Microsystems in Health Care

Microsystems in Health Care:

Part 9. Developing Small Clinical Units to Attain Peak Performance

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"Quality is never an accident. It begins with the intention to make a superior thing. It is always the result of intelligent action." —John Ruskin

This article, the last one in the nine-part Microsystems in Health Care series, focuses on what it takes, in the short term and long term, for clinical microsystems—the small, functional, front-line units that provide the most health care to the most people—to realize their potential and to attain peak performance. To achieve long-term gains, it may be important to have a sense of how actual clinical microsystems can grow, learn, adapt, and improve over extended periods of time. We provide a case study to highlight one microsystem's 10-year journey toward excellence and offer a framework that reflects a clinical microsystem's developmental journey toward high performance. This case study, like the other case studies presented in this series (see Sidebar 1, page 576), contributes to the evolution of clinical microsystem theory.

To make swift progress in the short term, it may be wise for the leaders of health systems to sponsor an action-learning program to catalyze development of clinical microsystems. We describe a "green belt curriculum" on microsystems fundamentals that can be used to initiate forward progress and to begin to anchor strategic and operational microsystems thinking in the local culture. The article concludes with a summary of important points, including what leaders can do to foster effective progress toward best performance.

Article-at-a-Glance

Background: This last Microsystems in Health Care series article focuses on what it takes, in the short term and long term, for clinical microsystems—the small, functional, front-line units that provide the most health care to the most people—to attain peak performance.

Case Study: A case study featuring the intensive care nursery at Dartmouth-Hitchcock Medical Center illustrates the 10-year evolution of a clinical microsystem. Related evolutionary principles begin with the intention to excel, involve all the players, use measurement and feedback, and create a learning system.

Discussion: A microsystem's typical developmental journey toward excellence entails five stages of growth—awareness as an interdependent group with the capacity to make changes, connecting routine daily work to the high purpose of benefiting patients, responding successfully to strategic challenges, measuring the microsystem's performance as a system, and juggling improvements while taking care of patients.

A Model Curriculum: Health system leaders can sponsor an action-learning program to catalyze development of clinical microsystems. A "green-belt curriculum" can help clinical staff members acquire the fundamental knowledge and skills that they will need to master if they are to increase their capacity to attain higher levels of performance; uses action-learning theory and sound education principles to provide the opportunity to learn, test, and gain some degree of mastery; and involves people in the challenging real work of improving.

Sidebar 1. Articles in the Microsystems in Health Care Series

1. Nelson E.C., et al.: Microsystems in Health Care: Part 1. Learning from high-performing front-line clinical units. *Jt Comm J Qual Improv* 28:472–493, Sep. 2002.	Presents background information describing clinical microsystems and summarizing recent research on the factors that blend together to generate high performance.
2. Nelson E.C., et al.: Microsystems in Health Care: Part 2. Creating a rich information environment. *Jt Comm J Qual Saf* 29:5–15, Jan. 2003.	Describes the vital role that data and information play in creating a rich and positive working environment that supports care delivery in real time and systematic improvement over time.
3. Godfrey M.M., et al.: Microsystems in Health Care: Part 3. Planning patient-centered services. *Jt Comm J Qual Saf* 29:159–170, Apr. 2003.	Deals with the design and redesign of core services and planning of care to match the needs of individual patients with the services offered by the health system.
4. Wasson J.H., et al.: Microsystems in health care: Part 4. Planning patient-centered care. *Jt Comm J Qual Saf* 29:227–237, May 2003.	Describes how high-performing microsystems design and plan patient-centered care.
5. Batalden P.B., et al.: Microsystems in Health Care: Part 5. How leaders are leading. *Jt Comm J Qual Saf* 29:297–308, Jun. 2003.	Explores the essence of leadership within clinical microsystems and focuses on three essential facets of leading—building knowledge, taking action, and reflecting on the current condition and the gap between the status quo and the desired state.
6. Mohr J.J., et al.: Microsystems in Health Care: Part 6. Designing patient safety into the microsystem. *Jt Comm J Qual Saf* 29:401–408, Aug. 2003.	Delves into the issue of safety—a fundamental property of all clinical microsystems as they attempt to do the right things in the right way each and every time and in a perfectly safe and reliable manner.
7. Kosnik L., Espinosa, J.A.: Microsystems in health care: Part 7. The microsystem as a platform for merging strategic planning and operations. *Jt Comm J Qual Saf* 29:452–459, Sep. 2003.	Explores the huge but mostly untapped potential for using microsystems thinking and techniques to promote strategic and sustainable improvement throughout large health care systems.
8. Huber T.P., et al.: Microsystems in Health Care: Part 8: Developing people and improving work life: What front-line staff told us. *Jt Comm J Qual Saf* 29:512–522, Oct. 2003.	Turns the spotlight onto the growth and development of staff—the greatest asset of virtually all clinical microsystems.
9. Batalden P.B., et al.: Microsystems in Health Care. Part 9: Developing small clinical units to attain peak performance. *Jt Comm J Qual Saf* 29:575–585, Nov. 2003.	Shows how a clinical microsystem can evolve over time to go from average to exemplary performance and offers a practical, action-learning program for planning growth and improvement.

Case Study: A Decade of Progress for an Intensive Care Nursery

This case study draws on a decade of experience, planned change, and growth in the intensive care nursery (ICN) at Dartmouth-Hitchcock Medical Center (DHMC). The ICN serves a mostly rural region of New Hampshire and Vermont, with a total population of approximately 750,000 people. The ICN was started in 1972 and currently has 31 beds.

Initial Stimulus and First Project: "Quiet Pleases," 1992

In 1992 Dr. Gene Nelson and a neonatologist and the ICN's medical director, Bill Edwards, were in conversation about the ICN. When asked about his vision for the

Value Compass for the DHMC

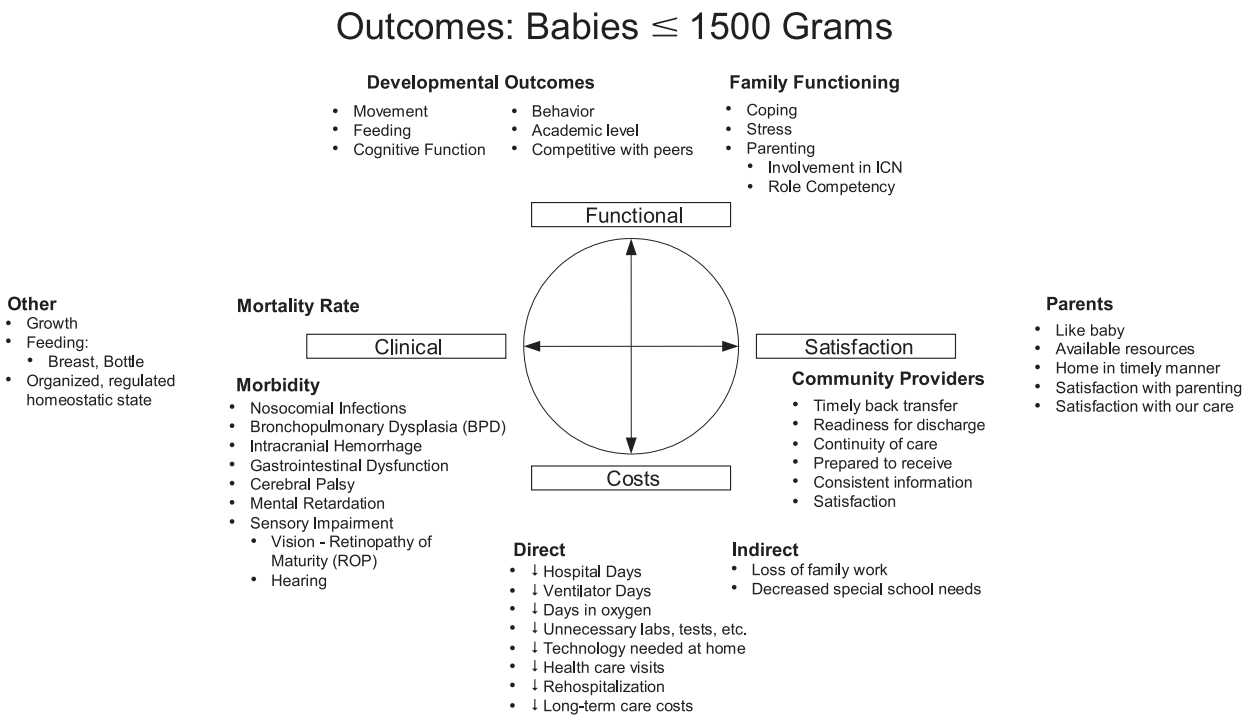

Figure 1. *The Intensive Care Nursery (ICN) at Dartmouth-Hitchcock Medical Center (DHMC) used a value compass to summarize the team's outcomes model.*

ICN, Dr. Edwards indicated that he would like to see it become the best in the world—not to claim bragging rights but rather to make it possible for infants and their families to have the best chance possible for successful outcomes. He asked rhetorically, "Would any family want anything less?"

This conversation was, in effect, a tipping point.[1] It set in motion events that accelerated and provided structure for a long and continuing quest for excellence in this ICN. With this vision in mind, Dr. Edwards and Dr. Nelson, who had recently joined DHMC, decided to start explicitly working toward the goal of achieving best possible outcomes. A brief synopsis of early activity follows.

Dr. Edwards invited an interdisciplinary team of about seven people from the ICN to embark with him on an action-learning activity, or "studio course," based on the principles that Donald Schön presented in his book *Educating the Reflective Practitioner.*[2] For approximately six months, the ICN team met weekly or biweekly for 60 minutes at a time. The first thing the team did was to talk about its mission and aim. Team members used clinical value compass thinking to do the following:

- Sharpen the team's aim—"to optimize the outcome of < 1500-gram babies, to decrease the incidence of major morbidity and mortality, and to do this at a lower cost"
- Clarify critical outcomes of care for key beneficiaries (the infants, their families, and community providers)

The ICN value compass that was developed in 1992 (and is still used today) summarized the team's outcomes model (Figure 1, above). The team then identified high-leverage areas that might be improved to realize better outcomes. This led to the selection of an initial, novel improvement theme that centered on noise reduction. This topic was selected because research had suggested that high noise levels could disturb the delicate physiology of low-birthweight infants and had the potential to cause serious adverse events. Assessment of the current sound state in the ICN revealed frequent, loud noises, and all staff members could be involved in noise

Before and After Results for Noise Levels in the Intermediate Care Unit in the ICN

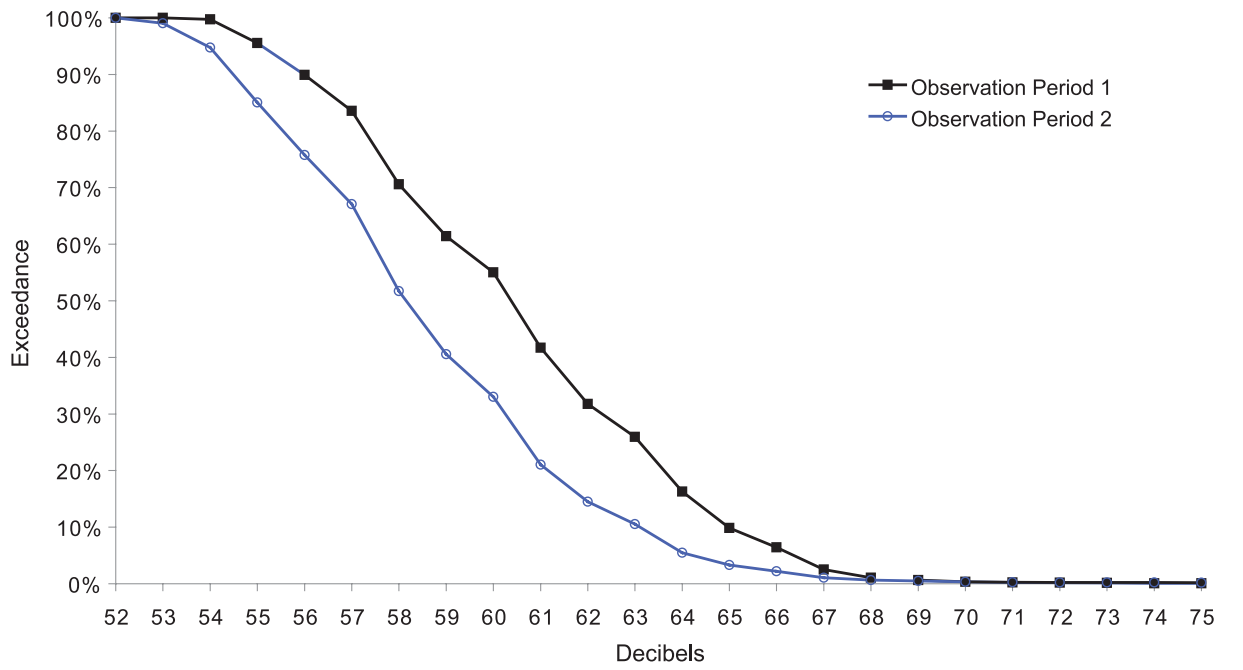

Figure 2. *After the intensive care nursery (ICN) initiated a series of changes, noise levels decreased in the intermediate care area within the ICN. Exceedance is the percentage of time exceeding each decibel level (C-weighted scale).*

reduction. The next steps involved assessing the sources of loud noises (people and equipment), gathering baseline data on noise levels, and planning tests of change using the scientific method, based on plan-do-study-act (PDSA).[3] The first set of changes focused on noise produced by staff, family, and visitors and was signified by the theme—prominently displayed—"Quiet Pleases." The second set of changes targeted equipment noise produced by myriad alarms—"buzzers, bells, and whistles"—that were constantly erupting to signal possible danger. After all these changes were initiated, noise levels decreased in the intermediate care area within the ICN (Figure 2, above).

Beyond the impact on noise reduction (which was real yet modest), this initial improvement work gave all the ICN staff disciplines—physicians, nurses, nursing assistants, administrative staff—an opportunity to work together to learn principles and methods that could be used in the future. It generated a visible, short-term "win," promoted local improvement knowledge, created a guiding coalition, used the scientific method (which was revered in the local culture), and fostered respectful interdependence and shared leadership patterns, all of which built a solid foundation for continuing on the path toward excellence and transformation.[4–6]

System Cost-Cutting Imperatives and Adaptive Responses, 1994–1997

In 1994 the DHMC health system faced serious financial challenges; all the clinical units were challenged to reduce costs. The ICN embarked on a length of stay (LOS) reduction program to reduce costs while maintaining or improving quality. Members of an interdisciplinary team focused on three high-leverage processes—discharge planning and case management, management of apnea and related discharge criteria, and management of infants' transition to oral feeding. These and other subsequent changes (for example, reducing unnecessary diagnostic tests, decreasing

Longitudinal Trends in the Number of Days that Infants in the ICN Spend on Mechanical Ventilation

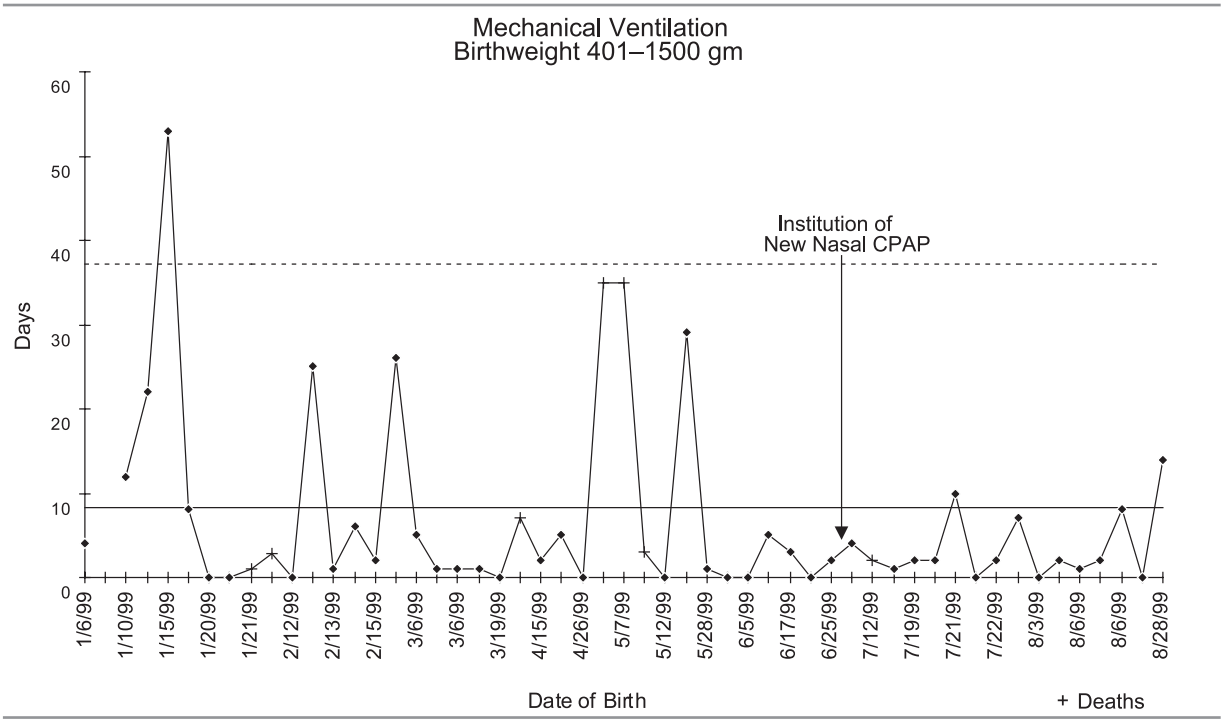

Figure 3. *Improved use of nasal continuous positive airway pressure led to a substantial decline in the mean number of days that infants use mechanical ventilation.*

total parenteral nutrition costs, and changing antibiotic prescribing patterns) led to recurring savings (estimated at $1.3 million per year) and measurable decreases in LOS. The ICN was subsequently able to achieve the lowest geographically adjusted median cost per infant in 1996–1997 compared with 30 other hospitals participating in the Vermont Oxford Network (VON) quality improvement collaborative described in the following section.

The ICN's Collaborative Work with VON, 1995–2003

Another important factor in the ICN's quest for best possible care has been participation in VON. In 1994, VON initiated a focus on collaborative multidisciplinary quality improvement, with the DHMC ICN as a charter member.[7,8] Close to 100 ICNs work together either directly or via teleconferencing to improve the quality of neonatal care.

By working with VON, the ICN at DHMC has been able to do the following:

- Reduce its nosocomial infection rate by approximately 70% in three years, from an annual rate of 39% to 13% among infants with birthweights ranging from 501 to 1,500 grams.
- Help plan and co-lead an international multicenter randomized controlled trial on the effectiveness of prophylactic skin care with an emollient on nosocomial infection rates and skin integrity in extremely low-birthweight infants (501–1,000 grams).[9,10]
- Improve use of nasal continuous positive airway pressure by benchmarking the best-known practices and best-observed outcomes and applying these practices and outcome measures. This activity led to large measurable improvements—for example, a substantial decline in the mean number of days that infants use mechanical ventilation (Figure 3, above).
- Co-lead and participate with 10 other centers in a program to increase family involvement in the child's care, which involved including parents, as members of the care team, in daily rounds.[11,12]

Evolutionary Principles: Transformation of Improvement Patterns in the DMHC ICN

The DMHC ICN case study reveals a clinical unit that is on the move and headed toward something better. It always had the intention to achieve superior results, but it lacked a method to do so. The case study embodies principles that may be helpful in guiding a microsystem's progress toward best possible performance.

Begin with the intention to excel. The improvement process is initiated and sustained with the intention to achieve best possible results. This aim is motivated not so much by the desire to capture the high ground or to bask in the limelight but to do what is best for the patients and families who have the potential to benefit from care.

Involve all the players. The leaders who are successful will find ways, over time, to involve all the microsystem players—interdisciplinary staff and patients and families—in the action of analyzing and improving processes and outcomes.

Focus on values that matter. The activity that will sustain a virtuous cycle of improvement in performance will connect to core values that matter to patients, families, and staff.

Keep both discipline and rhythm. Improvement work can be sustained over time and become part of the clinical microsystem's culture by inculcating new habits and new patterns that have an internal discipline and reliable rhythm. *Discipline* relates to things such as use of scientific method and open, respectful inquiry into authentic causes and full effects. *Rhythm* relates to devoting time to improving patient care even as large amounts of time are spent on providing patient care.

Use measurement and feedback. The discipline and the rhythm—the information essential for fostering learning systems—are both aided and abetted by using measurement and feedback to assess the gap between the current condition and the desired state.

Create a learning system. As Galileo stated, "You cannot teach a man anything; you can only help him find it within himself."[13] People learn in many ways—by being confronted with a worthy challenge, by taking action and reflecting on the results, by using the scientific method, by becoming keen participant observers of their own work processes and the related outcomes, by exchanging ideas and methods about what works and what fails, and so on. It is important to create the learning system and thereby the conditions under which staff members can learn and discover, test out new ideas, realize their own potential, and attempt to innovate.

Discussion

We first provide a general model that portrays a clinical microsystem's developmental journey toward best possible performance. We then introduce a curriculum and supporting materials that can be used to jump-start clinical microsystems to embark on their own path toward such performance.

A Microsystem's Developmental Journey

To complement the case study, which provides some of the details of one particular microsystem's developmental journey, Figure 4 (page 581) provides a model for the journey. The model calls attention to the five stages of growth, on which we now comment.

Stage 1. Create Awareness of Our Clinical Unit as an Interdependent Group of People with the Capacity to Make Changes. Often it is the invitation to describe or to represent the work of a clinical microsystem in a diagram that initiates a clinical microsystem's enhanced self-awareness. Members of the clinical microsystem will often note routines, habits, or processes that do not work very well or that do not make sense when they look at their functioning as a whole, and they may decide to change them. The experience of working on what some describe as the "foolishness" of our work—the things no one wants to admit, much less brag about (such as confusion and rework in patient flow) can lead to the realization that change as a unit is possible. The sense that "we" can take action on "our" unit begins a journey of empowerment for the microsystem.

Stage 2. Connect Our Routine Daily Work to the High Purpose of Benefiting Patients: See Ourselves as a "System." With the sense of "agency" (we can take action on our own work), a team often comes to the realization that it exists for the benefit of the recipients of its work. With the clarification of an aim—to benefit a defined population of patients—the providers, processes, and patterns are

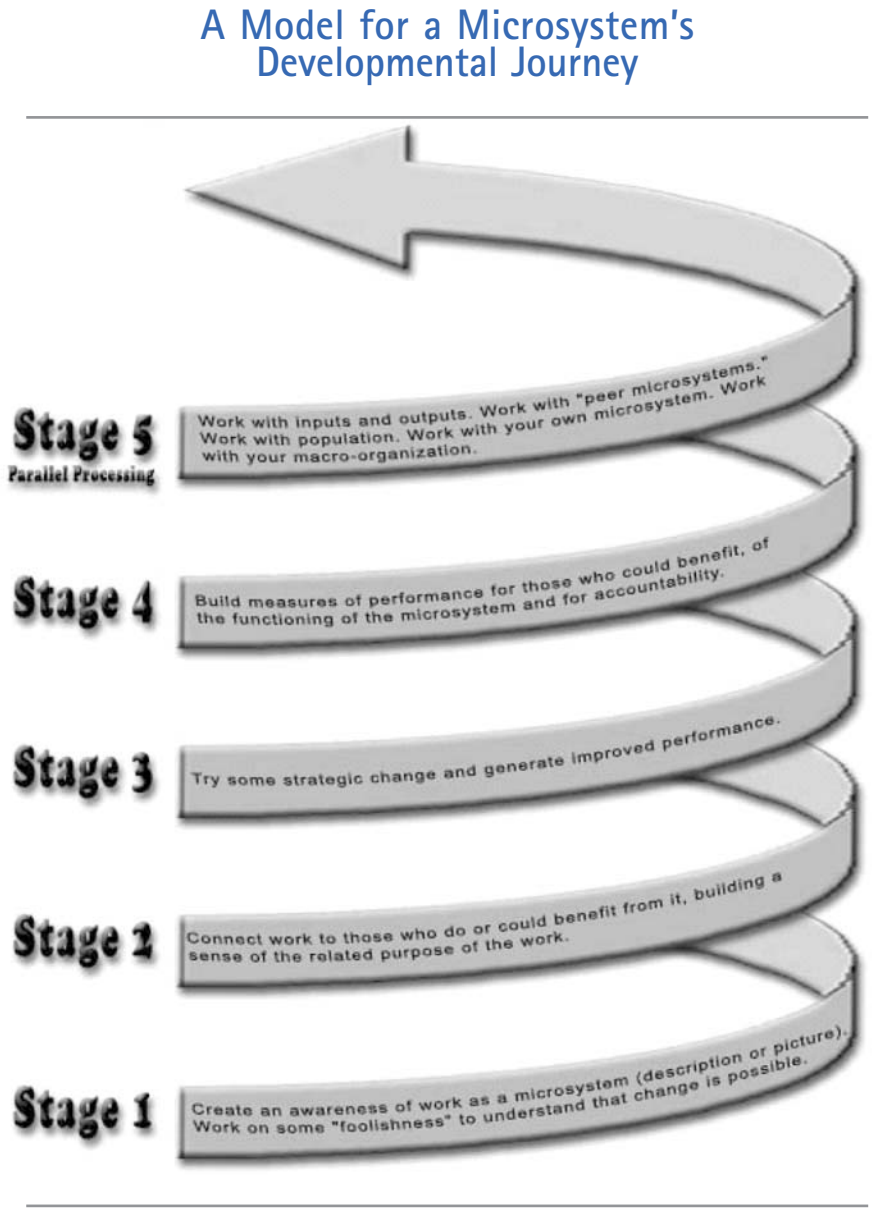

Figure 4. *This figure illustrates a general model for microsystems improvement; the model is based on work with and observations of hundreds of clinical microsystems during the past two decades.*

more easily seen as a system.[14,15] Relating the need of a population of patients to the daily work is a challenging step that is not often done.

Stage 3. Respond Successfully to a Strategic Challenge. When a microsystem that has a sense of itself as a system faces a strategic challenge, such as "eliminate waiting for access to appointments in primary and specialty care" or "cut costs by reducing LOS in the ICN," it can change its processes and forecast the implications of intended changes. However, for a clinical unit lacking this self-awareness, responding to a challenge is often a matter of "following the recipe" or "looking like we are moving forward and attending to the issue but really walking in place." The results will often show up later as a slow decline in the changed performance to previous (recipe following) or no measurable improvement after all (walking in place but looking attentive). Recipe-followers are often concerned about "holding the gains," whereas walkers-in-place ask others to provide valid measures that will reveal how good the performance really is. Clinical microsystems that have well-developed identities as systems seem better able to integrate large and small changes into their regular operations and sustain them over time.

Stage 4. Measure the Performance of Our System as a System. The clinical microsystem that has made some changes and that has developed a strong sense of itself as a system, however small, and that is producing many important outcomes, tends to be curious about the results—it wants to track its performance after making changes. Visual reminders of performance in the form of "data walls" are often present.[16] Measurement becomes a friend of the change and the microsystem's enhanced identity. The microsystem often begins to track important indicators of its process of providing services and its outcomes to gain a better understanding of what is happening and to put it in a better position to manage and improve its system.

Stage 5. Successfully Juggle Multiple Improvements While Taking Excellent Care of Patients . . . as We Continue to Develop an Enhanced Sense of Ourselves as a System. With the self-understanding, ability to change, and ability to track and reflect on its performance, the clinical microsystem is able to engage its context—the macrosystem in which it works and other microsystems with which it regularly interacts. It is now in a better position to do the following:

- Analyze, modify, and standardize its own operations, such as the internal flows (from input to output)
- Reach out and involve other members of the clinical microsystem who are only marginally connected to this new-found identity
- Focus renewed energy on finding ways to meet the needs of each individual patient, one by one, and the population of patients that it serves

The clinical microsystem finds that it is now possible to engage many people in many ways in taking actions to provide and improve care, to run multiple tests of change simultaneously, and to create a work environment that recognizes good work and promotes personal and professional growth.[17] It finds ways to foster a "virtuous" cycle or a positive, upward, evolutionary spiral.

A microsystem's developmental journey does not always work this way. "All models are wrong, some are useful."[18(p. 202)] Although the model is depicted in a stagewise linear fashion, the microsystem's developmental journey does not necessarily occur in this sequence; it has interactions and feedback loops. Although the model seems to imply an "entity"—that is, *the* clinical microsystem—many clinical microsystems more often resemble a loosely coupled group than a tightly linked interdependent team.[19,20] These caveats notwithstanding, the developmental model has proven helpful for members and leaders of clinical microsystems who are eager to reflect on their work and on their efforts to attain the highest levels of quality, safety, service, and efficiency. A developmental journey is not an overnight occurrence, and leadership that seeks knowledge, takes action, and reviews and reflects can keep the focus on the journey.[21]

A Model Curriculum for the Developmental Journey

We can sometimes identify clinical units and clinical programs that are extraordinary. Most health systems have many exemplary clinical units. However, most health systems recognize that what they need is not a "few pockets of gold" but a total system that is "solid gold."

The question is, How do we begin the evolution toward a solid-gold health system—one that is composed of many small systems that are excellent in what they do? Recall that the patient's health care journey often requires him or her to interact with many small clinical units that come together into a health system (care continuum) that addresses their changing health needs.[22]

There are many answers to this fundamental and challenging question: How might we embark successfully on improving the health system by improving the small systems of which it is composed? One very good answer has been given by Kosnik and Espinosa in Part 7 in the Microsystems in Health Care series.[23] This article demonstrates the powerful strategic value of applying microsystems thinking to the problem of organizationwide improvement in a large, complex health system.

Another complementary (but partial) answer to this question of organizationwide transformation is to provide each and every clinical microsystem (and the clinical support units, such as human resources, information services, and purchasing) with a basic learning program that will enable each individual microsystem to gain the skill and knowledge needed to start and sustain its own self-improvement from the inside out. Figure 5 (page 583) provides an overview of a model green-belt curriculum, which is based on more than 10 years' worth of direct experience in working with clinical units to redesign their work or to design completely new health care programs.*

The curriculum performs the following functions:

- Helps clinical staff members acquire the fundamental knowledge and skills that they will need to master if they are to increase their capacity to attain higher levels of performance

* It is referred to as a *green-belt curriculum* because of its connection to martial arts knowledge and practice. The green belt is the most important level, indicating the half-way mark to the master level. Green is the color of growth, grass, and forests, and it symbolizes that the student has begun to absorb the light; skills have begun to bloom (Bladyka K.: *Okinawan Karate Academy's Seidokan Karate Student Handbook.* Lebanon, NH, Mar. 1992.)

Overview of a "Green-Belt" Curriculum

Session 1:
- Introduction to microsystems thinking
- Meeting skills
- Diagnosing your microsystem
- Selecting theme for improvement
- Improvement Models: Plan-do-study-act (PDSA) and Clinical Improvement Worksheet (CIW)

Session 2:
- PDSA tools: Flowcharting and fishbones
- Introduction to idealized design of clinical office practices (IDCOP)
- Meeting skills: Silent idea generation and multivoting
- Quality is personal

Session 3:
- Developing smart changes
- Measuring for improvement: Run charts
- PDSA tool: Deployment flowcharts

Session 4:
- Workforce and workplace development
- PDSA tool: Pareto charts
- Measuring for improvement: Control charts
- Access to care

Session 5:
- Value stream mapping
- PDSA tool: Customer–supplier relationships
- Measuring for improvement: Clinical value compass thinking

Session 6:
- Generative star relationships
- Leading change
- Change concepts

Optional:
- Mental models
- Ladder of inference
- Left-hand column
- External environment
- Others

Figure 5. *The model green-belt curriculum can be adapted and used to help clinical microsystems take the first steps in their developmental journies.*

- Uses action-learning theory and sound education principles to provide the opportunity to learn, test, and gain some degree of mastery
- Involves people in the challenging real work of improving—assessing, diagnosing, treating—the small systems in which they work in ways that will matter[24]

The curriculum has been applied to diverse clinical units—such as primary care practices, specialty medical practices, inpatient clinical units, home health teams, and clinical support units, such as pharmacy, radiology, and pathology—and has been offered using various formats (for example, one day per month for six months, an accelerated workshop running for five consecutive half-days).

Two points about the green-belt learning model merit special emphasis.

Studio-Course Principles. Donald Schön uses the metaphor of an architectural studio course as a model for effective learning[25] to emphasize creating the conditions under which people can learn rather than use direct teaching or skills training. We base the curriculum on Schön's studio-course model and capitalize on the power of the following:

- Giving people a meaningful challenge to work on (for example, improve access, reduce errors, delight patients)
- Longitudinal learning that is a byproduct of working on the challenge
- The magic of interactive learning that involves peer-to-peer exchanges, teacher-to-student dialogue, microsystem–microsystem discussions, and microsystem-to-macro-organization conversations
- Drawing on other life experiences and knowledge bases and applying them to the challenge at hand

Many health care professionals do not regularly take the time to reflect on their practice. Once they have this "protected time," self-awareness grows.

Three-Thread Tactic. The aim of the green-belt curriculum is to intertwine three vital threads and to develop them in the learners over time. The three threads are as follows:

- Finding ways to do better at meeting each patient's needs
- Making the work experience for staff meaningful and joyous through learning to work in an interdisciplinary manner
- Increasing each staff person's capability to improve his or her work and to contribute to the betterment of the system

Several years ago, Donald Wolfe called attention to the needed competence for work in the microsystems and macrosystems of "applied behavioral sciences." He noted that "competence" always has a context (microsystem work life), is rooted in a knowledge base and in analytic skills (clinical knowledge and improvement knowledge), and is inevitably interdependent with values and involves the whole person (unity of organizational mission with personal values).[26] The green belt curriculum and the style of teaching that accompanies it are designed to reflect these themes.

Conclusion to the Microsystem Series

The challenge for leaders of health systems and for the people who work in them is to provide high-quality care that is patient centered, safe, effective, timely, equitable, and efficient.[27] This cannot be done today, but it could be done tomorrow if, and only if, we can redesign our systems.

A successful redesign requires creating the conditions for learning, improvement, and accountability at two primary levels—the large-systems level (populated by macro-organizations that exist in reimbursement, legal, policy, and regulatory milieus) and the small-systems level, characterized by clinical microsystems (for example, outpatient clinics, inpatient units, and other front-line delivery units and clinical support groups). We must pay close attention to these large-system issues; if we fail to do so, progress will be limited. However, we must also pay close attention to the small-system realities if we are to meet the quality challenge. There are many reasons for this. Small systems can be described as follows:

- The basic building blocks of health care
- The unit of clinical policy-in-use
- Where good value and safe care are "made"
- The locus of control for most of the variables that account for patient satisfaction
- The setting for interdisciplinary professional formation
- The locus of control of most of the work practice "dissatisfiers" and many of the "genuine motivators" for health professional pride and joy in work

For us, the joy of these insights is that they allow us to "see" the familiar with new eyes, as Proust observed about the discovery process.[28] The challenge comes from wearing the new lenses to see and asking ourselves the following questions:

1. What will it take for the processes of health professional education and development to recognize the cooperative and interdependent work of the professionals from different disciplines and prepare them accordingly?
2. What will help health system leaders recognize the opportunity they have to actively foster the development of the clinical microsystem, on which their macrosystems depend, and what will help those macrosystem organization leaders hold their microsystems accountable for the quality, value, and safety of patient care?
3. What "structures" of organization and work will enable the clinical microsystems to regularly improve value by facilitating the never-ending removal of waste and cost?
4. What practices and disciplines in clinical microsystems will help hold and honor the vitality of the paradox of the health of individuals and the health of populations that regularly arises in the clinical microsystem?

We hope that these articles, which focus attention on clinical microsystems—the places where patients and caregivers meet—will contribute to lasting improvements in patient care as well as betterment in the working life of those who provide the care. J

It takes a team to do the work that supports an article such as this and the others in this series. We are indebted to many people. This article made extensive use of the wonderful work of the interdisciplinary staff of the intensive care nursery at Dartmouth-Hitchcock Medical Center. Thomas Huber, M.S., managed the entire research project and made personal visits to all 20 clinical microsystems on which much of this work is based. He was assisted by Christine Campbell in analyzing the large volumes of qualitative data that were generated from the field work. Drs. Kerri Ashling and Tina Foster both contributed to the content analysis of the interview data. Elizabeth Koelsch managed the manuscript and coordinated the work of the authors, Coua Early supported design of many of the graphics, and Joy McAvoy provided the space in time for Paul Batalden to "put pen to paper." Finally, we once again wish to thank the Robert Wood Johnson Foundation Grant 036103 and our Senior Program Officer, Susan Hassmiller, Ph.D., R.N., for providing essential support for this undertaking.

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References

1. Gladwell M.: *The Tipping Point: How Little Things Can Make a Big Difference.* Boston: Little, Brown and Company, 2000.
2. Schön D.A.: *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions.* San Francisco: Jossey-Bass, 1990.
3. Nelson E., Batalden P., Ryer J.: *Clinical Improvement Action Guide.* Oakbrook Terrace, IL: Joint Commission on Accreditation of Healthcare Organizations, 1998.
4. Kotter J.: *Leading Change.* Boston: Harvard Business School Press, 1996.
5. Schein E.: *The Corporate Culture Survival Guide: Sense and Nonsense About Culture Change.* San Francisco: Jossey-Bass, 1999.
6. Weick K.E.: *Sensemaking in Organizations.* Thousand Oaks, CA: Sage Publications 1995.
7. Horbar J.D., et al.: Collaborative quality improvement for neonatal intensive care. NIC/Q Project Investigators of the Vermont Oxford Network. *Pediatrics* 107:14–22, Jan. 2001.
8. Rogowski J., et al.: Economic implications of neonatal intensive care unit collaborative quality improvement. *Pediatrics* 107:23–29, Jan. 2001.
9. Edwards W.H., Conner J.M., Soll R.F. for the Vermont Oxford Network: The effect of Aquaphor® original emollient ointment on nosocomial sepsis rates and skin integrity in infants of birth weight 501 to 1000 grams. *Pediatric Research* 49(4 Pt 2):388A, Apr. 2001.
10. Edwards W.H., Conner J.M., Soll R.F. for the Vermont Oxford Network Neonatal Skin Care Study Group: The effect of prophylactic ointment therapy on nosocomial sepsis rates and skin integrity in infants of birth weight 501–1000 grams. *Pediatrics,* in press.
11. Saunders R.P., et al.: Evaluation and development of potentially better practices for improving family-centered care in neonatal intensive care units. *Pediatrics* 111(4 Pt 2):437–449, Apr. 2003.
12. Cisneros-Moore K.A., et al.: Implementing potentially better practices for improving family-centered care in neonatal intensive care units: Successes and challenges. *Pediatrics* 111 (4 Pt 2):450–460, Apr. 2003.
13. Galileo Galilei: Italian astronomer and physicist (1564–1642). *The Quotations Page.* http://www.quotationspage.com/search.php3?Author=Galileo+Galilei&file=other (accessed Aug. 20, 2003).
14. Godfrey M.M., et al.: Microsystems in Health Care: Part 3. Planning patient-centered services. *Jt Comm J Qual Saf* 29:159–170, Apr. 2003.
15. Wasson J.H., et al.: Microsystems in health care: Part 4. Planning patient-centered care. *Jt Comm J Qual Saf* 29:227–237, May 2003.
16. Nelson E.C., et al.: Microsystems in Health Care: Part 2. Creating a rich information environment. *Jt Comm J Qual Saf* 29:5–15, Jan. 2003.
17. Huber T.P., et al.: Microsystems in Health Care: Part 8: Developing people and improving work life: What front-line staff told us. *Jt Comm J Qual Saf* 29:512–522, Oct. 2003.
18. Box G.: Statistics for Experimenters: An Introduction to Design, Data Analysis, and Model Building. New York: Wiley-Interscience, 1978.
19. Weick K.: *Making Sense of the Organization.* Malden, MA: Blackwell Publishers, 2001.
20. Scott W.R.: *Organizations: Rational, Natural, and Open Systems.* Englewood Cliffs, NJ: Prentice Hall, 1981.
21. Batalden P.B., et al.: Microsystems in Health Care: Part 5. How leaders are leading. *Jt Comm J Qual Saf* 29:297–308, Jun. 2003.
22. Nelson E.C., et al.: Microsystems in Health Care: Part 1. Learning from high-performing front-line clinical units. *Jt Comm J Qual Improv* 28:472–493, Sep. 2002.
23. Kosnik L., Espinosa J.A.: Microsystems in health care: Part 7. The microsystem as a platform for merging strategic planning and operations. *Jt Comm J Qual Saf* 29:452–459, Sep. 2003.
24. *Clinical Microsystems: Improving Health Care by Improving Healthcare Systems.* http://www.clinicalmicrosystem.org. (in development).
25. Schön D.: *The Reflective Practitioner: How the Professionals Think in Action.* New York: Basic Books, 1983.
26. Wolfe D.M.: *Developing Professional Competence in Applied Behavioral Sciences in New Directions for Experiential Learning, 8.* San Francisco: Jossey-Bass, 1980.
27. Institute of Medicine: *Crossing the Quality Chasm: A New Health System for the 21st Century.* Washington, DC: National Academy Press, 2001.
28. Proust Marcel: *The Quotations Page.* http://www.quotationspage.com/quotes/Marcel_Proust/ (accessed Aug. 2003).