of pulmonary surfactant administered to infants at risk using an early, prophylactic strategy, a 2004 study demonstrated that among more than 25 percent of neonatal units within the Vermont Oxford network, more than 30 percent of the infants who were treated with surfactant received the first dose more than 2 hours after birth. The authors concluded that “There is a gap between evidence from randomized controlled trials that supports prophylactic or early surfactant administration and what is actually done in routine practice at many units.”

In 2003, Henderson-Smart et al examined their unit’s own guidelines and practice parameters compared to the recommendations for practice published by the Neonatal Review Group of the Cochrane Collaboration. Among the 37 reviews where interventions were found to have clinically important benefits without clinically important harms, 86 percent of their local guidelines were consistent with Cochrane Review findings but in 14 percent of the cases, the recommended practices were either not embraced or done so inconsistently.
In addition to delays in the translation of evidence into practice and the failures to make this translation, the history of neonatology is littered with numerous examples of large numbers of neonates being harmed from clinicians using interventions not supported by adequate evidence. For example, the use of unrestricted, 100 percent oxygen was the standard of care prior to the 1956 study by Kinsey et al, leading to an unnecessary increase in retinopathy and blindness. Later, in the late 1970s and early 1980s, an unproven therapy, intravenous Vitamin E (E-Ferol), was administered in hopes of ameliorating retinopathy of prematurity, leading to scores of hepatic failures and deaths.¹⁹

**Bridging the Gap: Quality Improvement Collaboratives**

VON conducts multicenter quality improvement collaboratives called Neonatal Intensive Care Quality (NICQ)²⁰ that have embraced the principles of evidence-based medicine since their inception. In these collaboratives, participants are encouraged to develop four key habits for improvement, which are the basis of each collaborative. These key habits emphasize:

- Change
- Collaborative learning
- Evidence-based practice
- Systems thinking

Quality improvement (QI) initiatives such as NICQ are one way to bridge the gap between the evidence and practice. When there is strong evidence to support an intervention, QI may be used for implementation and execution. For example, when VON data revealed that many centers did not use pulmonary surfactant in accordance with the published evidence,¹⁷ Horbar et al conducted a cluster randomized trial of a multifaceted, collaborative quality improvement intervention (similar to the NICQ collaboratives) designed to promote evidence-based surfactant treatment for preterm infants.²¹ The multifaceted intervention consisted of rigorous evidence review, specifying discreet measures of performance, and mandating close follow up.

This intensive QI intervention was successful in improving evidence-based practice. Infants in intervention hospitals were more likely to receive surfactant in the delivery room [adjusted odds ratio 5.38 (95 percent CI 2.84 to 10.20)], were less likely to receive the first dose more than two hours after birth [adjusted odds ratio 0.35 (95 percent CI 0.24 to 0.53)], and received the first dose of surfactant sooner after birth (median of 21 minutes v 78 minutes, P < 0.001).

When there is insufficient evidence for a clinical intervention, or when there are gaps in the available evidence on a given topic, quality improvement projects may also be important in improving effective healthcare by helping identify areas where additional evidence is required and creating hypotheses for RCTs. One method employed by centers participating in QI efforts is called benchmarking. Benchmarking is the process
Chapter 3. Effectiveness in Healthcare

of comparing and evaluating various aspects of a process or method to another that is widely considered to be a standard or best practice. For example, observations from NICQ benchmarking visits suggested that low infection rates may be linked to decreased skin punctures and improved skin integrity. In response, VON designed a RCT of skin practices to address this issue and gather additional evidence.22

There are several good examples of how participants in the NICQ collaborative have embraced the use of evidence-based medicine principles to encourage effective healthcare from the very beginning. The NICQ 2007 Collaborative group from the Saint Barnabas Medical Center in Livingston, New Jersey, is one example. This group aimed to eliminate hospital acquired infections (see Table 3.2). Hand washing is recognized as the most effective way to prevent the transmission of microorganisms and considered the single most important measure in prevention of nosocomial infections.23 The Centers for Disease Control and Prevention (CDC) recognize the value of multidisciplinary hand-hygiene promotion in reduction of infectious risk in their published guidelines.24 Additionally, there exists evidence demonstrating a relationship between hand washing and reduction in infection in the NICU.25–28 The evidence demonstrates that proper hand hygiene practice has a marked impact on central line colonization, reducing the rate of bloodstream infections in VLBW infants.

The NICQ 2007 team from Saint Barnabas Medical Center made measurable improvements by taking the final step from an efficacious practice to an effective one. After reviewing and appraising the evidence, they applied the evidence into an in vivo setting. The last step is to measure one’s performance. Table 3.2 describes their approach.

Table 3.2 Eliminating Hospital-Acquired Infections at Saint Barnabas Medical Center

<table>
<thead>
<tr>
<th>Overall Aim: Eliminate Hospital-Acquired Infection</th>
<th>Overall Measure: Track the Number of Days Since Last BSI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Specific Aims</strong></td>
<td><strong>Specific Measures</strong></td>
</tr>
</tbody>
</table>
| Reduce line-associated bloodstream infection (BSI) by 50% | • Collect rate of line-related BSI monthly and quarterly according to birth weight category  
• Collect rate of line-related BSI monthly and quarterly for all NICU patients |
| Standardize hand-hygiene practices                 | • Perform hand-hygiene audits weekly  
• Perform bare arms audit                           |

Figure 3.1 illustrates the bloodstream infection (BSI) rates per month and per quarter, demonstrating improvement.
Figure 3.1 Improvement in Line-Related BSI Rate at Saint Barnabas

Conclusion

Provision of healthcare based on high-quality medical evidence that works not only in the laboratory but at the bedside is the hallmark of effective healthcare. Accordingly, effective healthcare is based on valid, high-level evidence, forming an inextricable link to evidenced-based medicine. High-level evidence typically comes from well-designed, well-populated randomized clinical trials or systematic reviews of several RCTs, such as the Cochrane Systematic Neonatal Reviews. Ideally, laboratory evidence has also been pragmatically customized and tested in clinical situations. When there is strong evidence to support an intervention, QI may be used for implementation and execution of the idea. However, when there is insufficient evidence for a clinical intervention, or when there are gaps in the available evidence on a given topic, quality improvement projects may also be important in improving effective healthcare by helping identify areas where additional evidence is required and by providing opportunities for benchmarking.
Chapter 3. Effectiveness in Healthcare

References


Chapter 3. Effectiveness in Healthcare

The Vermont Oxford Network is pleased to provide NICQ 2007: Improvement in Action under a Creative Commons, Share Alike, Non-Commercial License. (For information about the license, see: http://creativecommons.org/licenses/by-nc-sa/3.0/.)

When providing attribution to this chapter, please use the following citation:

Chapter 4 Equitable Care in the NICU

Stephaine Hale Walker, MD, MPH
Assistant Professor of Pediatrics, Vanderbilt University Medical Center
Neonatologist, Monroe Carell Jr. Children's Hospital at Vanderbilt

As data continue to indicate, the burden of disease remains extremely high among the U.S. minority populations. The frequency of diseases such as diabetes, obesity, hypertension, asthma, and cancers are comparably much higher among African-Americans, Latinos, and Native Americans than in the Caucasian population. This is also the case for disorders plaguing mothers and their infants in the perinatal period. Although rapid advances in neonatology over the last three decades have dramatically improved the overall risk of mortality and morbidity for critically ill newborns, disparities in care and outcomes for infants born to ethnic minorities persist, and may even have worsened.

Infant Mortality in the Minority Population

In 2002, the infant mortality rate in the United States, defined as death within the first 365 days of life, was 7 deaths per 1000 live births.\(^1\) Although the U.S. is one of the wealthiest countries in the world and expends more per capita on medical care than any other country, our infant mortality rate is higher than that of many other industrialized countries. When comparing infant mortality in the U.S. by race, the infant mortality rate among African-American infants was almost 2.5 times higher than the rate among white infants (13.9 and 5.8 per 1000 live births, respectively). This gap has increased by more than 40 percent since 1960. Overall, the three leading causes of infant mortality are (1) congenital abnormalities; (2) prematurity (<37 weeks gestation)/very low birth weight (birth weight <1500g; [VLBW]); and (3) sudden infant death syndrome (SIDS).\(^2\)

However, despite being the second leading cause of death overall, the number one leading cause of death for African-American infants is prematurity/VLBW. What’s more, although VLBW infants make up less than 2 percent of all births, they contribute to 64 percent of all neonatal deaths (death during the first 28 days of life).\(^3\) This finding is especially striking because neonatal mortality accounts for the majority of all infant deaths.

Data on Disparities and Discussion in the Literature

One has to wonder, what are we doing as neonatal intensive care providers, if anything, to contribute to the disparities in outcomes that we see in infants? Are we caring for our patients differently?

Very little data exist regarding how the equity of the care we provide our families affects infant outcomes. In fact, a look at the national neonatal and infant outcomes data based on birth weight suggests that these patients are cared for in similar manners regardless of race/ethnicity and that it is the gestational age/weight that has the greatest influence
on survival. While there are as yet no hard data documenting that unequal treatment of patients exists in the NICU, we do know that cultural barriers exist, that they play a role in parent satisfaction, and that they also come into play as we strive to provide the best possible care in the NICU. Several important reports suggest ways to think about and address these barriers.

The first is the Institute of Medicine 2002 report, *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*, which revealed the uncomfortable reality that people of color receive a lower quality of care compared to their white counterparts across the board. This was the case even after taking into account factors such as co-morbidities, health insurance, socioeconomic status, and staging at time of presentation. The report suggests providing tools to help healthcare professionals become more “culturally competent.” “Clinical cultural competence,” as defined by Dr. Joseph Betancourt, director of the Disparities Solution Center at Massachusetts General Hospital, is “using training and education to raise providers’ awareness of how socio-cultural factors affect health beliefs and behaviors; improving communication across cultures; empowering patients to take active roles in medical encounters; building trust between providers and patients and between patients and the health care system; being attentive to the effects of race, ethnicity, and culture on clinical decision-making.”

Culturally competent healthcare ties into efforts to address inequities in health outcomes, but simultaneously addresses efforts to develop a system that delivers high-quality care.

In addition to culturally competent care, the *Unequal Treatment* report highlighted the importance of improving “provider-patient” communication as a method of addressing racial and ethnic disparities in healthcare. When an infant is in the neonatal intensive care unit, the “patient” being cared for is not just the infant; it’s the infant along with the parents and/or family. As providers, we often find ourselves “treating” the whole family. One could argue that the overall well-being of our infants is affected by how we succeed in taking care of the family unit.

Most recently, with insight from the 2007 annual *National Healthcare Disparities Report* produced by the Agency for Healthcare Research and Quality, the U.S. Department of Health and Human Services’ Office of Minority Health (OMH) collaborated with the National Public Health and Hospital Institute, the Institute for Healthcare Improvement, and the Disparities Solution Center on a 2008 report entitled *Assuring Healthcare Equity: A Healthcare Equity Blueprint*. This report offers various strategies for providers and healthcare organizations to better address disparities. The proposed strategies focused on 5 areas: creating partnerships with the community, patients, and families; exercising governance and executive leadership for providing quality and equitable care; providing evidence-based care to all patients in a culturally and linguistically appropriate manner; establishing measures for equitable care; and understanding and being responsive to cultural needs and expectations while communicating in the
patient’s (family’s) language.” Given that no two healthcare settings are identical, these interventions can (and should) be tailored to the specific, unique needs of each.

**Barriers to Care**

What are the factors that may influence our ability to provide high-quality, equitable care to the racially and ethnically diverse families of the infants who come to the NICU? At least four broad issues may influence medical encounters:

- Language or cultural differences, both of which may lead to misunderstandings between the family and the provider.
- Mistrust and discomfort voicing concerns or asking questions of the provider as a result of previous encounters within the healthcare system or because of various cultural beliefs.
- A family’s relative or perceived health literacy.
- The economic challenges of families dealing with unexpected indirect costs of having a child in the NICU, such as transportation, child care for other children, and missed wages possibly creating enormous stresses for the family.

Any of the above may result in poor communication or interaction between the family and care team and, in theory, has the potential to impact the quality of care we provide.

In addition to the factors coming primarily from the family’s side of the interaction, as providers we bring our own issues to work, which in turn may negatively influence the quality of an encounter with a family. For instance, some care providers may simply have limited skills in interacting with families of diverse cultural backgrounds. Providers have various ways of expressing their own relative level of stress towards caring for critically ill infants or comfort related to dying infants, which in turn may negatively impact the interaction with the family if language or cultural differences have not been addressed. Last but not least, as caregivers we bring our own stereotypes and biases to work, whether consciously or unconsciously.

In our NICUs today, we are faced with families from diverse backgrounds, those who have unique family structures, and those with challenging histories. For example, in any given day, we may interact with parents who are non-English speaking, or from a different culture or background, with same-sex couples, interracial couples, couples from particular sects or faiths, single parents helped by surrogates, or even those dealing with a history of drug use. As caregivers, we are a diverse group as well. Some of our patients’ families resemble our own families or backgrounds, whereas others do not. Consequently, as providers we inherently interact better with certain families than others. Learning to be honest with ourselves and developing a greater awareness of our own feelings or belief systems—and how these influence our interaction with families—would certainly be a step in the right direction.
Addressing Disparities through NICU Staff Education

We can make a number of interventions to address the needs of families while simultaneously continuing to provide high-quality care for their children. First, it is important that the NICU staff is equipped with the skills to interact appropriately with families from various cultural backgrounds. Cultural competency training has been shown to improve attitudes, knowledge, and skills of healthcare professionals by teaching ways to communicate with families who have limited English proficiency, limited health literacy, alternative health beliefs, and various religious beliefs. At the same time, such training has been shown to improve parent satisfaction.

The most effective training enables staff to learn about themselves and their own reactions, raising awareness of subtle stereotyping and enhancing the ability to self-correct and compensate. Such training also demonstrates how to integrate cultural competency into all discussions of patient care and operations—for example, staff meetings, presentations, and other core activities. The U.S. Department of Health and Human Services Office of Minority Health, among other organizations, has created a set of standards known as the National Standards on Culturally and Linguistically Appropriate Services (CLAS standards), which are intended to aid providers and organizations in providing culturally competent care.

Addressing Disparities by Providing Resources for Parents

Resources include educational materials, social needs assessments, and interpreter services.

Educational Materials
The staff should be equipped to provide NICU families from diverse cultural and ethnic backgrounds with proper educational resources. An important purpose of this material is to help families better understand why their infant is in the NICU, what the staff will attempt to do to make their infant better, and what some of the care options and choices are or will be. Both web-based and printed resources should be available. This material should also be available in different languages. In terms of health literacy and general literacy, the material should be of ninth grade reading level to help ensure that it is easily accessible. Furthermore, it cannot be assumed that speaking a language also implies an ability to read in that language. For this reason, asking the family their language preference for written material is often helpful. When you create family educational material for your unit, consider using parent input about what families actually want to know.

Social and Economic Needs
In addition to information that helps families understand and make choices about the care of their infant, some families may demonstrate a variety of economic needs as a result of having a sick infant in the hospital for a relatively long period of time. As providers, we should be sensitive to these needs to the best of our ability.
institutions, the social workers are able to provide subway or bus tokens or cab vouchers for transportation, parking vouchers, and hospital food vouchers. Establishing a standard way by which each family’s unique social needs can be assessed is essential, as is having team members designated as responsible for addressing these needs.

**Interpreter Services**

Interpreter services are another critical resource for working with families from diverse backgrounds. Because research has demonstrated significant healthcare inequalities for patients with limited English proficiency, interpreter services should be available as needed and at all times. There is clear evidence that interpreter use can improve communication between the team and parents/families, resulting in improved parent understanding and satisfaction. Language services can allow families to participate in clinical decision making by facilitating their understanding of uncertainty, risks, and treatment choices while at the same time enabling providers to obtain truly informed consent. Such services can also improve healthcare providers’ ability to ascertain families’ preferences, values, as well as alternative health beliefs. For example, one can understand how imperative interpreter services would be if an already critically ill preemie of a non-English speaking family had a sudden, life-threatening event such as a severe intracranial hemorrhage and the NICU team needed to alert the family and talk to them regarding subsequent steps in care. The proper use of interpreter services would be essential in helping the family and medical team make the appropriate joint decision for the patient and family about whether to continue or redirect care in some way.

Systems that use interpreter services successfully have identified bilingual and multilingual staff and trained them to be interpreters. In addition, it is important to train providers how to properly use both trained and untrained interpreters or telephone interpreters. Finally, it is important to post visible and accessible lists of local options for interpretation—including telephone interpreters or in-person interpreters—so that staff can arrange services in a timely manner.

Keep in mind that using family members as interpreters is not ideal, since family members can misinterpret medical information or even withhold information from both the staff and family. In addition, using family or friends as interpreters may improperly label the individual as being proficient in English, when in fact they are not.

**Addressing Disparities through Standardized Data Collection**

Standardized data collection is an essential first step in identifying and addressing potential disparities in healthcare and adequately measuring whether the intended change occurred, and if so, in assessing the changes in outcomes. It is essential that each NICU collect, analyze, and report patient population data, as well as quality and patient
NICQ 2007: Improvement in Action

safety indicators, by race, ethnicity, and language. The integration of cultural competency measures into parent satisfaction assessments, internal audits, performance improvement efforts, and error reduction programs (for example, through the use of interpreters) would also provide key information. Ultimately, physicians and team members need to receive feedback on their performance. Remaining transparent when dealing with any errors and barriers to quality care in areas where disparities have been identified will be essential in moving closer to creating a more equitable, high-quality NICU.

Table 4.1 lists some aims and measures for improving equitable treatment, as developed by the 2007 NICQ collaborative.

Table 4.1 Aims and Measures for Equitable Care in the NICU

<table>
<thead>
<tr>
<th>Aims</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>To collect data on race, ethnicity, and primary language</td>
<td>Is patient/parental data properly documented in the chart?</td>
</tr>
</tbody>
</table>
| To ensure that all patients receive standard of care that matches their need | • Did the patient (grouped by gestational age, disease process, and so on) receive those treatments documented as the standard of care in your unit?  
  • Of those that did not receive the standard of care, stratify by race/ethnicity/language |
| To improve the cultural competency of staff                         | • Percent of staff who completed cultural competency training  
  • Results of parent satisfaction surveys                             |
| To make appropriate use of interpreter services                     | • Percent of parents/families who are documented as not having English as their primary language and who actually received interpreter services  
  • Results of parent satisfaction surveys                              |
| To create and ensure the optimal use of education material          | • Was parent input a part of the creation/approval process for educational materials used in the hospital?  
  • Results of parent satisfaction surveys                              |

Case Study

During the 2007 NICQ collaborative, the Children’s Hospital Central California in Madera decided they would establish a goal to provide equitable care for all of their patients and families in the NICU, with a primary focus on improving communication. In doing so, their aim was to “provide high-quality, comprehensive healthcare to our patients and families regardless of their ability to pay...recognizing the importance of delivering care that complements and incorporates our families’ religious and cultural beliefs...[and] respecting the language and race of each of the families we serve.”
This NICU sought to measure their aim using a parent satisfaction survey through which data were collected. The survey focused on such things as whether the explanations given to parents regarding their infants were given in a language they could understand; perceived existence of social services, chaplain/pastoral services, and interpreter services and parental level of satisfaction with these services. Special attention was given to parents’ perception of the availability and use of interpreters.

A number of changes were made within the NICU in order to adequately address the aim. Conferences were provided to the NICU staff on health literacy and quality of care in the NICU, with case scenarios provided by staff RNs and social workers. In addition, a system was created to forward parental concerns to staff in real time (as close as possible to when concerns were expressed) rather than retrospectively. The NICU in Madera also stipulated that before patient/family education materials were approved for use in the hospital, the materials needed to be reviewed by English-speaking and Spanish-speaking families.

Ultimately, as a result of addressing the aim established by the NICU, all of the staff at Children’s Hospital Central California completed the annual cultural competency training by the end of the measurement period. During the same period, they also noted a corresponding improvement in parent satisfaction based on survey results regarding interaction with NICU staff and use of NICU services and resources. It can be argued that by integrating cultural competency teaching and concepts into daily NICU discussion, Children’s Hospital Central California not only made significant improvements in the tangible family resources given to parents, but was also successful in creating a more equitable environment for families of diverse backgrounds.

**Conclusion**

When the NICU staff is trained to engage in culturally competent exchanges, provide appropriate educational resources to families, consistently utilize appropriate interpretation services, and use agreed upon care and treatment plans inclusive of input from the family, our families are more engaged, empowered, and educated, enabling them to be active participants in their child’s care as part of the team. The impact of these interventions on neonatal outcomes cannot be easily measured. But knowing that significant barriers to equitable care in our NICUs exist, it makes sense that as providers, we would want to intervene to provide the best overall quality of care to our “patient-family.”

To enable your NICU to adequately identify those areas where concerns exist, it is imperative that your unit collect, analyze, and report data by race, ethnicity, and language. Doing so will enable the establishment of aims that are relevant and specific to your particular NICU in order to properly create a plan to address and later measure for improvement.
References

1. MacDorman MF, Martin JA, Mathews TJ, Hoyert DL, Ventura SJ. Explaining the

2. National Center for Health Statistics. Infant, neonatal, postneonatal deaths, percent
of total deaths, and mortality rates for the 15 leading causes of infant death by race

3. Gortmaker S, Wise P. The first injustice: socioeconomic disparities, health services

4. Institute of Medicine. Unequal treatment: confronting racial and ethnic disparities in
http://www.iom.edu/Reports/2002/Unequal-Treatment-Confronting-Racial-and-
Ethnic-Disparities-in-Health-Care

5. Betancourt J. Improving quality and achieving equity: the role of cultural
competence in reducing racial and ethnic disparities in health care. The
Commonwealth Fund, 2006. Available at:
http://www.commonwealthfund.org/Content/Publications/Fund-
Reports/2006/Oct/Improving-Quality-and-Achieving-Equity--The-Role-of-Cultural-

6. Agency for Healthcare Research and Quality. Key themes and highlights from the
Research and Quality, 2008.

7. National Public Health and Hospitals Institute, in collaboration with the Institute for
Healthcare Improvement and the Disparities Solution Center. Assuring healthcare
Improvement, 2008. Available at:
http://www.ihi.org/IHI/Topics/PatientCenteredCare/PatientCenteredCareGeneral/To
ools/HealthcareEquityBlueprint.htm

2000; 6:93-99

9. Betancourt J, Green A, Carrillo J. Cultural competence and health care disparities:

standards on culturally and linguistically appropriate services. Available at:

competency in children’s health care—expanding perspectives. Cambridge, Mass:
NICHQ, July 2005.

12. Hampers L, McNulty. Professional interpreters and bilingual physicians in a
pediatric emergency department: effect on resource utilization. Archives of Ped and
The Vermont Oxford Network is pleased to provide NICQ 2007: Improvement in Action under a Creative Commons, Share Alike, Non-Commercial License. (For information about the license, see: http://creativecommons.org/licenses/by-nc-sa/3.0/.)

When providing attribution to this chapter, please use the following citation:

Walker SH; Equitable Care in the NICU from NICQ 2007: Improvement in Action; Horbar JD, Leahy K, Handyside J, eds. Vermont Oxford Network, Burlington, Vermont, 2010 (first published online at www.vtoxford.org)
Chapter 5  Improving Efficiency

Diane C. Frndak, PhD, MBA, PA-C
Vice President of Organizational Excellence, West Penn Allegheny Health System

In 1914 Earnest Amory Codman, MD, wrote:

You hospital superintendents are too easy. You work hard and faithfully reducing your expenses here and there—a half cent per pound on potatoes or floor polish. And you let the members of the staff throw away money by producing waste products in the form of unnecessary deaths, ill-judged operations and careless diagnoses.¹

Today we still throw money away, not only because of unnecessary mortality or harm caused by medical errors, but also because of the way that the work of healthcare workers is designed. Healthcare organizations try earnestly to save money on the expense side but continue to poorly recognize some of the hidden wastes impacting the efficiency of healthcare. A prime example of such hidden inefficiencies is the “friction” that healthcare workers deal with as they work—for example, frequent operational failures, glitches, waiting, interruptions, rework, disruptions and workarounds that impede the flow of work.

The Institute of Medicine’s (IOM) landmark report, *Crossing the Quality Chasm*, established six quality improvement goals for restructuring the healthcare system: improving safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity. This chapter focuses on efficiency.

Our starting point is a fresh look at the meaning of efficiency in a healthcare setting and how to achieve it. Too frequently healthcare leaders have defined efficiency as operating with the smallest number of workers, purchasing cheaper supplies and materials, and spending the shortest time possible with patients. In addition, healthcare managers have taken this incomplete understanding of efficiency and made it a top priority in their organizations, elevating it above other aims. Unfortunately, this approach has inadvertently created distaste for efficiency in the minds of patients and healthcare professionals at the front lines. This chapter suggests that the trade-offs many of us have come to associate with efficiency are often unnecessary.

Definitions of Efficiency and Types of Waste

The IOM definition of efficiency is avoiding waste, particularly of equipment, supplies, ideas and energy. Healthcare has recently been learning from other industries, such as manufacturing, about how they have approached improving efficiency. Some of the principles of the Toyota Production System have been helpful to healthcare workers in understanding their work processes.
Here are the eight types of waste Toyota has defined, and some examples of how these definitions apply to healthcare:

1. **Overproduction:** Toyota defines overproduction as providing more than is required by the next customer. The company considers this type of inefficiency the most serious form of waste because of the other wastes overproduction creates. In the manufacturing setting, overproduction occurs through preparing too early or too much, processing large batches, or having too many projects active at one time. An example in healthcare might be prepping more patients for surgery than the operating room is ready to receive.

2. **Waiting:** Waiting is any idle time when no value—such as the healing process—is created. In healthcare, waiting is especially associated with transfers, lab results, or discharge delays. Waiting can impact the patient, family, and healthcare workers.

3. **Unnecessary transportation:** By unnecessary transportation, Toyota means any movement of materials or people that does not add value to the service. Examples in healthcare include sending patients or nurses to multiple departments or engaging in unnecessary handoffs.

4. **Overprocessing:** Overprocessing is any effort that adds no value to the product or service. Examples of overprocessing in healthcare include redundant paperwork, ineffective meetings, too many steps in a process, sending papers not required, unnecessary log sheets, or manual data collection.

5. **Unnecessary inventory:** In healthcare, this form of waste includes supplies or information kept “just in case,” including data collected but not utilized. In healthcare, the ultimate “product” is actually the patients we serve. “Unnecessary inventory” in this context can be equated with filled patient waiting rooms and sleepovers in the Emergency Department. Although waiting patients are work-in-process inventory and not strictly speaking unnecessary, the queuing of patients between processes is similar to manufacturing inventory issues. We need to streamline the flow of patients much like manufacturers streamline the flow of inventory.

6. **Untapped creativity:** The waste of not using people’s ideas, insights, energy, and skills is just as much a problem in healthcare as it is in manufacturing or in other settings. In particular, in the NICU and other healthcare environments, we frequently fail to collect and make use of the insights of people at the front lines, such as housekeepers, doctors, nursing staff, and the families of patients. Untapped creativity may contribute to waste in achieving efficiency.
Chapter 5. Improving Efficiency

7. **Defects:** In manufacturing, defects cause the need to rework or repair, and they represent waste in its simplest form. In healthcare, defects are just as direct a form of waste. Examples include infections, missed exams, medication errors, rework, miscommunications, or inconsistent instructions.

8. **Unnecessary or excess motion:** Any movement of people or machines that does not add value is a form of waste. In healthcare and especially in the NICU, efficiency is critical because time is critical. It’s important to identify excess motion in the form of extra steps, repeated phone calls, or walking to another unit to get supplies or equipment.

One of Toyota’s key insights is that to achieve the optimal level of overall performance, efficiency should be viewed from the perspective of the customer. Applying this principle to healthcare, we could say that work that is not providing value to the patient/family is considered non-value-added (NVA) work and usually also overburdens healthcare workers. Improving efficiency should be an improvement for the patient/family and healthcare workers alike.

**Hidden Wastes: Workarounds and Faux Problem Solving**

Because waste can be hidden within a clinical microsystem such as the NICU, systematically assessing processes for the various wastes is an appropriate first step in improving efficiency. A surprising first step in making improvements is creating “new eyes” to recognize glitches, workarounds, operational failures, or problems. Several of the NICUs in the Vermont Oxford Neonatology Improvement Network (NICQ) described systematic approaches to analyze their work environments from the patient and the worker perspective. After this analysis, they were able to identify opportunities for improvement.

Observations of NICUs and other healthcare environments demonstrate that they are typically complex and can become chaotic environments, with staff performing workarounds as they attempt to do their daily tasks. These workarounds become waste. More important than specific instances of waste, according to Spear and Schmidhofer, is that by tolerating the ambiguity about exactly what is supposed to be done and when, instead of learning from the problem and working to improve the process, NICUs create opportunities for risks to patient safety, delays, reduced effectiveness, and lack of patient centeredness. As healthcare workers become used to the workarounds, they start accepting small glitches or operational failures, which in turn become the definition of normal. This dysfunctional “normal” fails to provide the desired level of care for patients or family, but such subtle deviance frequently becomes normalized into the work.

Are we solving the problem or merely addressing the latest symptom? Healthcare organizations often do not use effective problem-solving mechanisms for dealing with
these front-line operational failures. Tucker discovered Level One problem solving (doing whatever it takes to take care of the patient) occurs over 90 percent of the time based on first-hand observation of front-line healthcare worker problem solving. This approach does not prevent the problem from reoccurring for the same reason. At the same time, Tucker found that Level Two problem solving (actions focused on elimination of the problem) occurs only 1 percent of the time. Tolerating Level One problem solving may actually numb the organization to the impact of the poorly designed system.

A practical example of this behavior is demonstrated when a nursing unit documented 200 occurrences of missing medications in a month but did not identify why the medications were missing so that the root causes of the problem could be corrected. But the inefficiency of repeatedly calling the pharmacy and reworking the process of sending the medication continues. As a result, the day-to-day friction continues, with frustration building among staff and patients’ needs being delayed.

The costs of waste add up. Using an estimate of $117 per operational failure, Tucker calculated that the cost for operational failures is $95 per hour. To further quantify the impact of this inefficiency, observations documented that the average nurse spends between 31 and 44 percent of her time in direct patient care and between 34 and 49 percent on coordination of related activities. Storfjell’s research further quantifies the cost of waste as she documents that a surgical nursing unit spends $756,000 on waste related to wage costs per year.  

**Starting at the Front Line with Problem Solving**

When do most organizations start to react to problems or events? Frequently, an organizational approach to problem solving is initiated when small issues cascade, accidentally resulting in a serious event. If a report identifies poor results or a sentinel event occurs, the organization usually forms a special committee or task force and creates an action plan. Problem solving is seen as a higher-level function left to technical experts in quality, patient safety, administration, infection prevention, or process improvement. Solutions are generated by these experts in conference rooms using knowledge gathered through metrics, observations, opinions, and past experience.

Who knows about these issues, and who is impacted by the frustrating daily friction within the system? Deep in the systems of the organization, the customers and front-line workers know almost 100 percent of how the system is performing. Since the point of care is where the value exchange occurs in healthcare, the experience of the patient is the sharp end of healthcare. A classic study of a typical Japanese manufacturing company estimated senior leaders are aware of only 4 percent of the problems within the organization. This has been called the iceberg of ignorance, but could also be called the iceberg of knowledge because using the ideas and energy of the front-line staff provides organizational insights.
However, reports to leadership are unfortunately often after the fact, aggregating data that are sometimes compared to benchmarks. If the rate is favorable against the benchmark, organizational complacency may result. The significance to the individual patient can be lost in the numbers. Even if serious events are addressed closer to the time when they occur, the harm has unfortunately already been done. As with real icebergs, the damage may be done by the accumulation of unresolved issues under the surface, rather than by the visible tip.

Where do these more serious problems originate? Observations of a nurse on a step-down unit for four hours demonstrated 36 potential patient safety issues and intense complexity to the physical movement of the nurse. None of these failures or waste was likely to cascade into incidents of actually harming the patient, mostly because these were very small issues such as a missing medication which can be quickly resolved in the course of work. Tucker’s observations showed an average of one operational failure every 74 min, or 6.5 every eight-hour shift. Anyone who has been a patient, a front-line healthcare worker, or even spent an hour of time observing healthcare in hospitals recognizes that these small, friction-generating, no-harm events are occurring continuously.

Toyota has refined a method to address these small problems and healthcare can learn from their experience. Toyota employs an “on-the-line” problem identification and redesign model that involves the expertise of the front-line workers, as compared to other models using “off-the-line,” expert-based, and usually retrospective problem solving. Applying these concepts would focus on the ideal where each healthcare professional performs his or her work defect free, immediately on customer demand, without waste, safe in all aspects, and one-by-one. The front-line problem-solving methods of this manufacturing company have transferability to healthcare’s front lines.

**Efficiency Problems and Front-Line Solutions**

In a recent study, Storfjell identified eight processes where non-value-added activities commonly occur:

1. Admission, transfer, discharge
2. Shift report
3. Obtaining supplies and equipment
4. Medication administration
5. Arranging diagnostic testing
6. Documentation
7. Communication
8. Staffing
Likewise, a 36-hospital time and motion study identified three main targets for improving the efficiency of nursing care: documentation, medication administration, and care coordination. These areas are validated by the NICQ posters presented in 2007 because many of the hospitals discovered these same areas as opportunities for improvement.

One of the areas of waste identified by the 2007 NICQ survey included the amount of time it took for admission, discharge, and transitions in care. Of the NICQ hospitals in 2007, about 11 hospitals studied these transitions and were able to eliminate waste in the process. Example improvements included:

- Standardizing admission materials or processes, especially during critical times such as the Golden Hour or the time immediately after admission
- Standardizing shift-to-shift reporting
- Creating standardized order sheets
- Making check sheets for reminders
- Enhancing communication before, during, or after the transition for follow-up visits and exams.

Another common theme in waste in NICUs involves organized supplies and equipment availability. There were five facilities that addressed problems with the lack of supplies or equipment and were able to demonstrate efficiency improvements. Tucker has identified supplies and equipment as an area of frequent operational failure and notes that on average nurses spend 42 minutes of each 8-hour shift dealing with missing items, such as medications and broken or missing equipment. Some example solutions for reducing this kind of waste include reorganizing bedside carts so the night stocking is easier, or evaluating the necessity of certain supplies and developing replenishment cycles that meet ongoing needs.

Another potentially wasteful activity that has been discovered is that nurses spend about 45 percent of their work time at the nurses’ station or off the unit entirely. Several of the NICQ NICUs addressed enhancing bedside availability of staff and developed some
standardized processes to achieve better patient access to the nurse, thus decreasing potential waste while simultaneously improving the patient experience. The case study from University of Minnesota Amplatz Children’s Hospital focused on the frequency with which the nurse left the baby within the first 30 minutes of admission (see sidebar). This NICU was able to demonstrate a 54 percent improvement in the number of times the nurse left the bedside during this timeframe.

These examples begin the process of demonstrating that through front-line, multidisciplinary teams, NICUs can determine appropriate aims and measures, make improvements, and produce results to address these areas of inefficiency.

**Efficiency Aims and Measures**

As a step in eliminating NICU inefficiencies, efficiency aims can be defined and specific measures tracked. Table 5.1 lists some common NICU efficiency aims and the related measures.

**Table 5.1 NICU Efficiency Aims and Measures**

<table>
<thead>
<tr>
<th>Aims</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>To minimize stress in infants admitted to the NICU and improve the long-term outcomes, as well as maximize efficiency of the multidisciplinary team during the first hour of life</td>
<td>Completion of the Golden Hour care within one hour utilizing teamwork</td>
</tr>
<tr>
<td>To increase the number of playbook pages for standardized processes</td>
<td>Playbook pages developed for:</td>
</tr>
<tr>
<td></td>
<td>- Admission bed setup</td>
</tr>
<tr>
<td></td>
<td>- A.M. lab draws</td>
</tr>
<tr>
<td></td>
<td>- Contact isolation</td>
</tr>
<tr>
<td></td>
<td>- Making staff assignments</td>
</tr>
<tr>
<td></td>
<td>- Oxygen saturation limits</td>
</tr>
<tr>
<td></td>
<td>- ROP exam process</td>
</tr>
<tr>
<td></td>
<td>- VAP bundle for the NICU</td>
</tr>
<tr>
<td>To have appropriate supplies and equipment at the bedside prior to admission</td>
<td>Tallied number of times nurse leaves the bedside within 30 minutes of admission</td>
</tr>
<tr>
<td>To evaluate the time nurses are off the unit for procedures and surgery</td>
<td>Number of hours per month RNs off unit with infant</td>
</tr>
<tr>
<td>To decrease unit costs by efficiently and safely managing staffing through targeted use of part-time and per-diem staff before full-time staff</td>
<td>Number of overtime hours versus the number on nonovertime hours per month</td>
</tr>
<tr>
<td>To ensure that 100 percent of babies admitted to the NICU who meet AAP criteria for ROP screening are in fact screened</td>
<td>Tallied number of qualified infants scheduled for exam versus those not scheduled for exam</td>
</tr>
</tbody>
</table>
Aims | Measures
---|---
To identify patients who are within three days of being discharged and begin completing a standardized list of items needed for efficient discharge | Recorded amount of time required for discharge of each NICU infant
To standardize bed setup and to decrease wasted time and supplies | Staff audits
To ensure that discharge is efficient, individualized, and family centered | Huddle QI Two-week post discharge survey QI timeliness of circs, downloads, and paperwork Daily phone call log

**Conclusion**

Efficiency is primarily about eliminating waste, and healthcare has considerable opportunity to improve problem solving in order to address inefficiencies. By changing the focus and timing of problem solving through recognition of both workarounds and ambiguity in the definitions of processes, as well as through real-time redesign of work by front-line healthcare workers, we can achieve better nursing care and engagement as well as the type of efficiency Codman originally sought. The NICQ examples provide wonderful learning experiences for other healthcare organizations.

**References**

Chapter 5. Improving Efficiency

The Vermont Oxford Network is pleased to provide NICQ 2007: Improvement in Action under a Creative Commons, Share Alike, Non-Commercial License. (For information about the license, see: http://creativecommons.org/licenses/by-nc-sa/3.0/.)

When providing attribution to this chapter, please use the following citation: Frndak DC; Improving Efficiency from NICQ 2007: Improvement in Action; Horbar JD, Leahy K, Handyside J, eds. Vermont Oxford Network, Burlington, Vermont, 2010 (first published online at www.vtoxford.org).
Chapter 6  Timely Care Delivery

Karen E. McKinley, RN, MBA
Vice President, Division of Quality and Safety, Geisinger Health System

In *Crossing the Quality Chasm: A New Health System for the 21st Century*, the Institute of Medicine established “timely” as one of the six dimensions of quality. “Timely” is defined as reducing waits and sometimes harmful delays for both those who receive and those who give care.¹ *Crossing the Quality Chasm* got significant public attention, as well as attention among healthcare professionals, leading to many interpretations of this dimension.

Paul Batalden, in the Institute for Healthcare Improvement 2009 Progress Report, stated: “…there are many principles of improvement that will and should withstand the test of time. We should focus on the basics—illness burden in individuals and populations, system performance (quality, safety, cost), and professional competence and joy in work—while enabling continual change.”² Timely care, particularly in the NICU, should be addressed using these basic principles.

NICU improvement teams look for a balanced approach to affect timely actions and responses: elimination of delays, balanced with dedicated time as appropriate, to thoroughly complete a patient care task or their improvement work. The clinical rationale for timeliness is to provide the right care at the right time, every time, without workarounds or excuses. The goal of this chapter is to describe the issues surrounding timely care delivery in the NICU and how the turnaround of critical tests and other important care processes can be improved.

**Timeliness in Context of the NICU**

In the NICU, timely care is often equated with quick, immediate action. This expectation of immediacy is visible every day in our NICUs, where time is a critical factor. Family expectations for a full-term, healthy baby are replaced with the anxiety and fear from suddenly having a very premature or very sick baby. What’s more, the clinical imperatives of transport, physician presence at delivery, diagnosis, consults, and treatment can conflict with the family imperatives of waiting to see, touch and hold their baby, waiting for interaction with the care team, waiting for results, and finally waiting for the baby to go home. Open communication about these different needs and the planning of the care delivery processes with the family helps to mitigate these conflicts.

Another issue surrounding timeliness is cost. Time spent, whether in work or rework, is a cost to organizations. Healthcare costs are expected to reach $4.3 trillion or 19.5 percent of the GDP by 2017.³ This predicted rise in cost comes at the same time when hospital admission growth is in general slowing significantly.⁴ In this environment, healthcare organizations tend to focus on the efficiency part of timeliness, such as
reducing staffing and increasing patient volumes, rather than on innovation and quality improvement. Often these efforts deflect the attention of healthcare providers away from delivering high-quality and safe care to patients.

Beyond the association of timely care with quick action and with cost-saving efficiencies, Webster’s online dictionary provides a definition of timely that is particularly relevant for the NICU. Webster’s defines timely as “occurring at a suitable or opportune time; well timed.” In complex environments such as the NICU, the appropriate timing of every action may be the most important consideration and can change the outcome of a life. True efficiency while delivering a care process is always a good thing; when engaging in something such as hand washing or parent education, effectiveness is obviously more important than haste.

**Aims and Measures for Improving Timeliness**

Several important standards and reports make it clear that timeliness is currently considered one of the most important aspects of healthcare quality. The Joint Commission standard, NPSG.02.03.01, addresses timeliness in patient safety goal 2C: “Measure and assess, and if appropriate, take action to improve the timeliness of reporting, and the timeliness of receipt by the responsible licensed caregiver of critical tests and values.” The emphasis on timely reporting of test results and other critical values is a primary way to improve timeliness in the NICU. As the aims and measures in Table 6.1 illustrate, one goal of the NICQ collaborative is to implement continuous assessment and measurement of processes related to timely reporting of results and delivery of care.

The Agency for Healthcare Research and Quality (AHRQ) has also provided some recommendations for addressing timeliness. In the 2007 National Healthcare Quality Report, AHRQ defines timeliness as “the health care system’s capacity to provide health care quickly after a need is recognized.” Three measures are referenced in the report, one of which has a direct impact on NICU patients and families: the interval between identifying a need for specific tests and treatments and actually receiving those services. The AHRQ report also relates the importance of timeliness to mortality and morbidity, stating:

- Lack of timeliness can result in emotional distress, physical harm, and higher treatment costs for patients.
- Timely antibiotic treatments are associated with improved clinical outcomes.
All of the teams in NICQ 2007 were positively influenced to organize their improvement work using clinical microsystem methodologies as described by Nelson, Batalden, and Godfrey in *Quality by Design: A Clinical Microsystems Approach*. There are two fundamentals of microsystem improvement that, in particular, relate to timeliness:

- Consider the development of a *rhythm* for the improvement work within the microsystem. From the daily huddles to the improvement team meetings to the annual department retreat; every staff member should be aware of what happens within their microsystem.
- Implementation cycles need to be shortened so that the benefit to the patient and family occurs in a more timely way. It is important to set a rigorous *pace* for both improvement and implementation.

Improvement work is often an add-on to a staff member’s current job. Leaders cite that available time is the issue. If improving the work is truly part of doing the work, planning among microsystem members, in particular leadership, is essential. Making time to assess, diagnose, and treat the microsystem is essential to successful and timely delivery of care.

### Table 6.1 Sample Timeliness Aims and Measures for NICQ 2007

<table>
<thead>
<tr>
<th>Aims</th>
<th>Measures</th>
</tr>
</thead>
</table>
| To improve processes of communicating changes and/or concerns in patient’s condition | • Staff satisfaction with revised communication processes  
• Night shift understanding and usage of the SBAR (Situation-Background-Assessment-Recommendation) technique |
| To administer antibiotics within one hour of admission by December 1, 2008 | • Time to ampicillin  
• Time to gentamicin |
| To ensure that 100 percent of families whose infants meet criteria will receive CPR education prior to infant discharge | Percent of families whose infants meet criteria who receive CPR education prior to infant discharge |
| To complete circumcision at least 24 hours prior to discharge     | Circumcision time as compared to discharge time |
| To ensure that all a.m. labs will be drawn by 0400 and will be available to review during shift change at 0700 | Tracking time of lab draws and lab results available at shift change |
### NICQ 2007: Improvement in Action

<table>
<thead>
<tr>
<th>Aims</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>To decrease the time from when the echo/head ultrasound results were known by the attending physician to the time these results were shared with the parents to no longer than six hours</td>
<td>Tracking time results known by physician to time parents were informed</td>
</tr>
<tr>
<td>To stabilize neonates who are less than 30 weeks gestational age using Golden Hour Clock worksheet with practices completed within one hour</td>
<td>Completion of Golden Hour criteria</td>
</tr>
</tbody>
</table>
| To ensure full compliance with patient safety goal 2C – Measure and assess, and if appropriate, take action to improve the timeliness of reporting, and the timeliness of receipt by the responsible licensed caregiver, of critical tests and critical results and values | • Using a children’s hospital patient safety scorecard  
• Using NICU-based audits                                                                    |

### The Case for Timeliness

A review of the NICQ anonymous error reporting identified numerous reported errors that were due to delays in care. The majority of these delays listed poor communication and lack of teamwork as contributing factors to the delays. High-performing organizations, including NICUs, focus on failure in order to continually improve.7

Consider what could be done to eliminate the following errors:

- **Delay in consult:** A pulmonary consult for an infant being discharged is ordered. No response was received and the discharge was delayed by 48 hours. Despite the wait, the infant was discharged on oxygen *without* the consult being completed.

- **Delay in consult:** Waited three days for an ordered ophthalmology consult before the family was discharged and had to take the shuttle to another campus for the eye exam to be completed. The reporting staff felt that the discharge and equipment education were compromised.

- **Communication failure:** Attempted to move an infant who was to be withdrawn from support into another room after discharge. The move was delayed by two hours while the family waited for environmental services, causing anxiety among the family members.
Case Study
Timeliness is a critical component of all care delivered in the NICU. Consider the shared achievements of colleagues such as Yakima Valley in NICQ 2007 to begin or enhance your efforts to improve the timeliness of care for patients and families in your NICU.

BACKGROUND
Early, aggressive nutrition is well supported in literature as being imperative in the management of the very low birth weight (VLBW) infant, defined as birth weight < 1.5 kg. A 26-week gestational age premature infant receiving only dextrose will deplete 1 to 2 percent of endogenous protein stores daily, while it would accrue over 2 percent daily in utero. Studies show that high-dose amino acid administration immediately after birth is safe and limits catabolism, preserves endogenous protein stores, improves nitrogen balance, decreases the incidence of growth failure, and improves glucose tolerance.8,9

This study was carried out in a 15-bed NICU within a 225 bed nonprofit community hospital. The NICU had 275 admissions in 2006, including 27 VLBW infants. Parenteral nutrition is prepared once daily in the inpatient pharmacy. Using standardized administration times, up to 24 hours can pass before patient specific parenteral nutrition can be started.

The study objectives were: 1) Primary outcomes: Reduce time to initiation of parenteral nutrition in VLBW infants and administer amino acid containing parenteral nutrition as the first IV fluid after birth; 2) Secondary outcomes: Reduce time for the infant to return to birth weight, days of parenteral nutrition, and length of stay.

METHODS
Beginning June 1, 2006, a “vanilla” starter parenteral nutrition was implemented. The mixture is called “vanilla” because it is clear in color unlike other parenteral nutrition with vitamins. This premade mixture for newborns is non-patient-specific and consists of 10 percent dextrose, 2 percent amino acids, and 1 unit/ml heparin. It is prepared in volumes of 250 mL with an expiration date at 14 days.10

The pharmacy was alerted to an anticipated delivery of a VLBW infant, and removed one of the two premade vanilla starter solutions. It was hand-labeled with the patient’s name and sent to the NICU, to be used as the first IV fluids after IV access was obtained.

The vanilla starter solution program was implemented June 1, 2007. The study groups consisted of an historical control group of VLBW infants from February 2006 to May 2007, with data collection via retrospective chart review, and all VLBW infants admitted from June 2007 to May 2008 for whom prospective chart review was conducted.
RESULTS AND DISCUSSION
Data were collected on all VLBW infants in the designated time period. There were no significant differences in gestational age or birth weight between treatment groups.

The median time after birth to initiation of parenteral nutrition was 16.2 hours (the range was 2.3 to 25.4 hours) in the historical group, versus 1.4 hours (range 0.95 to 3.4 hours) in the prospectively studied group. This represents a 91 percent reduction in time to initiation of parenteral nutrition after birth for the second study group.

The cost of the service was found to be low, with the estimated annual cost of unused vanilla bags being less than $250. An additional benefit of the vanilla solution was fewer entries into IV lines since parenteral nutrition was started immediately after IV access was obtained, thus decreasing risk of contamination and infection. It was found that extremely low birth weight infants could not tolerate the 10 percent solution and a 5 percent dextrose vanilla solution has since been added.

Use of a premade “vanilla” parenteral nutrition solution significantly reduced time to parenteral nutrition initiation in VLBW infants in a community hospital, meeting the goal that all VLBW infants receive parenteral nutrition as the first intravenous fluids following birth.

Conclusion
Each NICU in the 2007 NICQ collaborative contributed to the body of knowledge in improving timely treatment, results and access to care. This knowledge is accessible and available to all who are interested. Although the authors of Crossing the Quality Chasm did not offer a simple prescription for improving timeliness or any other dimension of healthcare, this report provides a vision of what is possible and the path that can be taken.

References


**Case Study References**


NICQ 2007: Improvement in Action

The Vermont Oxford Network is pleased to provide NICQ 2007: Improvement in Action under a Creative Commons, Share Alike, Non-Commercial License. (For information about the license, see: http://creativecommons.org/licenses/by-nc-sa/3.0/.)

When providing attribution to this chapter, please use the following citation:

McKinley KE; Timely Care Delivery from NICQ 2007: Improvement in Action; Horbar JD, Leahy K, Handyside J, eds. Vermont Oxford Network, Burlington, Vermont, 2010 (first published online at www.vtoxford.org)
Chapter 7 First Do No Harm: Environmental Responsibility in the NICU

Michelle Gottlieb, MEM
Health Care Without Harm
Steering Committee member and co-coordinator of the Healthy Food in Health Care Initiative

Nancy Dickeman, MA
Environmental Health and Sustainable Healthcare Consultant
Washington Physicians for Social Responsibility

The notion that healthcare is designed to heal is fundamental to our society’s vision of medicine, yet there is a growing recognition that healthcare institutions can be a significant contributor to both chemical contamination and disease burden. Over 10 years ago, with the emergence of the organization Health Care Without Harm, hospitals and healthcare leaders began to recognize and address their industry’s contribution to environmental and public health harm. With the oath to “do no harm,” healthcare providers have an ethical imperative to lead the path to more sustainable design and operations. Because healthcare leaders are seen as trusted members of society, and because hospitals and healthcare providers have a tremendous opportunity to promote prevention and wellness, this sector is well poised to emerge as leaders in modeling health and sustainability.

Environmental Contamination in Hospitals: A Review of the Issues

What contamination issues are most evident and pressing within the healthcare sector? The following overview outlines health and sustainability topics relevant to all departments within the hospital. In many cases the NICU, which cares for the most vulnerable population, has been at the forefront of efforts to choose safer materials and to “green” the supply chain. An example is provided in the Seattle Children’s case study, which tracks their efforts to move from di-2-ethylhexyl phthalate (DEHP) elimination within their NICU to becoming a leader within the healthcare sustainability movement. By adopting safer chemicals policies and taking action to phase out toxic chemicals within institutions, the healthcare sector can play a vital role in transforming the marketplace and protecting health and the environment.

Environmental health and sustainability within the healthcare setting is a vast topic. This chapter can only touch on the many possibilities for choosing safer, healthier products and processes. At the end of this chapter, the section “Key Organizational Resources for Sustainability in Healthcare” describes the work of four groups, including Health Care Without Harm, that are leading the way toward environmental responsibility.
WASTE
Hospitals generate more than two million tons of waste each year.\(^1\) Previously, most hospitals combined all of their waste streams and burned them in incinerators. According to the U.S. Environmental Protection Agency (EPA), in 1995 medical waste incinerators were the largest source of dioxin air emissions. Dioxin is a known carcinogen that has been linked to birth defects, immune system disorders, and other harmful health effects. A range of processes produce dioxin as a byproduct, including incineration of polyvinyl chloride (PVC) products, chlorine bleaching of pulp and paper, certain types of chemical manufacturing, and other industrial procedures that include the combustion of chlorine.

The EPA also estimates that medical waste incineration contributed 10 percent of the mercury air emissions in the United States.\(^2\) Mercury is a potent neurotoxin that can cause developmental defects and harm the brain, kidneys, and lungs. Mercury is found in various thermometers, blood pressure devices, lab chemicals, cleaners, and other products used in healthcare. For nearly all uses of mercury in healthcare, safe and cost-effective alternatives are readily available both in the United States and internationally. Other pollutants from incineration include furans, acid gases, heavy metals, and particulates.

Now that the health effects of dioxin, mercury, and other pollutants are better understood, and with the growing recognition of alternative technologies and waste minimization strategies, hospitals are engaging in more sustainable operations, and often saving money in the process. Hospitals are taking various steps to protect both human health and the environment, including waste segregation to isolate the hazardous and infectious waste, source reduction to eliminate or minimize waste at the source, and resource recovery and recycling, which ultimately lowers disposal costs. In response to regulatory advances and education from advocacy groups like Health Care Without Harm and Practice Greenhealth (formerly H2E), 5000 medical-waste incinerators have closed since the mid-1990s.\(^3\) In addition to the environmental benefits hospitals create through waste reduction, they experience substantial cost savings as a result of their waste reduction efforts. According to the Joint Commission on Accreditation of Healthcare Organizations, in 2000, hospital waste disposal costs ranged from $44 to $68 per ton.\(^4\) For examples of waste reduction and cost savings efforts by hospitals since the Joint Commission’s report, see the Seattle Children’s hospital case study described later in this chapter. For additional analysis of waste reduction in the healthcare sector, and strategies for “greener” healthcare waste policies, see a recent article in the British Medical Journal.\(^5\)

CLIMATE CHANGE—HEALTHCARE’S OPPORTUNITY FOR LEADERSHIP
Climate change has emerged as an urgent and catastrophic issue of the new millennium. Climate change has the capacity to produce severe consequences for human health, providing an opportunity—and a call to action—for the healthcare sector to play a role in climate change mitigation.
Chapter 7. First Do No Harm: Environmental Responsibility in the NICU

After the food service industry, the healthcare sector ranks second as an energy consumer. Energy use in medical facilities is highly intensive. In fact, hospitals expend about twice as much total energy per square foot as traditional offices. Inpatient care facilities are major greenhouse gas producers. According to the U.S. Department of Energy, “The health care industry has a critical role to play in climate change mitigation.” The United Kingdom has released a major new carbon reduction initiative for the National Health Service (NHS). According to the new report, “Saving Carbon, Improving Health,” the NHS is responsible for 25 percent of England’s public sector emissions, with more than 18 million tons of carbon dioxide a year.

The intensive energy use by the health sector also results in toxic air emissions which can impact the health of the very communities that the hospitals serve. According to the United States Environmental Protection Agency (EPA), the United States health sector’s 73 billion kWh “conventional” electricity use adds over US $600 million per year in increased health costs. This figure includes increases in asthma, respiratory illness, and hospital emergency department visits.

**FOOD SYSTEMS AND CLIMATE CHANGE**

Recognition is growing about the significant contribution of food and food production to global climate change. Major shifts in the U.S. food system in the last century are having negative impacts on human and ecological health. Our industrialized food system relies on inputs of petroleum-based products such as pesticides, herbicides, fertilizers, and fuel—so much so that the food system accounts for more greenhouse gas emissions globally than the transportation sector. The UN Food and Agriculture Organization reports that the livestock sector generates an estimated 18 percent of global greenhouse gas emissions. Food transport is another major climate change contributor: the typical food item in the U.S. travels around 2000 miles from farm to plate.

By creating menus and serving foods that are produced and distributed in ways that reduce embodied energy in foods and greenhouse gas emissions, hospital foodservice can play an influential role in reducing their own climate change impacts. Hospital food service can adopt waste minimization and energy efficiency practices that similarly minimize their carbon footprint. In addition, efforts to reduce climate impact have a variety of co-benefits that include improved nutritional health, support of local food economies, and reductions in exposure to toxic pesticides. These are all powerful reasons for the healthcare sector to position itself as a leader in promoting healthier food production practices.

Healthcare’s action on these issues is growing: mobilized by HCWH’s Healthy Food in Healthcare campaign, hospitals across the country are recognizing the power of their role in advocating for local food production that promotes ecological, economic, and community health. They are setting a standard for other institutions to follow and
supporting necessary public policy interventions as they relate to food and food production.

**Cleaning and Disinfection**

Infection control in healthcare is a crucial concern. Healthcare-associated infections (HAI) cost between 5 and 6 billion dollars annually and result in almost 100,000 deaths in the U.S. Yet the process of cleaning and disinfecting healthcare facilities can involve potentially hazardous substances that pose significant health risks to the workers applying them, to patients and bystanders in the area, and to overall indoor air quality. Long-term exposure to disinfectants containing quaternary ammonium compounds may lead to occupational asthma and hypersensitivity syndrome. Chemicals used in floor strippers and polishing compounds include diethylene glycol ether and a range of other compounds that have been linked to respiratory irritation, dizziness, nausea, fatigue, and other health problems. Cleaners can also contain high levels of volatile organic compounds (VOCs), a significant contributor to indoor air pollution.

Healthcare facilities throughout the country have successfully implemented green cleaning programs while maintaining the efficacy of their infection control efforts. Facilities can begin first addressing resource-intensive practices and toxic or irritating chemicals that can clearly be replaced by alternatives without impacting infection transmission. Some examples of alternative cleaning products include:

- Replacing floor strippers and finishes that contain heavy metals and asthmagens
- Substituting low-VOC (volatile organic compound) glass cleaners
- Using 100% recycled content bathroom paper products
- Employing carcinogen-free carpet cleaners
- Introducing high-filtration vacuums

Practice Greenhealth provides a variety of resources to aid hospitals in their transition to safer disinfection and green cleaning programs.

**Building Materials**

The healthcare industry represents $16 billion and more than 100 million square feet of construction per year. This presents an enormous opportunity for the healthcare sector to impact the marketplace by favoring green building. Scientific studies conducted over the past couple of decades reveal the impact of building construction and operation on both environmental degradation and human illness. In contrast, hospitals incorporating green building into their facilities, through the use of safer interior and exterior materials, provide benefits to patients and their families, hospital staff, and the communities they serve.

One product category of concern being addressed by healthcare, due to toxicity and human health implications, is chlorinated plastics, including polyvinyl chloride (PVC). PVC is the most widely used chlorinated plastic polymer in the United States. The U.S.

7-4
produces 14 billion pounds per year, with 75 percent attributable to the building industry. The entire lifecycle of PVC—from production through disposal—is problematic due to unavoidable production of the byproduct dioxin, a known carcinogen and a reproductive and developmental toxicant, as well as other hazardous materials. Due to the rigidity of PVC, softeners (known as phthalates), with their own host of health and environmental implications, are added to flexible PVC products. Phthalates are found in flexible building materials and interior applications, including window casings, wall coverings, vinyl flooring, and shower curtains. Studies have linked moisture and vinyl flooring with increased incidences of asthma, making this a priority area for adoption of safer alternatives materials within the healthcare setting.

The next section will review the reproductive and developmental health effects associated with phthalates in medical devices, but according to studies outlined in the review article *Toxic Chemicals in Building Materials*, evidence is emerging that exposure to phthalates from building materials has been linked to respiratory problems such as rhinitis and asthma in adults and children. This has implications not only for vulnerable NICU patients, but also for the staff who are exposed to phthalates as they migrate into the air from flooring, wall coverings, upholstery, and other materials.

Brominated fire retardants (BFRs) such as polybrominated diphenyl ethers (PBDEs) represent another class of chemicals of concern. These chemicals are routinely added to foams, electronics, and textiles to reduce the flammability of materials that are laden with synthetic compounds. PBDEs are structurally similar to PCBs, which were banned in the 1970s due to their persistence in the environment and link to cancers. PBDEs are also associated with permanent learning and behavioral disorders and harmful effects on the immune, reproductive, nervous, and endocrine systems. High levels of PBDEs have been found in human breast milk, wildlife, and in the environment. In many countries, and certain U.S. states, these findings have prompted bans on the most toxic congeners. Infants and children are especially vulnerable to harm from these exposures. Safer alternative materials and processes that meet flammability standards exist and are increasing in use and demand.

There are many chemicals of concern that are routinely added to building materials within healthcare construction that have implications for health and the environment, including heavy metals, volatile organic compounds (VOCs such as formaldehyde), and semi-volatile organic compounds (SVOCs). The Healthy Building Network provides information on the use of toxic chemicals in building materials and safer alternatives.

**DEHP: Exposure Concerns and Steps for Action**

A key issue for the NICU to address is phase-out of polyvinyl chloride (PVC) medical devices containing di-2-ethylhexyl phthalate (DEHP). Recognizing the risk of harm and the need to prevent DEHP patient exposures, the FDA issued a *Public Health Notification on PVC Devices* in 2002. The notification identified key areas of concern
and most vulnerable patient populations, and recommended that healthcare providers move away from these devices. The notification states: “Exposure to DEHP has produced a range of adverse effects in laboratory animals, but of greatest concern are effects on the development of the male reproductive system and production of normal sperm in young animals.”

Exposures to DEHP are linked to serious health impacts and, as outlined in the FDA notification, are of greatest concern for male neonates. Infants and young children, as well as pregnant and lactating women, are also especially vulnerable to harm. In vitro, animal, and human neonate studies have shown DEHP to have an adverse effect on the tissues of the male reproductive tract, and on the lungs, kidney, and liver when administered at levels similar to those which neonates may be exposed during medical treatment in NICUs. Animal studies deemed relevant to humans have provided the basis for additional regulatory actions.

Assessments conducted for the governments of the United States, Canada, and the European Union have all concluded that exposures to DEHP are of concern to vulnerable populations, as well as to adults undergoing certain medical procedures. All of the government-sponsored assessments point to the need for action, with the Canadian and Swedish studies recommending specific action to reduce DEHP exposure in healthcare and other vulnerable populations. The FDA has recommended that medical device manufacturers reformulate products to remove DEHP and that hospitals use alternatives to DEHP-containing products, whenever possible, for high-risk populations.

The National Toxicology Program’s Report in 2006 restated its serious concern that certain intensive medical treatments of male infants may result in DEHP exposure levels that affect development of the male reproductive tract.21 A Harvard study (September, 2005) indicated that infants treated with PVC medical devices containing DEHP experienced significantly higher levels of DEHP exposures than infants treated with DEHP-free devices.22

These exposures may be compounded by the exposures to phthalates infants receive outside of the medical setting. In their report Phthalates and Cumulative Risk Assessment: The Task Ahead, The National Academy of Sciences recommends that risks associated with phthalate exposure should be considered in the context of cumulative exposures to all phthalates and other anti-androgens.23

Responding to the science, to the FDA notification, and recognizing the increasing availability of safe PVC/DEHP-free medical devices in the marketplace, the American Medical Association in 2006 approved a resolution encouraging healthcare providers to transition away from PVC medical devices, especially those containing DEHP. In
addition, the Joint Commission, in its February 2008 issue of Environment of Care News, profiled this issue, and included an excerpt of its Applicable Standards for Safety.

**RESOURCES AND ACTION ON DEHP PHASE OUT**

Hospitals and healthcare systems have adopted various approaches in their work to phase out DEHP-containing medical devices and to transition to safer alternatives. Evaluating existing products and contracts and conducting an audit of DEHP materials is a first step. In the past decade, manufacturers have increased availability of DEHP-free alternatives, making it easier for hospitals to make the transition. See “Sustainability Goals and Objectives” for specific suggestions on achieving a greener NICU.

A variety of resources to help hospitals in their work towards PVC/DEHP phase-out is provided online by Health Care Without Harm. Essential tools include a trio of lists of PVC/DEHP-free alternatives:

- Medical devices in the NICU
- Medical devices hospital-wide
- PVC-free building interior flooring and finish products

The Health Care Without Harm resources include a step-by-step guide on how to conduct an audit, as well as case studies chronicling the various ways NICUs have addressed PVC/DEHP phase out. The Weight of the Evidence on DEHP provides an overview of science and policy actions addressing concerns and phase out of PVC and DEHP.

Based on existing science coupled with FDA recommendations, taking steps to remove DEHP-containing medical devices is essential for protecting the health of the most vulnerable populations a hospital serves. Adopting safer alternative products is a fundamental step for hospitals striving to provide the highest caliber of care and to address the broader umbrella of sustainability and environmental health.

**Sustainability Goals and Objectives**

There are many paths toward environmental sustainability within the hospital. The best approach is one that engages a cross-disciplinary group from a variety of departments who can work together toward sustainability goals. Here are some suggested guidelines that in many cases can also save money by reducing waste and energy usage:

- Adopt a comprehensive policy that forms a foundation for environmentally preferable purchasing throughout the hospital. The policy should emphasize reduction of products containing toxic chemicals and prioritize human and environmental health for patients, staff, and the community.
NICQ 2007: Improvement in Action

- Improve the efficiency of energy end uses to reduce both energy costs and greenhouse gas emissions.
- Displace the use of conventional energy with clean, renewable energy.
- Establish a hospital-wide waste reduction policy.
- Adopt a food purchasing program that promotes local and sustainably grown foods.
- Establish green building guidelines for the design, renovation, and operations of the hospital.
- Assemble an interdisciplinary team to address PVC/DEHP phase-out and adopt an environmentally preferred purchasing policy.
- Conduct an audit of existing products and contracts.
- Review documents on PVC and PVC/DEHP-free alternatives to guide purchasing and set benchmarks for phase-out and elimination.

The Green Guide for Health Care

The most comprehensive tool for integrating and tracking progress toward sustainability within the healthcare sector is the Green Guide for Health Care™ (GGHC).

The GGHC is “the healthcare sector’s first quantifiable sustainable design toolkit integrating enhanced environmental and health principles and practices into the planning, design, construction, operations, and maintenance of their facilities.”

The GGHC provides the healthcare sector with a voluntary, self-certifying metric toolkit of best practices that designers, owners, and operators can use to guide and evaluate their progress towards high-performance, healing environments. It is designed to serve as a voluntary educational guide for early adopters of sustainable design, construction, and operations practices to encourage continuous improvement in the healthcare sector.

The GGHC has developed specific credits related to operations and maintenance that cover all the topics outlined in this chapter, along with resources and suggested strategies for implementation. The GGHC can be downloaded for free or a hard copy can be ordered online.

Seattle Children’s: A Case Study for Greening the NICU and Pediatric Hospital

Seattle Children’s Hospital, a 250-bed facility ranked as a top pediatric hospital by U.S. News & World Report, operates a Level III Neonatal Intensive Care Unit that provides the highest level of intensive care for newborns. It also operates Pediatric and Cardiac Intensive Care Units providing intensive care for children 6 months to age 21.

FIRST STEPS: EXCELLENCE IN CARE AND ENVIRONMENTAL HEALTH COMMITMENT

Building upon the foundation it has established for excellence in delivering healthcare and providing specialty expertise, Seattle Children’s recognized its responsibility to meet a standard of excellence for providing sustainable healthcare. In 2004, the hospital assembled an interdisciplinary team to evaluate its medical devices containing PVC and
DEHP. Clinical Nurse Specialist Sue Heffernan, MN, RN, led these efforts. One of the hospital’s pediatric urologists, Richard Grady, MD, also played a pivotal role. The team included representatives from pediatric and neonatal intensive care, respiratory therapy, dialysis, the ECMO team, the blood usage committee, and purchasing/central services.

This team evaluated PVC/DEHP devices in use, and assessed pivotal product areas for initiating the transition to safer alternative products. IV and TPN tubing sets, enteral feeding tubes and accessories, catheters (umbilical, vascular and urinary), and breast pump and feeding accessories were identified as critical areas for the transition. Making the switch required coordinating the new tubing with IV pumps and seeing the process through some challenges. In one case, the new intralipid bag caused some leaking issues with the new tubing. Rather than reverting to the DEHP bag, Seattle Children’s converted to glass containers until the issue was resolved.

Transitioning away from medical devices containing PVC/DEHP began in the NICU, addressing the hospital’s most vulnerable patients to reduce DEHP exposures. While the impetus to phase out PVC/DEHP was initiated in the NICU, it was not feasible to have different tubing in different areas of the hospital or to selectively use tubing based on patient age. Seattle Children’s went house-wide with the changes, focusing first on IV and feeding tubing.

With this groundwork laid and rising awareness regarding environmentally preferable products in healthcare, Seattle Children’s was ready to embark on a program to become one of the greenest pediatric hospitals in the nation.

**The Clean, Green Initiative**

The initiative, dubbed the Clean, Green Initiative, addresses an umbrella of sustainability issues in healthcare. With funding support from the Martin Fabert Foundation, Seattle Children’s worked with a support team from Health Care Without Harm on this broad campaign.

The Clean, Green Initiative has taken a multi-focus and initially grassroots approach that is supported by an Environmentally Preferable Purchasing Policy that promotes review of environmental impacts with all major procurement decisions. This policy plays a critical role in the transformative work of the initiative, providing hospital leadership with support for the greening efforts and establishing a commitment for staff. Key areas of the initiative include:

- Phasing out products containing PVC/DEHP
- Waste reduction and recycling
- Energy savings
- Emphasis on sustainable foods
- Toxic-free cleaning products and soaps
- Exploring the use of organic linens
NICQ 2007: Improvement in Action

- Concern about employee transportation and climate change
- Elimination of the use of pesticides
- Use of building, interior flooring, and other materials that do not contaminate the environment
- Concern about contaminants in electronics
- Regulation of pharmaceutical waste in medical waste streams

Another essential element in the Clean, Green Initiative’s success and its popularity among staff has been its Green Ambassador Program, a self-appointed departmental champion, promoting a grassroots, team approach for this important Initiative.

As the program has matured, the hospital named a Sustainability Manager who chairs a Green Team comprised of staff in leadership roles in key departments. The Sustainability Manager helps initiate, implement, and sustain the hospital’s green initiatives. The successes of the program have also grown. In addition to phasing out all medical devices containing PVC/DEHP and continuing to be mercury-free, Seattle Children’s has achieved the following successes:

- Won awards for its employee transportation program
- Implemented a farmer’s market and sustainable foods program
- Paved the way for hospitals in Washington State to begin food composting
- Made advances in disposal of hazardous pharmaceutical waste
- Managed an integrated pest management program while maintaining beautiful grounds

The hospital has also made impressive strides in waste reduction, with the benefit of $43,507 in cost savings in 2008 compared to 2007. During the year, Seattle Children’s implemented single-stream recycling and recycled 450 tons of mixed recyclable materials (90 more tons of recycled materials than in 2007). It also reduced 3.5 more tons of hazardous waste, reduced and substituted waste solvents and toxins such as xylene and formalin, and moved to a recyclable-sharps container system that diverted 9000 pounds of plastics from the landfill for the year.

Seattle Children’s is currently working to incorporate safer materials into building projects and is applying for certification in the LEED green building rating system for a new outpatient clinic located in nearby Bellevue, Washington. The hospital is also calculating their 2008 carbon footprint. In recognition of these achievements, Seattle Children’s won the Governor’s Award for Sustainable Practices in August 2008 from the Washington state Department of Ecology.

**Comprehensive Excellence in Delivering Care**

Seattle Children’s work towards phasing out DEHP and establishing a foundation for taking action on sustainability issues is a central tenet of its commitment to providing
excellence in care. Seattle Children’s emphasizes its commitment to health in its Clean, Green Initiative’s vision statement:

Our vision is to create a healthy health care system – a system which is environmentally aware and dedicated to the health of children, staff, our communities, and the global environment. We envision a system where patients and staff interact in a healing environment that embraces safer building products, clean air, reduced toxins, safe working practices, energy and water efficiency, education, and a commitment to public health demonstrated through waste volume and toxicity reduction.

The Future of Healthcare Sustainability

Each day hospitals purchase thousands of products that can negatively impact patient, worker, and ecological health. Each day hospitals make decisions on construction of new buildings, medical devices to use, food to serve, energy generation, and more. Now more than ever, hospitals and healthcare systems have a tremendous opportunity to truly embody the Hippocratic oath and “first do no harm.” Following the lead of the pediatric hospital Seattle Children’s and the Kaiser Permanente healthcare system, hospitals can implement safer chemicals policies that transition away from use of products containing toxic chemicals. In their move towards safer alternatives, these systems have created a guiding stance that is protective of health and the environment. In the words of Kaiser Permanente’s mission statement:

Kaiser Permanente aspires to create an environment for its workers, members, and visitors that is free from the hazards posed by chemicals that are harmful to humans, animals, and the environment. [Kaiser Permanente’s mission is to] provide affordable, high-quality healthcare services to improve the health of our members and the communities we serve. Our concern for the health of our communities extends to the air we breathe and the water we drink.  

Hospitals can join a growing list of facilities that are demonstrating their commitment to purchasing and using PVC/DEHP free medical devices in the NICU, and beyond. Healthcare professionals can host Grand Rounds and other forums for learning more about environmental health and engaging as leaders around sustainability. They can advocate for health and prevention by issuing resolutions and policies through their medical associations, such as the American Medical Association and the American Nursing Association, have done on a range of environmental health and sustainability issues. See “Key Organizational Resources on Sustainability in Healthcare” for a description of four coalitions that provide support and technical assistance.

The hospital has an opportunity not only to heal a sick patient, but to reach out beyond the hospital walls to heal a sick planet, and become a leader in promoting health and prevention in the broadest terms.
References


5. Hutchins DC, White SM. Coming round to recycling. BMJ 2009; 338:b609. Available at: www.bmj.com/cgi/content/full/338/mar10_2/b609?eaf


Chapter 7. First Do No Harm: Environmental Responsibility in the NICU


Note: In addition to the referenced documents, information, facts and figure in this chapter were derived from the Health Care Without Harm website and previous publications (www.noharm.org).

Thanks to Dr. Ted Schettler for his input and review, and Sue Heffernan and her colleagues for the Seattle Children’s case study and their fabulous sustainability initiatives. The authors also thank all their colleagues at Health Care Without Harm and Practice Greenhealth for providing much of the information and tools described in the chapter.
The Vermont Oxford Network is pleased to provide NICQ 2007: Improvement in Action under a Creative Commons, Share Alike, Non-Commercial License. (For information about the license, see: http://creativecommons.org/licenses/by-nc-sa/3.0/.)

When providing attribution to this chapter, please use the following citation:

Key Organizational Resources on Sustainability in Healthcare

**Health Care Without Harm** (HCWH) (www.noharm.org) is an international coalition that guides the healthcare sector to make environmentally preferred purchasing, practices, and policies, without compromising patient care or safety, so that it is ecologically sustainable and no longer a source of harm to public health and the environment. HCWH provides technical assistance, product research, support, advocacy, and education. Its goals include safer products, materials, and chemicals; alternatives to incineration; green building and operations; sustainable foods and food systems; and safe and healthy places for workers and patients, so that the healthcare sector can become a true healing environment.

**Practice Greenhealth** (formerly Hospitals for a Healthy Environment) (www.practicegreenhealth.org) formed out of Hospitals for a Healthy Environment, the Healthcare Clean Energy Exchange (HCEE) and the Green Guide for Health Care. Its goal is to provide tools, education, and recognition on environmental sustainability in the healthcare sector. HCEE has developed a web-based, open source resource tool called the Energy Impact Calculator (EIC) for measurement of the health impacts and costs of a hospital’s energy use. The EIC enables energy purchasers to make business decisions on energy efficiency projects and renewable energy purchases with a fuller understanding of energy’s true costs. HCEE also operates a healthcare-focused, web-based, clean energy and environmental commodities reverse auction platform to help healthcare facilities contain or reduce their energy costs, lock in more stable pricing, and be good environmental stewards.

The **Healthy Building Network’s** (www.healthybuilding.net) mission is to transform the market for building materials to advance the best environmental, health, and social practices. Since 2000, HBN’s projects have directly resulted in the introduction of new, healthier building materials into commercial markets, shifting over $4 billion in materials purchases from toxic materials to healthier alternatives that are comparable in both price and performance to the materials they have replaced. They have played a key role in establishing precedent-setting green building guidelines for healthcare facilities. They have also introduced well-built, healthy, and green modular demonstration homes to the affordable housing market in the Gulf States region and developed the first online evaluation tool for building materials.
The Global Health and Safety Initiative (GHSI) (www.globalhealthsafety.org) is a sector-wide collaboration to transform the way that healthcare designs, builds, and operates its facilities, as well as the products used within those facilities. GHSI aims to build a learning community and to leverage the expertise of its partners to support evidence-based improvements that advance patient and worker safety and environmental sustainability.
Chapter 8 Measure What Matters

Eugene C. Nelson, DSc
Professor, Community and Family Medicine, The Dartmouth Institute for
Health Policy and Clinical Practice, Center for Leadership and Improvement,
Dartmouth-Hitchcock Health and Dartmouth Medical School

William H. Edwards, MD
MPH, Professor and Vice Chair of Pediatrics, Children's Hospital at
Dartmouth-Hitchcock Medical Center

Every health system that wants to grow and thrive in today’s competitive world must be able to say “Yes” to three imperatives:

- Are we improving patient and population outcomes?
- Are we improving system performance?
- Are we able to grow and develop our staff?

As illustrated in Figure 8.1, these three imperatives combine to create a virtuous cycle that engages everyone in improving a healthcare system.¹

Figure 8.1 Quality Improvement in Healthcare

![Figure 8.1 Quality Improvement in Healthcare](image-url)
NICQ 2007: Improvement in Action

However, it is one thing to know what must be done and another thing to know if it is getting done. This chapter briefly describes some measurement tools that can be used to provide care to very low birth weight infants at high risk for poor outcomes:

- Two measurement frameworks called the value compass and the balanced scorecard
- Two measurement metaphors that we will refer to as a cascade for aligning health systems metrics that work at different levels of a health system and a dashboard for tracking the performance of clinical units.

Measurement frameworks, used in this context, provide a set of major categories of measures for the value of care or the performance of an organization. The frameworks provide general guidance on what types of things should be included to provide comprehensive and useful measures of specific phenomena. In the case of the compass, outcomes and costs are the focus, and in the case of the scorecard, it is organizational performance and success.

In contrast to measurement frameworks, measurement metaphors do not offer a specific set of key categories that require quantification. Instead, they provide a way of conceptualizing the properties of the measurement frameworks. A cascade is a metaphor for aligning measures at different levels of an organization. A dashboard is a metaphor calling for a customized set of measures designed for use in discrete locations by specific role players.

All four of these measurement devices are integrated in the Measure What Matters worksheet, which is presented at the end of this chapter, along with some case study implementations of the worksheet that illustrate how specific NICUs have adapted these tools to manage and improve care.

The Compass and the Scorecard

Performance metrics can provide the best source of information on whether or not strategic intent is being transformed into operating reality. It is possible to use two complementary frameworks—the value compass and the balanced scorecard—to learn how well strategic intent is being converted into operating results in the real world of healthcare delivery.

In general, the compass framework can be used to provide data on patient and population outcomes, while the scorecard can be used to provide data on system performance and staff development. The compass was developed by clinicians and health services researchers seeking to measure patients’ outcomes. The scorecard was formulated by business school faculty attempting to measure business units’ performance. The frameworks are summarized and compared in Table 8.1.
## Table 8.1 The Value Compass and the Balanced Scorecard

<table>
<thead>
<tr>
<th>Topic</th>
<th>Value Compass</th>
<th>Balanced Scorecard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question</td>
<td>Is our healthcare system providing high-quality, high-value care to patients and populations?</td>
<td>Is our healthcare business producing results needed to thrive in a competitive environment?</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Clinical, functional, satisfaction, costs</td>
<td>Learning and innovation, core processes, customer satisfaction, finance and growth</td>
</tr>
<tr>
<td>Unit of analysis</td>
<td>The patient and patients aggregated to form a population</td>
<td>The business unit and business units aggregated to form an organization</td>
</tr>
<tr>
<td>Levels of aggregation</td>
<td>Patient, physician, microsystem, mesosystem, macrosystem, community, and region</td>
<td>Microsystem, mesosystem, and macrosystem</td>
</tr>
<tr>
<td>Special features</td>
<td>Can be used to: (a) Clarify and quantify the aims of a health system (b) Measure the value of what it produces (c) Represent the main interests of different stakeholders</td>
<td>Can be used to: (a) Convert strategy into measurable operational goals, current values relative to goal, and actions to take to reach goals (b) Promote accountability throughout the organization (c) Illustrate leadership’s theory about what must be done to grow and thrive in a challenging climate</td>
</tr>
</tbody>
</table>
THE VALUE COMPASS

The compass (Figure 8.2) seeks to answer the question, “Is our healthcare system providing high-quality and high-value care to patients and populations?” The compass is patient-centered. The measures are taken on individual patients or specific patient populations, and therefore the unit of analysis is the patient.

Figure 8.2 Clinical Value Compass Framework
Figure 8.3 shows a value compass in the context of a Measures for Improvement chart developed by the Medical University of South Carolina (MUSC). The value compass appears in the upper-left panel of Figure 8.3. Figure 8.4 shows a close-up of the MUSC value compass.

Figure 8.3 MUSC Measures for Improvement Chart
Figure 8.4 Value Compass Example: MUSC

The compass display focuses exclusively on low birth weight infants cared for in a particular location. It includes available data related to clinical outcomes, functional status, parent satisfaction, and costs. Some of the compass quadrants have substantial scope and depth (for example, clinical) while some of the quadrants have only limited information (for example, costs). This value compass for low birth weight infants shows areas of strength as well as opportunities for improvement. It can be used to set priorities for improvement, for monitoring changes over time and for evaluating the impact of improvement projects (as it is updated over time).

Like a handheld compass used for navigation, the value compass is divided into four primary quadrants that can provide data to answer critical questions:

- **Clinical status (west):** What is the patient’s biological status, such as signs, symptoms, morbidity, mortality, complications?
- **Functional and risk status (north):** What is the patient’s functional status, such as physical activity, mental health, cognitive function, social and role function, vitality? What is the patient’s risk, such as smoking, BMI, exercise, and so on?
• Satisfaction (east): What are the patient’s perceptions about the quality of care and on how much their health benefited from treatment, relative to their expectations and needs?

• Cost (south): What are the direct costs of the patient’s medical care, including office visits, hospital stays, medications, tests, and treatments? What are the indirect social costs, including time lost from school or work, and reductions in work productivity associated with illness or injury?

The compass provides a comprehensive view of outcomes and is designed to suggest that outcomes should not be measured by a focus only on, for example, clinical or cost outcomes. Instead, the compass captures the primary interests of the different stakeholders. Doctors and nurses tend to focus on biological outcomes; patients and families key in on functional and satisfaction results (the patient’s everyday health status and their perceptions of their healthcare experiences); and employers and purchasers often fix their gaze on healthcare costs and lost productivity. The compass captures measures that are crucial to all groups.

In addition to being comprehensive, the compass is dynamic: it can be used to focus on changes in states over time. Each particular metric on a value compass can be shown as a trend and placed on an accompanying run chart—or a statistical process control chart—to reveal the change in any particular outcome over time and to show variation and trends in performance. The bottom half of Figure 8.5 shows trend data for the MUSC NICU example. In this case, the trend data show important outcomes such as infection rates and chronic lung disease.

**Figure 8.5 Charting Trends from the Value Compass Framework**
It is also possible to create a value compass for individual patients and to show changes in their outcomes over time. For example, the Dartmouth Spine Center uses the value compass framework to track changes in individual patients by updating each person’s clinical, functional, satisfaction, and cost data at the point of service. This helps the patient and the clinician to get on the same page with respect to how the patient is doing and to build a plan of care that matches the patient’s needs and preferences.  

Finally, the compass can measure the value of care. Value can be defined and measured based on the outcomes in relationship to the costs over time. A basic value formula looks like this:

\[
\text{Value} = \frac{\text{biological} + \frac{\text{functional/risk}}{\text{risk}} + \text{satisfaction}}{\text{over time}} + \frac{\text{medical costs} + \text{social costs}}{\text{over time}}
\]

By way of example, Figures 8.6 and 8.7 summarize two-year follow-up results in value compasses for patients with herniated disks and spinal stenosis. These patients participated in an NIH funded randomized controlled trial (RCT) on spine surgery. Consenting patients were randomly assigned to either receive surgery or nonsurgical care (if they did not choose a priori to have one or the other modes of treatment). The figures show the differences between groups who received surgical care versus nonsurgical care for these two different spine conditions. They also show the value of care measured in terms of the cost per “quality adjusted life year” conferred by surgery over nonsurgical care. \textsuperscript{12, 13}
Figure 8.6 Compass Display of Outcomes and Value: Herniated Disks

<table>
<thead>
<tr>
<th>Herniated Disk</th>
<th>Outcomes @ 2 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery</td>
<td>Non-Surgery</td>
</tr>
<tr>
<td>41 Ave Age</td>
<td>44 Ave Age</td>
</tr>
<tr>
<td>43% Female</td>
<td>45% Female</td>
</tr>
</tbody>
</table>

- Reduced Oswestry Symptoms
- Functional
- Satisfaction
- Costs

Physical SF-36 Improvement

Cost per Quality Adjusted Life Year Added By Surgery

$74,870

$10,195

$25,221

Satisfied With Improvement

44

32

1.64 QALY

1.44 QALY

58%

44 Ave Age

45% Female

41 Ave Age

43% Female

Total Direct & Indirect Costs
**THE BALANCED SCORECARD**

The scorecard (Figure 8.8) strives to answer the question, “Is our healthcare business producing results needed to thrive in a competitive environment?” The scorecard is business-centered. The measures are focused on discrete business units, and therefore the units of analysis are cost centers within an organization.
Figure 8.8 Balanced Scorecard Framework

The scorecard is multifaceted and answers primary questions in four domains:

- **Innovation and learning**: What things must be developed or learned to meet customers’ needs and face competitive challenges?
- **Core processes**: What things need to work well to provide high-quality services and products that meet customers’ needs at a price they are willing to pay?
- **Customer satisfaction**: What are the perceptions of external customers (i.e., ultimate customers or people who benefit from services and who are employed by the service-providing organization) about the quality and value of the services and products? What do internal customers (i.e., coworkers or people who are employed by the service-providing organization and who depend on other staff to supply them with information, materials or services that are needed to meet needs of external customers) think about their own ability to do good work in a positive environment and to have their human needs for recognition and growth met?
- **Finance and growth**: How strong are the organization’s financial underpinnings? Is the organization growing to meet customer demand and to expand market share?

Figure 8.9 shows a scorecard for the MUSC NICU. The scorecard focuses on low birth weight infants and calls for measures and actions related to innovation and learning (Improve Communication and Group Dynamics), core processes (Reduce Chronic Lung Disease and Hospital Acquired Infections), customer satisfaction (Improve Parent and Employee Satisfaction), and finance (Operate Within NICU Operating Budget for Fiscal Year). The MUSC scorecard is used to specify priority actions, to evaluate progress over time based on measured results, and to align this NICU’s improvement and operating plan with the strategic and operating plan of the larger organization of which it is a part.
The scorecard can include time trend charts to reveal the dynamic nature of changes in key results. It can be used to show changes over time on vital drivers of enterprise success over time.

The scorecard is strategic and operational, reflecting the organization’s overall strategy and its deployment to different operating units across the enterprise. The scorecard is also tactical and practical. A well-designed scorecard can summarize the overall strategic theme and specific metrics related to the theme, along with current values and target values, and who will take what actions, by when, to achieve target values. Finally, the scorecard meets the requirements for successful execution in real-world organizations. It links strategy with operations and with people, and does this in a transparent and measurable way.9

Another example of scorecard use comes from Dartmouth-Hitchcock Health (DHH), an integrated healthcare system serving New Hampshire and eastern Vermont. The number one quality and safety priority for DHH is to eliminate preventable harm, and a leading cause of harm in the DHH system is hospital acquired infections (HAIs); leading sources of HAIs, in turn, are poor hand hygiene and central line management. The DHH scorecard includes trends in HAIs as well as specific actions to improve hand hygiene and to reduce central line infections. Specifically, DHH’s scorecard data show trends in hand hygiene compliance (with separate breakouts for hand washing rates among physicians and nurses) as well as trends in central line infections (days between new infections), and it associates these trends with specific actions that the ICN staff have taken to improve hand hygiene and to reduce central line infections.

---

8-12
Cascades and Dashboards
Now let’s take a look at two measurement metaphors: measurement cascades and measurement dashboards. Both provide useful ways of thinking about the properties of measurement devices. Cascade thinking helps measures to fit together in a larger organization by providing alignment of actions and measured results across different levels of an enterprise. Dashboard thinking helps measures to have practical utility for staff who are managing processes and taking actions in complex working environments.

The Cascade
Imagine that you are the president of a healthcare system seeking to transform the system and to do this in a measurable way. You work with staff to establish the strategy and operating plan and system-level (“big dot”) measures of success such as quality, safety, value, innovation, core processes, customer satisfaction, and financial strength. The challenge is to deploy the strategic and operating plan throughout all levels of the organization and to have line-of-sight measures that “cascade” down from the top of the organization and reach all the way to the front-line units where care is actually delivered.10

To illustrate the cascading metrics concept, consider a system-level measure like healthcare costs per person, or adverse events per 1000 patients. It is possible to disaggregate the big dots (at the macrosystem level, L1) to view performance at the mesosystem level (L2), and then to further disaggregate the measure to reveal performance at the microsystem level (L3). Thus, we develop the image of cascading metrics that go from the level of the whole system (the macrosystem, such as Dartmouth Hitchcock Health) all the way to a front line system (the microsystem such as the intensive care nursery). The measurement cascade enables the organization to take a system-level measure and to break it down into its contributing parts based on the source in the system. As shown in Figure 8.10, it would be possible to quantify what portion of all adverse events are related to adverse drug events (ADEs) and then to further categorize the ADEs occurring in different subpopulations served by the hospital (pediatrics, cancer, maternity, and so on). Finally, within pediatrics, you could trace the contributions made by patients in specific clinical units that serve this population, such as the intensive care nursery, the pediatric intensive care unit, and so on.
The aim of cascade thinking, when applied to front-line microsystems, is to begin to connect the dots—from big dot to small dot and vice versa. A good way to start building measurement cascades that link the front office with the front line is to determine the specific things that take place in the microsystem that contribute to achieving system-wide aims. In this way, we use small-dot and big-dot thinking to provide a basis for aggregating and disaggregating key results. Cascades promote the alignment of improvement work at different levels of the organization in order to facilitate accountability for making performance improvements when needed, and to monitor that improvements are being sustained.

Figure 8.11 provides a real-life illustration of two measurement cascades—one for parent/patient satisfaction and another for employee turnover. In this case the cascade links the NICU (a microsystem) with the Children’s Hospital (a mesosystem) and finally with the Medical University of South Carolina (a macrosystem).
THE DASHBOARD

Although dashboard (or instrument panel) thinking is relatively new in healthcare, it is accelerating and will likely become a prominent part of the future of healthcare.11

To understand the potential of the dashboard, consider the following thought experiment.

Imagine that you are a competent pilot flying a reliable airplane. You look at your aircraft’s dashboard and at a glance you can read your gauges and dials to check on your airspeed, altitude, orientation, heading, and fuel level. You can monitor your flight path versus your flight plan, the electrical systems, and the engine temperature. If a core system malfunctions, you will be warned by alarms and flashing lights. You are confident that you will land safely at your desired destination.

Now imagine you are flying this same plane, but that it is night, it is snowing hard, you need to land in a small airstrip between two mountains, and by the way, your dashboard suddenly goes dark. How confident are you about your chances of finding your airport and landing safely without the help of your dashboard?
Compared to pilots, most healthcare professionals and health systems find themselves “flying blind” all too often. Dashboard thinking invites you to consider the vital information that you need to have at hand to safely and efficiently do the right thing in the right way at the right time. A good healthcare system needs to manage many critical processes simultaneously: to provide care for patients, to manage the health of populations, to get an early warning of impending problems, and to run the system in a way that optimizes patient outcomes, system performance, and staff vitality. Tomorrow’s electronic health records and visual display devices, if properly designed, can provide healthcare with useful dashboards capable of streaming real-time data into displays to guide intelligent, timely action.

The goal of the dashboard idea is to help front-line Microsystems like NICUs begin to construct an instrument-panel-like data display to improve their ability to provide safe, timely, effective, and efficient care. A good way to start building a dashboard for a NICU is to blend the value compass and balanced scorecard approaches to create a compact, unit-specific collection of data that includes vital “gauges” related to patient/population outcomes, system performance, and staff development and well-being. Figure 8.12, from Baptist Children’s Hospital, and Figure 8.13, from Sunnybrook Health Sciences Centre, show examples of dashboards for their NICUs based on a blending of compass and scorecard frameworks.
Figure 8.12 Dashboard Example: Baptist Children’s Hospital

Measures for Improvement
Baptist Children’s Hospital, Miami, Florida

Our Value Compass

Our Balanced Scorecard

Plot the dots

Our Unit Dashboard

Cascading Measures
The Measure What Matters Worksheet

The Measure What Matters worksheet (MWM), shown in Figures 8.14, 8.15, and 8.16, was designed to identify key measures for tracking and improving clinical unit performance. The worksheet aims to be a guide for constructing a way to display results—both at a specific point in real time and over time—by integrating all four of the tools we’ve described so far. Specifically, the MWM worksheet uses the value compass and balanced scorecard frameworks to create dashboards that are based on organization-wide measurement cascades (when possible).

The steps we recommend for using the MWM worksheet are as follows:

**Step 1. Create compass.** Create a clinical value compass for the microsystem or clinical unit to measure clinical, functional, satisfaction, and cost outcomes.

**Step 2. Create scorecard.** Create a balanced scorecard for the microsystem/clinical unit to measure strategic and operational progress on innovation and learning, core processes, customer satisfaction, and finance.
Step 3. **Determine strategic measures.** To understand the potential to create a measurement cascade, determine the organization’s strategic measures and illustrate how specific measures descend through the organization from the macrosystem level to the mesosystem level and finally to the microsystem level of the enterprise.

**Step 4. Construct dashboard.** Use key value compass and balanced scorecard measures to construct a dashboard or instrument panel to monitor progress and performance. Use the dashboard to show trends by plotting points with data from run charts or control charts and by illustrating key results in tables or figures. The dashboard can include both point-in-time data displays as well as over-time displays.

**Step 5. Create cascading measures.** Make any further refinements and finalize the measurement cascades that align measured performance metrics at different levels of your organization.

To take full advantage of the MWM worksheet, keep the following critical principles in mind:

- **Aim to show real-time results:** The closer the data are to showing real-time results, the more useful the information will be in guiding intelligent and timely action for improving performance, maintaining performance, or quickly spotting positive or negative trends.

- **Give the dashboard high visibility:** The more visible the dashboard is to members of the front-line clinical microsystem and the more attention that is paid to it—in huddles, in team meetings, in all staff meetings, and at annual retreats—the more helpful it will be. By emphasizing the importance of the dashboard, you will tighten the linkage between measuring performance, improving performance, and maintaining high levels of safety and efficiency.
NICQ 2007: Improvement in Action

Figure 8.14 MWM Worksheet: Part 1

1. Create clinical value compass (unit of analysis is patients)
   - Whole population
   - Subpopulation
   - Disease specific subpopulation
   - Individual patient

2. Functional

3. Biological/Clinical

4. Patient/Family Satisfaction

5. Cost


Figure 8.15 MWM Worksheet: Part 2

1. Create your balanced scorecard (unit of analysis is microsystem)
   - Innovation and Learning
     - Safe
     - Timely
     - Effective
     - Efficient
     - Equitable
     - Patient Centered
     - Socially Responsible

2. Core Processes

3. Customer Satisfaction

4. Financial

Examples: Using the MWM Worksheet in VON NICUs

The Vermont Oxford Network collaborative (VON NICQ 2007) started with the bold aim of using measures to improve performance and to enhance leadership by implementing the ideas presented in this paper. Over an 18-month period, dozens of NICU teams learned how to adapt the methods we’ve described—compasses, scorecards, dashboards and cascades—to their own clinical microsystems. In the final phase of the collaborative, the NICQ 2007 participants were introduced to the MWM worksheet and were shown an illustrative mock up of a measures for improvement data wall to bring all of their work together (Figure 8.17).
More than 50 NICUs met the challenge, constructed their own data walls, and shared them at the final session of the collaborative. There were many excellent examples of how different intensive care nurseries took these principles and methods, made them their own, and began using them to manage and improve performance.

This chapter has shown three extraordinary examples of Measures for Improvement Data Walls—one from the Medical University of South Carolina in Charleston, South Carolina; one from Baptist Children’s Hospital in Miami, Florida; and one from Sunnybrook Health Sciences Centre in Toronto, Canada. Each of these three case examples shares the same overall structure: compasses and scorecards blended to form dashboards, data plotted over time, and line-of-sight metric cascades. Each has tailored the basic ideas to the unique context of their specific NICU.

**Conclusion**

The aim to provide the best possible care in the most caring way to infants, mothers, fathers and families is widely shared. If we are to achieve this aim, however, we will need to get better at healing and helping. We will need to squeeze more health from fewer resources. We will need to engage everyone—paid staff as well as patients and families—not just in improving performance, but also in growing as professionals.
To know whether or not we are turning the corner on transforming healthcare and substantially improving health, we will need meaningful measures that can flow into a rich information environment—to provide early warnings of danger, to provide timely evidence of healing, and to connect trying specific methods and approaches with learning about the actual results of these efforts. Compasses and scorecards can guide us on the journey and help us gauge our progress. Dashboards and cascades can keep us alert and aligned with the mission and vision.

References
NICQ 2007: Improvement in Action


Acknowledgements

The authors wish to recognize the special work done by Marjorie M. Godfrey, MS, RN in creating the Measure What Matters worksheet and the following outstanding clinical teams that contributed examples of their work: the Medical University of South Carolina in Charleston, South Carolina; Baptist Children’s Hospital in Miami, Florida; Sunnybrook Health Sciences Centre in Toronto, Canada; and the Intensive Care Nursery at Dartmouth-Hitchcock Medical Center in Lebanon, New Hampshire. We also want to thank Dr. James Weinstein and his colleagues at the Dartmouth Spine Center and in the multi-center SPORT trial for their work on which the spine value compasses (Figures 8.6 and 8.7) are based.

The Vermont Oxford Network is pleased to provide NICQ 2007: Improvement in Action under a Creative Commons, Share Alike, Non-Commercial License. (For information about the license, see: http://creativecommons.org/licenses/by-nc-sa/3.0/.)

When providing attribution to this chapter, please use the following citation: