The series of articles on microsystems is intended to provide useful ideas and methods that can be used in diverse clinical settings—outpatient, inpatient, skilled care, and home care—to create the conditions for sustained improvement in clinical quality and value in a way that is appreciated by patients and exciting to the front-line staff who serve them.

MICROSYSTEMS IN HEALTH CARE

Microsystems in Health Care: Part 1. Learning from High-Performing Front-Line Clinical Units

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The health care system in the United States can, under certain conditions, deliver magnificent and sensitive state-of-the-art care. It can snatch life from the jaws of death and produce medical miracles. The case of Ken Bladyka (Sidebar, p 475), is one example of the health care system's stellar performance. Yet the system is often severely flawed and dysfunctional. The Institute of Medicine's recent report—*Crossing the Quality Chasm: A New Health System for the 21st Century*—makes the point of system failure clear:[1]

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Article-at-a-Glance

Background: Clinical microsystems are the small, functional, front-line units that provide most health care to most people. They are the essential building blocks of larger organizations and of the health system. They are the place where patients and providers meet. The quality and value of care produced by a large health system can be no better than the services generated by the small systems of which it is composed.

Methods: A wide net was cast to identify and study a sampling of the best-quality, best-value small clinical units in North America. Twenty microsystems, representing different component parts of the health system, were examined from December 2000 through June 2001, using qualitative methods supplemented by medical record and finance reviews.

Results: The study of the 20 high-performing sites generated many best practice ideas (processes and methods) that microsystems use to accomplish their goals. Nine success characteristics were related to high performance: leadership, culture, macro-organizational support of microsystems, patient focus, staff focus, interdependence of care team, information and information technology, process improvement, and performance patterns. These success factors were interrelated and together contributed to the microsystem's ability to provide superior, cost-effective care and at the same time create a positive and attractive working environment.

Conclusions: A seamless, patient-centered, high-quality, safe, and efficient health system cannot be realized without the transformation of the essential building blocks that combine to form the care continuum.

- "Health care today harms too frequently and routinely fails to deliver its potential benefits."[1(p 1)]
- "Tens of thousands of Americans die each year from errors in their care, and hundreds of thousands suffer or barely escape from nonfatal injuries that a truly high quality care system would largely prevent."[1(p 2)]
- "During the last decade alone, more than 70 publications in leading peer-reviewed clinical journals have documented serious quality shortcomings."[1(p 3)]
- "The current system cannot do the job. Trying harder will not work. Changing systems of care will."[1(p 4)]

This article introduces the concept of the clinical microsystem, summarizes recent research on 20 high-performing microsystems sampled from the care continuum, and stresses the strategic and practical importance of focusing health system improvement work specifically on the design and redesign of small functional clinical units.

Qualitative research methods were used to analyze 250 hours of conversations with microsystem personnel augmented by chart reviews and financial data. Principles, processes, and examples were gleaned from the interviews to describe what these exemplary microsystems are doing to achieve superior performance.

So, what *is* the true nature of our health system? Sometimes it works well, but all too often it fails to deliver what is needed.

True Structure of the System, Embedded Systems, and the Need to Transform Front-Line Systems

The true structure of the health system the patient experiences varies widely. Patients in need of care may find

- clinical staff working together (or against one another);
- smooth-running front-line health care units (or units in tangles);

The authors thank the staff in the 20 clinical systems (Appendix 1, p 493) for teaching so much about what can be done to innovate and provide superior care to patients and community residents. They also express their appreciation for the extensive contributions made by Kerri Ashling, MD, Richard Brandenburg, PhD, and Valerie Stender, RN, in medical record review, financial, and operational analyses. The authors are very grateful to the Robert Wood Johnson Foundation for its generous support of this investigation, (RWJ Grant Number 036103). They deeply appreciate the guidance and inspiration provided by Professor J. Brian Quinn, PhD. Finally, they acknowledge the encouragement and ideas offered by Donald Berwick, MD, and his colleagues at the Institute for Healthcare Improvement.

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- information readily available, flowing easily, and in a timely fashion (or not);
- health care units that are often embedded in helpful larger organizations (or cruel Byzantine bureaucracies);
- health care units that are seamlessly linked together (or totally disjointed); and
- high-quality, sensitive, efficient care (or care that is harmful or even lethal, wasteful, and expensive).

In brief, it can be said that the true structure of the health system is composed of a few basic parts—front-line clinical microsystems, overarching macrosystems, and patient subpopulations needing care. As the Bladyka case illustrates, "it is easy to view the entire health care continuum as an elaborate network of microsystems that work together (more or less) to reduce the burden of illness for populations of people."[2(p 669)]

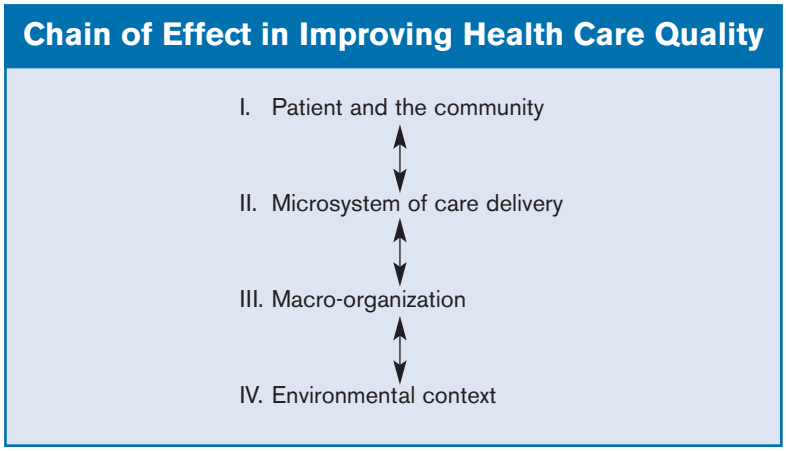

Figure 1. *While there are various levels to improve health care, our approach in this work is focused at the microsystem level, at front-line clinical teams that interact with patients and produce outcomes. Source: Donald Berwick, MD, IHI. Used with permission.*

Here are three fundamental assumptions about the structure of the health system:

1. Bigger systems (macrosystems) are made of smaller systems;

2. These smaller systems (microsystems) produce quality, safety, and cost outcomes at the front line of care; and

3. Ultimately the outcomes of the macrosystems can be no better than the microsystems of which it is composed.

The concept of clinical microsystems is being used in three national projects: the Institute of Medicine's *Crossing the Quality Chasm Report*, The Institute for Healthcare Improvement's (IHI's; Boston) Idealized Design of Clinical Office Practice Program, and the IHI's Pursuing Perfection program.[3]

Donald Berwick's "chain of effect in improving health care quality"[4] (Figure 1, above) shows the chain of effect and highlights the pivotal role that is played by the microsystems of care delivery.

To bring about fundamental change in the health system of the magnitude required, there will need to be systematic transformation *at all levels* of the system. Although many attempts have been made to change the system—by focusing on individual patients, the individual physicians serving these patients, the larger provider organizations, the payment system, and other aspects of health care policy—there have been very few efforts to understand and change the front-line clinical units that actually deliver the care. To move toward a "perfected" system of care, the performance of each individual microsystem must be optimized and the linkages between different clinical microsystems must be seamless, timely, efficient, and thoroughly reliable. Although change is required at all levels of the system, the powerful new idea here is that the microsystem concept offers an opportunity to transform health care at the front line of service delivery.

Describing Clinical Microsystems

Microsystems include patients, clinicians, processes, and recurring patterns—cultural patterns, information flow patterns, and results patterns. Microsystems in health care can be defined in the following way:

> A clinical microsystem is a **small group** of people who work together on a regular basis to provide care to discrete **subpopulations of patients**. It has clinical and business **aims**, linked **processes**, and a shared **information** environment, and it produces performance **outcomes**. Microsystems evolve over time and are often **embedded** in larger organizations. They are **complex adaptive systems**, and as such they must do the primary work associated with core aims, meet the needs of internal staff, and maintain themselves over time as clinical units.

Microsystems, the essential building blocks of the health system, can be found everywhere and vary widely in terms of quality, safety outcomes, and cost performance. A microsystem is the local milieu in which patients, providers, support staff, information, and processes converge for the purpose of providing care

Sidebar. The Bladyka Case

Ken Bladyka is a 40-year-old resident of New Hampshire who has a wife and two children. He has a 6th-degree black belt in karate and has earned several national and international gold medals. Last summer, while attending the Amateur Athletic Union National Karate championships to watch his son compete, he noticed bruises on his arm. When he got home he noticed more bruises and petechiae on his legs, and Paige, Ken's wife, was horrified when she saw severe bruises on his back as well as his arms and legs. This happened on the Fourth of July, and the sequence of activities that transpired during the next 3 months is depicted in the figure below. On October 3, testing at FHCRC revealed that the bone marrow transplant had started to produce positive results. Ken continued to recover and recuperate while residing at the Paul Gross Housing unit (Seattle) and anxiously waiting to return to home and family and work.

Ken's health system journey is depicted in the figure below, which shows the front-line clinical units–that is, the smallest group of people who worked directly with Ken at each step of his care, such as the family doctor office, the DHMC hematology inpatient unit, and the bone marrow testing units. These smaller, front-line clinical units can be seen as clinical microsystems. It also shows the larger umbrella organizations, or macrosystems, such as DHMC and FHCRC, that played a part in the care. The Bladyka case study provides a glimpse of the true structure of the health system. But before examining the true structure of the delivery system, it is important to emphasize some facts that arise from the Bladyka case:

1. This could happen to you.
2. This could happen to your family and friends.
3. Ken needs high-quality, safe, and affordable care.
4. Ken found front-line health systems that met his special needs–pockets of gold that were spread across the country.
5. We need a solid-gold system–that is, a high-quality, high-value, high-reliability system–throughout the nation.

Flowchart of Ken Bladyka's Journey Through the Health System

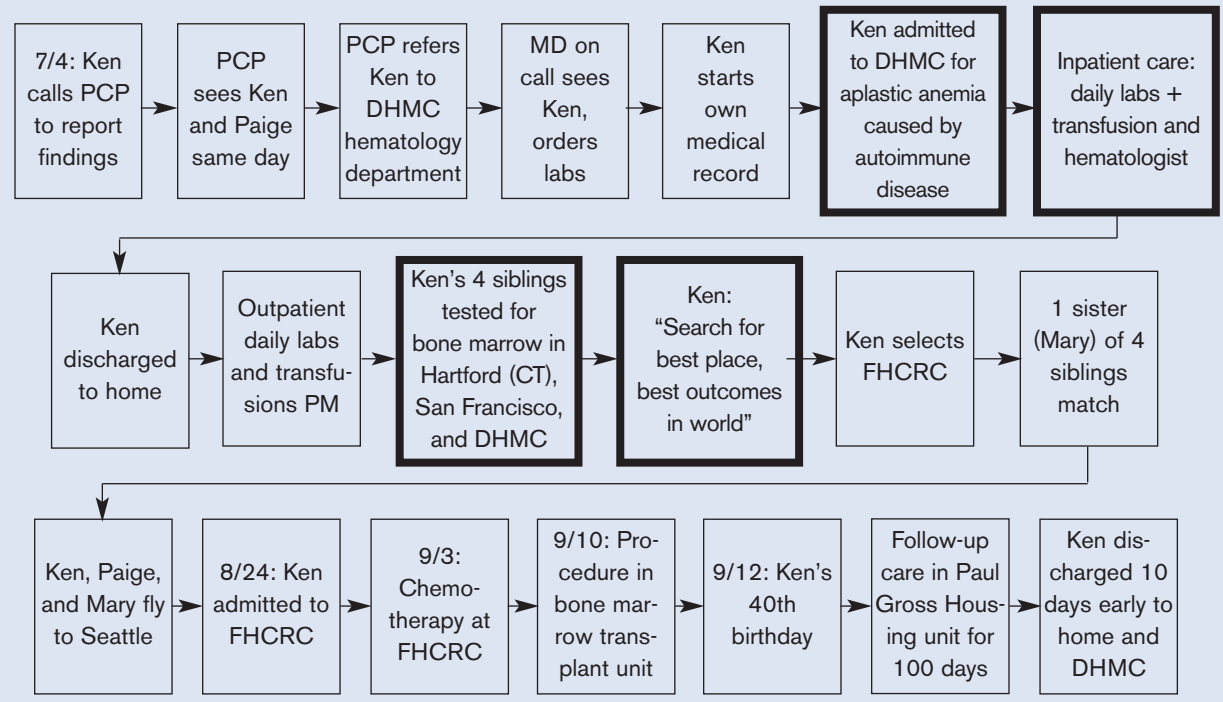

Figure. *Ken Bladyka's health care journey across multiple macrosystems, as represented by the large bolded boxes, is depicted. Within each macrosystem, care was delivered through multiple microsystems; each microsystem is represented by an individual box. PCP, primary care physician; DHMC, Dartmouth-Hitchcock Medical Center; FHCRC, Fred Hutchinson Cancer Research Center.*

to meet health needs. If a person were to explore his or her local health system, he or she would discover myriad clinical microsystems: a family practice, a renal dialysis team, an orthopedic practice, an in vitro fertilization center, a cardiac surgery team, a neonatal intensive care unit, a home health care delivery team, an emergency department, an inpatient maternity unit, and so on.

As described in the Bladyka case, these individual microsystems are tightly or loosely connected with one another and perform better or worse under different operating conditions. Our ability to see them as functional units is challenged by our conventions for compartmentalization and departmentalization—for example, human resources, accounting, and information technology. Our commitment to professional disciplines and specialties as a prime organizing principle often creates barriers that impede the daily work of clinical microsystems.

Another way to describe clinical microsystems is with a high-level diagram that portrays its "anatomy"—the biological-like set of parts that come together to form the microsystem organism (that is, interrelated elements that work together toward a common goal).

Figure 2 (p 477) uses a microsystem framework to illustrate the anatomy of a typical internal medicine practice.[5] This clinical microsystem, like all others, is composed of patients who form different subpopulations (healthy, chronic, high risk). The patients interact with clinicians and support staff, who perform distinct roles—physician, nurse, nurse practitioner, medical assistant, receptionist, and so on. The patients and staff work to meet patients' needs by engaging in direct care processes—accessing systems, assessing needs, diagnosing problems, establishing treatment plans, and following up over time. These direct care processes are assisted by supporting processes that involve distinct tools and resources such as medical records, scheduling, diagnostic tests, medications, and billing. The result of the interaction between patients and staff and clinical and support processes is to produce patterns of critical results—biological outcomes, functional status and risk outcomes, patient perceptions of goodness of care, and cost outcomes that combine to represent the value of care.

The patterns of results also include the elements of practice culture—what it "feels like" to work in the clinical unit, as well as elements of business success such as direct costs, operating revenues, and productivity. Importantly, the clinical unit has a semipermeable boundary that mediates relationships with patients and with many support services and external microsystems. Furthermore, it is embedded in, influences, and is influenced by a larger organization that itself is embedded in a certain environment—a payment environment, a regulatory environment, a cultural-social-political environment. Thus, the simple concept of a clinical microsystem is in fact a complex, adaptive system that evolves over time.

Complex adaptive systems are found in nature and in human groups. They can be contrasted with mechanical systems, which tend to be more predictable and not subject to emergent behavior. Fritof Capra, a noted biologist and author, suggests that a useful way to analyze complex adaptive systems arising in nature is to use a framework that includes structure, process, and patterns.[5,6] Patterns are the consistent behaviors, sentiments, and results that emerge from the relationships of the parts involved in a complex adaptive system.[7]

Previous Research on Microsystems, Organizational Performance, and Quality

The clinical microsystem work described in this article represents an extension of the authors' earlier work on improvement in health care. For example, in 1996 the authors wrote a four-part series on clinical improvement that was published in *The Joint Commission Journal on Quality Improvement*.[8] That series describes concepts and methods for improving the quality and value of care provided for specific subpopulations of patients.

The microsystem work described herein amplifies that earlier work by taking into account the structural units—that is, clinical microsystems—responsible for delivering care to specific patient populations—and the manner in which these microsystems function on the basis of the interplay of patients, providers, processes, and patterns within and between microsystems. The primary emphasis of the former work was on the clinical process that generates outcomes—quality and costs—for patients served by clinical systems. This new body of work retains a strong emphasis on clinical processes and patient-based outcomes but expands the frame to include

- an explicit focus on the local context—that is, the naturally occurring clinical units that form the front line of health care delivery;

The Anatomy of a Clinical Microsystem: A Specific Case Example

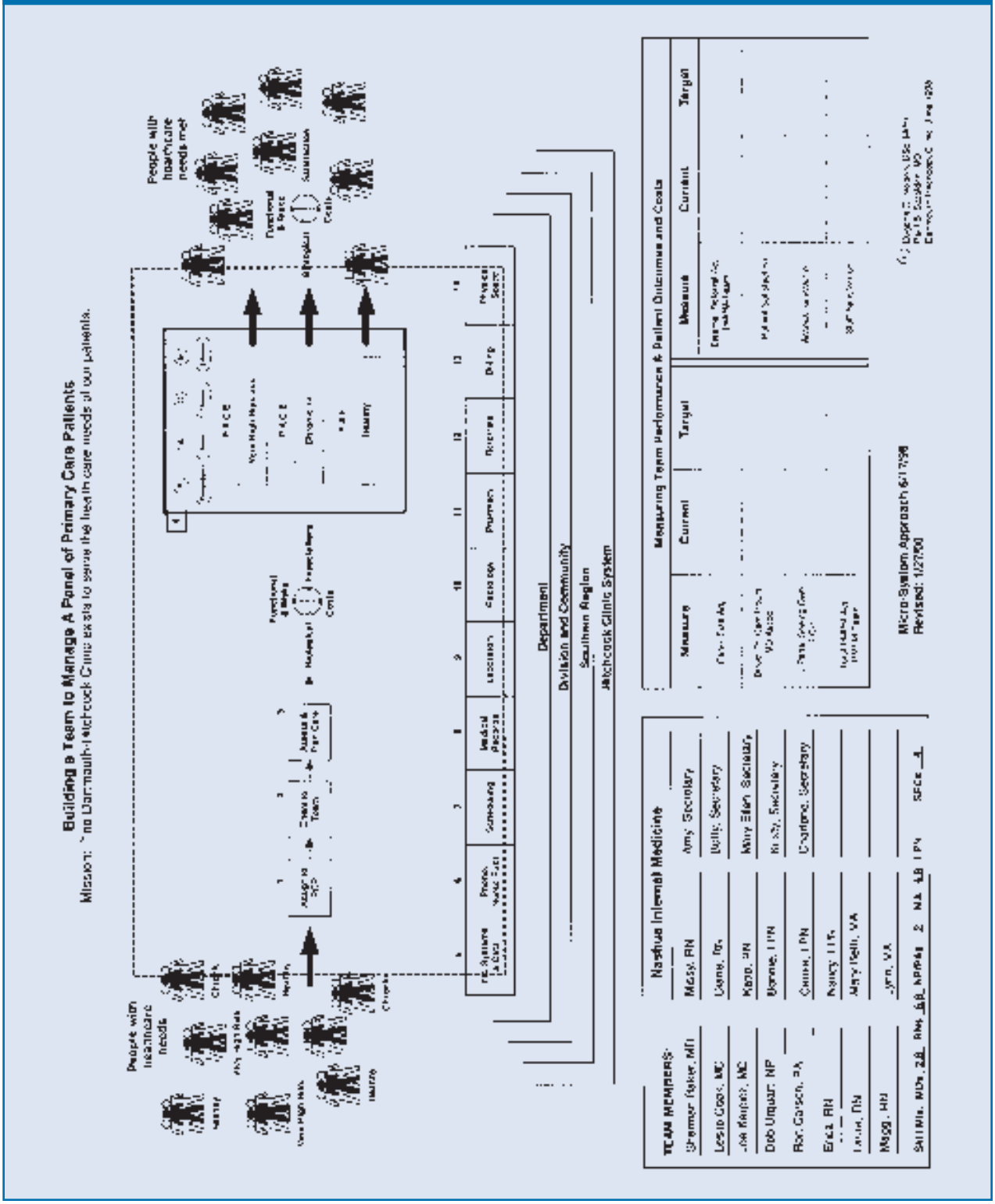

Figure 2. *The clinical microsystem consists of a population of patients with subpopulations. Examples of subpopulations are healthy, chronic, and high-risk patients. The patients interact with people through many processes. The "patterns" are the outcomes of patient care, people working together, and performance of the clinical microsystem.*

- consideration of the information environment that supports/undermines care delivery;
- the interactions among staff within microsystems and the interactions between clinical microsystems that work together to provide comprehensive care; and
- the relationship between clinical microsystems and the larger systems in which they are embedded (for example, the macro-organization and the community).

The research on microsystems described in this article generally builds on ideas developed by Deming, Senge, Wheatley, and others who have applied systems thinking to organizational development, leadership, and improvement.[9–11] The emerging fields of chaos theory, complexity science, and complex adaptive systems have also influenced our thinking.[11–14]

The seminal idea for the microsystem in health care stems from the work of James Brian Quinn that was summarized in his 1992 book, *Intelligent Enterprise*.[15] Quinn's book is based on primary research that he conducted on the world's best-of-best service organizations, such as FedEx, Mary Kay Cosmetics, McDonald's, and Nordstrom. His aim was to determine what these extraordinary organizations were doing to enjoy such explosive growth, high margins, and wonderful reputations with customers. He found that these leading service organizations organized around, and continually engineered, the front-line interface relationship that connected the organization's core competency with the needs of the individual customers. Quinn called this front-line activity the "smallest replicable unit" or the "minimum replicable unit" that embedded the service delivery process. The smallest replicable unit, or the microsystem, idea has critical implications for strategy, information technology, and other key aspects of creating intelligent enterprise. Two excerpts from Quinn's book convey the power and scope of this organizing principle—senior leaders' focus on continually improving the performance of the front-line delivery units:

- *On core strategy:* "Critical to effective system design is conceptualizing the smallest replicable unit and its potential use in strategy as early as possible in the design process."[15(p 109)]
- *On informatics and improvement:* "Through careful work design and iterative learning processes, they both reengineered their processes to use this knowledge and developed databases and feedback systems to capture and update needed information at the micro levels desired."[15(p 105)]

Mohr and Donaldson[16] recently investigated high-performing clinical microsystems. Their research was based on a national search for the highest-quality clinical microsystems. Forty-three clinical units were identified, and leaders of those units participated in in-depth interviews conducted by the authors. The results of the interviews were analyzed to determine the characteristics that seemed to be most responsible for enabling these high-quality microsystems to be successful. The results suggested that eight dimensions were associated with high quality:

- Constancy of purpose;
- Investment in improvement;
- Alignment of role and training for efficiency and staff satisfaction;
- Interdependence of the care team to meet patient needs;
- Integration of information and technology into work flows;
- Ongoing measurement of outcomes;
- Supportiveness of the larger organization; and
- Connection to the community to enhance care delivery and extend influence.

Our study of clinical microsystems builds directly on Mohr and Donaldson's work.

Study of Clinical Microsystems

The aim of our research study, which we conducted from June 2000 through June 2002, was to identify the success characteristics—the principles, processes, and methods—that high-performing clinical microsystems use to provide care that is characterized by both high quality and cost-efficiency. The method was to identify 20 high-performing clinical microsystems from different parts of the care continuum and to study their performance on the basis of site visits, detailed personal interviews, direct observations, and reviews of medical record and financial information. The research was sponsored by the Robert Wood Johnson Foundation and was conducted by a research team based at Dartmouth Medical School's Center for the Evaluative Clinical Sciences.

The research methods are now described in more detail.

Research Design

The research design was an observational study that, for the most part, used qualitative methods such as personal interviews and direct observations, with a limited review of medical records and analysis of financial data. An overview of the research design is provided in Figure 3 (p 480).

Sampling

The objective was to select 20 high-performing clinical microsystems (that is, small groups of people that work together regularly to provide care to discrete subpopulations of patients) that represented different components of the care continuum: primary care, specialty care, inpatient care, nursing home care, and home health care.

First, to begin the process of identifying 20 of the best performers from across North America, we employed five complementary search patterns:

1. *Award winners and measured high performance:* Searched for clinical units that had won national or regional awards and/or had best quality and cost measures in established databases;

2. *Literature citations:* Searched, using resources such as Dow Jones Interactive, LexisNexis, Tablebase, and ProQuest, for clinical units that were prominently mentioned in the professional literature;

3. *Previous research and field experience:* Used the lists of top-performing clinical units from prior research conducted by the Institute of Medicine[16] and used the field experience from the IHI's clinical performance Breakthrough Series on best-known clinical units;

4. *Expert opinion:* Interviewed national health care leaders and quality of care experts to request their nominations for best-performing microsystems in North America; and

5. *Best within best:* Interviewed leaders of exemplary large organizations, such as the Mayo Clinic, Massachusetts General Hospital, Henry Ford Health System, and the Scripps Clinic, and requested nominations for best-performing small clinical units within their enterprises.

Second, we entered the names of the identified clinical units into a table to enable the research team to identify those microsystems that garnered the most mentions across the five different search patterns and to review the strength of each potential clinical unit with respect to exemplary performance (120 sites identified). We then selected the most promising microsystems within each category (primary care, specialty care, inpatient care, nursing home care, and home health care) and invited these sites, using a mailed invitation and personal phone calls, to take part in an interview (75 sites invited).

Third, we conducted structured screening interviews over the telephone with potential sites and asked their leaders to complete a brief questionnaire that gathered further background information on each site and their quality–cost performance (60 sites completed screening interview).

Fourth, we selected the 20 sites on the basis of the results of the screening interview, questionnaire, and willingness to participate.

Data Collection

Data for the project were collected using several different methods. To screen sites for possible inclusion in the study, we used two data collection instruments:

Self-administered microsystem survey. This 15-item survey was mailed to potential sites for self-completion and was used for self-assessment of performance based on key characteristics identified in the IOM study.[16]

Telephone interview. A 30-minute telephone survey was conducted with potential sites on the basis of a semistructured interview guide that was used to gather data on the nature of the microsystem and delivery processes, the quality of care and services, cost-efficiency, and waste reduction.

After sites had been selected for inclusion in the study, 2-day site visits were held from December 2000 through June 2001 to conduct in-depth interviews and provide an opportunity for limited direct observation. We gathered information using these methods:

In-depth interviews. An interview guide was used to conduct detailed, face-to-face interviews with staff in each microsystem. These interviews ranged in length from approximately 20 to 90 minutes, with most interviews lasting either 30 or 60 minutes. Interviews were conducted with a mix of staff within each microsystem, to gain perspective from all types of staff—clinical leader, administrative leader, physicians, nurses, clinical technicians, clinical support staff, and clerical staff. In addition, interviews were

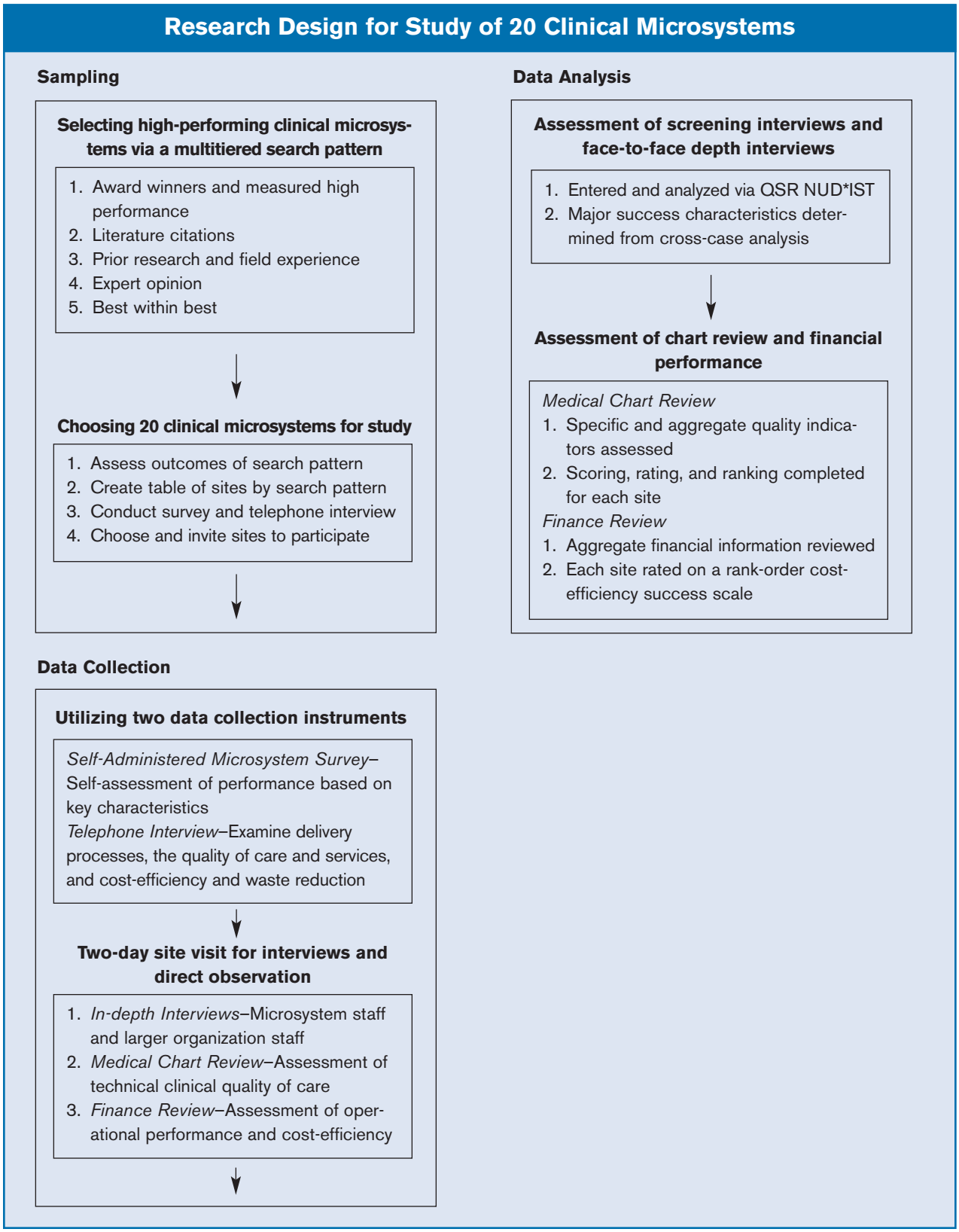

Figure 3. *Twenty high-performing clinical microsystems from different parts of the care continuum were studied on the basis of site visits, detailed personal interviews, direct observations, and reviews of medical record and financial information.*

held with selected staff (for example, senior leader, financial officer, information officer) from the larger organization of which the clinical microsystem was a part.

Medical chart review. A medical record expert who was part of the research team coordinated a limited review of medical records in each of the microsystems. A detailed protocol was used to select the medical records of 100 relevant patients within each clinical microsystem. These patients represented cases involving typical services and medical problems that were commonly treated by the unit. Structured data collection forms were used to gather specific information on the technical quality of care that was provided in each clinical unit.

Finance review. Information related to the financial performance of each microsystem was collected based on available data and reports such as annual reports, quarterly reports, and productivity data reflecting operating revenues, operating costs, waste reduction efforts, and operational efficiency.

For each microsystem site, complete data included the screening survey, screening interview, personal in-depth interviews, and medical and financial records. The interviews were documented by the study's lead field researcher [T.P.H.], using a tape recorder and/or by taking detailed notes. The only data set with partial information related to finance. With some notable exceptions, most of the microsystems studied did not have accurate, detailed information to provide a sound basis for determining actual costs, revenues, and savings accrued over time. Financial information tended to be based on classic accounting system assumptions that focus detailed data collection on individual practitioners and standard departments rather than the microsystem. Consequently, it was not possible to accurately assess each site's financial performance and productivity.

Data Analysis

The verbatim information from the screening interviews and the face-to-face in-depth interviews were transcribed and entered into a content analysis program called QSR NUD*IST (Macarthur, Australia). The interview information was then analyzed, with the assistance of the content analysis software, using the method known as cross-case analysis.[17] This is a standard qualitative research method that involves deconstructing all of the meaningful utterances (interview segments) into individual text units and then placing the text units into affinity groups and reconstructing the information for the purpose of identifying common themes—in this case, major success characteristics. Some text units had content that could be coded into two or more affinity groups, and the classification system that we used provided for a text unit to be classified into one or more categories.

Major success characteristics can be described as the primary factors that these high-performing microsystems appear to share in common and that appear to be associated with high-quality and high-efficiency patterns of performance. Two members of the research team [T.P.H., J.J.M.] independently analyzed all the verbatim content and placed the content into affinity groups (coding categories). Using conventional content analysis methods enables these categories to evolve as case material is processed. Coding results between the two analysts were compared, discrepancies between the two analysts were discussed, and consensus was reached to resolve differences. The data were aggregated within each site to determine what proportion of the coded verbatim text units fell within each of the primary success characteristics.

The screening process was designed to identify high-quality, high-efficiency sites. The subsequent site visits provided strong confirmation that the site selection process was successful at identifying high performers. All 20 sites were exemplary in many ways. Nevertheless, each site was to some extent unique and had its own set of particular strengths and further improvement opportunities with respect to quality and efficiency.

Results of limited medical record reviews and financial analyses were primarily used to help identify which sites might be especially promising for best-of-best processes and methods.

Analysis of the medical charts was based on 100 randomly selected records, which were coded on the basis of a review of five features of care (Figure 4, p 482):

- Problem list,
- Medication list,
- Allergy list,

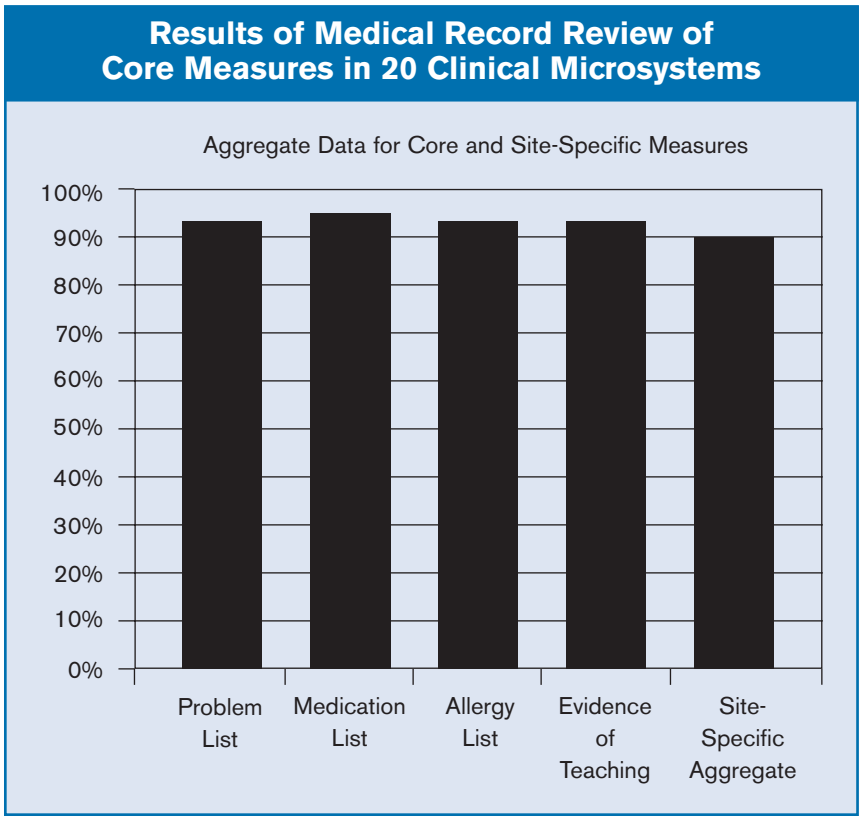

Figure 4. *Based on a review of 100 randomly selected records at each of the 20 sites, 90%–95% of the records showed evidence of the identified features.*

- Evidence of patient teaching, and
- Site-specific clinical measure of process or outcome quality that was relevant for the patient subpopulation treated by the clinical unit (for example, glycosolated hemoglobin level, mortality rate).

After all the data were in, some sites displayed evidence of superior performance across the board. That is to say, internal trend data on technical quality, health outcomes, costs, and revenues, in addition to the results from the site interviews and the medical record review, provided extremely strong evidence of stellar, summa cum laude performance. We used these sites somewhat more heavily to identify best-of-best processes and methods within the set of the 20 high-performing clinical units. We especially relied on several clinical microsystems that had extraordinary results. This select group shared many common methods and processes, even though they were in different regions of the country and had little knowledge of one another. For example, all these units made extensive use of daily interdisciplinary huddles, monthly performance review sessions, over-time data displays, home-grown real-time informatics solutions, and annual all-staff retreats for establishing improvement themes and monitoring performance in mission-critical areas.

Results

High-Performing Sites

The 20 clinical microsystems (Appendix 1, p 492) selected for study represented 16 different U.S. states and Canadian provinces. There were four primary care practices, five medical specialty practices, four inpatient care units, four home health care units, and three nursing home and hospice facilities. Many of the clinical microsystems were parts of larger, well-known systems—for example, the Mayo Clinic, Massachusetts General Hospital, and Intermountain Health Care—whereas some were parts of smaller, lesser-known organizations—for example, Norumbega, ThedaCare, and Intermountain Orthopedics.

The Nine Success Characteristics

Analysis of the results suggests that each clinical unit from the 20 high-performing sites is indeed a complex, dynamic system with interacting elements that come together to produce superior performance. No single feature or success characteristic can stand alone to produce high-quality, high-value systemic results. That being said, a common set of nine success characteristics were shared by these microsystems and interact with one another to produce highly favorable systemic outcomes:

- Leadership of microsystem;
- Culture of microsystem;
- Macro-organizational support of microsystem;
- Patient focus;
- Staff focus;
- Interdependence of care team;
- Information and information technology;
- Process improvement; and
- Performance pattern.

These nine success characteristics fall into four main groups and interact dynamically with one another (Figure 5, right).

In addition to these nine primary characteristics, three additional themes emerged from the content analysis and were frequently mentioned, although not as much as the nine cited above—patient safety, health professional education, and the external environment (for example, financial, regulatory, policy, and market environment) in which the microsystem is embedded.

Content analysis of the interview text showed that seven of the nine success characteristics were mentioned frequently (Table 1, p 484). For example, process improvement methods were mentioned in 13.5% of all text units coded (ATUC), and staff focus was mentioned in 9.4% of ATUC. The remaining two success characteristics—culture (4.3% of ATUC) and organizational support of microsystem (3.2% of ATUC)—were important but less frequently mentioned.

There was substantial variation in the prominence of the nine success characteristics across sites. For example, leadership, which accounted for 7.7% of the coded comments on average, ranged from a high of 13.2% in a nursing home to a low of 3.1% in a home health site. Similarly, staff focus, which accounted for 9.4% of coded comments on average, ranged across sites from a high of 20.9% in a home health unit to 1.6% in a specialty medicine unit. This variation across sites suggests that different clinical units in different contexts serving different types of patients may possess these success characteristics to greater or lesser degrees.

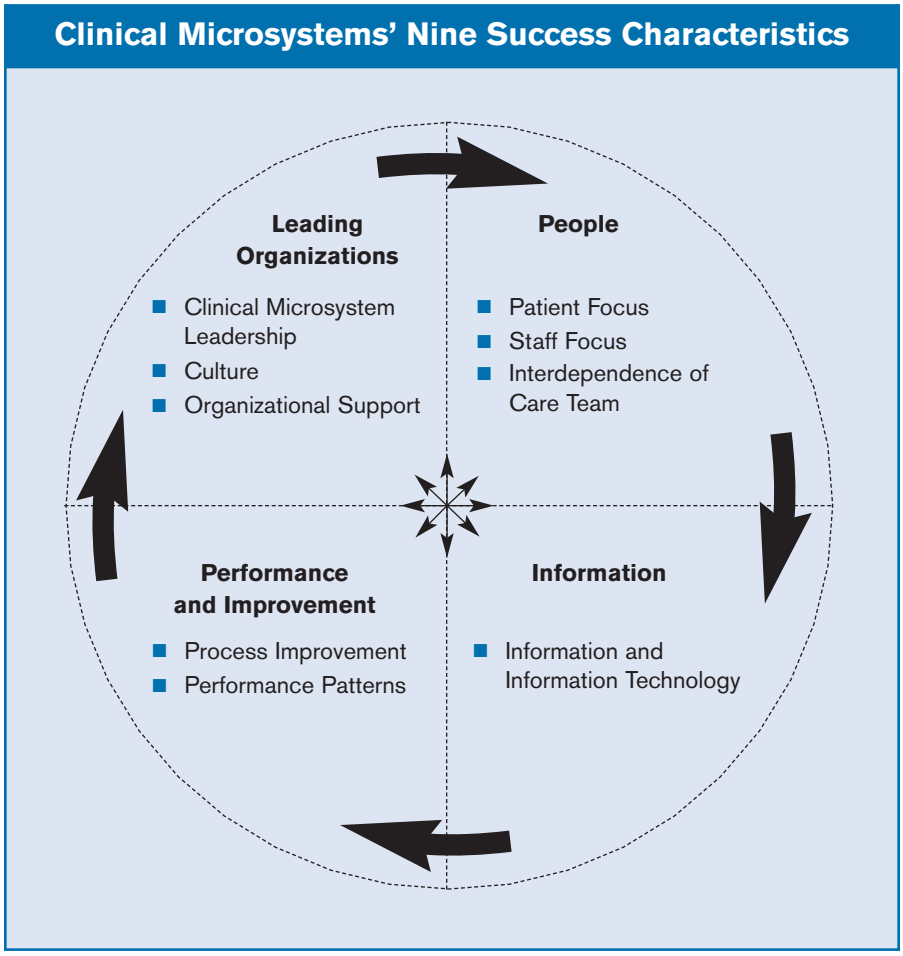

Figure 5. *The nine success characteristics are interdependent and very dynamic. An improvement in one area may affect other characteristics.*

Principles Associated with the Nine Success Characteristics

Each of the nine success characteristics reflects a broad range of features and also reflects underlying principles. Table 2 (pp 485–486) provides more information on the nature of the success characteristics and on illustrative principles that underlie them. For example, patient focus reflects a primary concern with meeting all patient needs—caring, listening, educating, innovating to meet unique needs—and smooth flow of services and can be encapsulated with a simple principle: We are all here for the same reason—the patient.

Specific Examples of the Nine Success Characteristics

The site interviews provide many varied and rich examples of the ways that the nine success characteristics

Table 1. Frequency of Mentions of Coded Text Units (% of All Text Units Coded) into *N* Success Characteristics Across 20 Clinical Microsystems

Code Name	Leadership	Culture	Organizational Support	Patient Focus	Staff Focus	Interdependence of Care Team	Information and Information Technology	Process Improvement	Performance Patterns
Home Health #1	7.8%	2.4%	3.8%	16.7%	9.4%	10.6%	2.8%	21.4%	9.4%
Home Health #2	3.1%	4.1%	1.2%	10.3%	20.9%	4.7%	5.3%	10.8%	10.9%
Home Health #3	5.7%	2.3%	0.5%	6.0%	6.6%	9.8%	7.2%	2.9%	4.2%
Home Health #4	10.8%	4.6%	3.3%	6.5%	4.0%	15.2%	14.5%	14.1%	7.0%
Inpatient Care #1	3.8%	8.4%	0.2%	9.7%	10.0%	3.8%	2.6%	10.4%	8.4%
Inpatient Care #2	9.9%	4.7%	3.6%	9.4%	11.2%	14.1%	15.7%	14.1%	9.2%
Inpatient Care #3	6.9%	4.0%	5.7%	4.0%	10.2%	7.6%	12.1%	12.5%	4.7%
Inpatient Care #4	3.5%	0.8%	2.3%	8.0%	3.7%	10.0%	10.0%	10.8%	11.7%
Nursing Home #1	9.3%	2.7%	6.3%	9.3%	8.7%	6.6%	2.1%	5.1%	13.0%
Nursing Home #2	13.2%	6.4%	1.6%	10.6%	12.5%	10.0%	5.9%	17.1%	9.6%
Nursing Home #3	12.0%	8.7%	9.9%	17.8%	13.1%	11.4%	7.3%	13.4%	11.1%
Primary Care #1	6.8%	9.9%	2.3%	8.2%	16.6%	7.2%	17.3%	19.6%	3.5%
Primary Care #2	4.1%	1.8%	3.5%	4.9%	6.7%	7.5%	7.7%	5.5%	7.7%
Primary Care #3	4.8%	3.4%	1.8%	2.9%	5.5%	2.9%	5.3%	11.9%	6.3%
Primary Care #4	10.2%	4.3%	1.3%	9.2%	16.8%	6.2%	6.6%	13.9%	6.6%
Specialty Care #1	10.9%	2.1%	4.7%	5.5%	5.1%	5.1%	12.4%	7.5%	16.0%
Specialty Care #2	8.0%	6.7%	4.0%	8.0%	8.0%	5.8%	5.2%	23.9%	14.4%
Specialty Care #3	9.7%	3.2%	0.4%	11.0%	9.9%	3.8%	6.5%	16.2%	7.0%
Specialty Care #4	6.3%	2.1%	4.7%	0.5%	1.6%	1.2%	2.8%	19.0%	3.3%
Specialty Care #5	8.0%	3.0%	3.2%	6.2%	7.5%	10.2%	17.7%	20.4%	3.5%
Mean % Overall	**7.7%**	**4.3%**	**3.2%**	**8.2%**	**9.4%**	**7.7%**	**8.3%**	**13.5%**	**8.4%**

manifest themselves in these clinical microsystems. Table 3 (pp 487–489) provides some actual examples from the original interview notes of each of the nine success characteristics. For example, with respect to patient focus, a typical statement follows:

> At first you think you would miss the big cases that you had at a general hospital, and you do at first, but then after a while you realize they were just cases. Here you get to interact with the patient, and the patient is not just a case but instead is a person.

Best Practices: Processes and Methods Associated with High Performance

The study of the high-performing sites generated many best practice ideas (processes and methods) that microsystems use to accomplish their goals. Some of these best practices are contained in *Clinical Microsystem Action Guide*.[18] Although a complete list of all these best practices is beyond the scope of this article, Table 4 (p 490) provides a sampling of them across four major themes. For example, one process used in many sites to ensure that the patient focus was correct was to hold a daily case conference to discuss the status of each patient and to develop an optimal treatment plan that best matched the patient's changing needs.

Discussion

The results showed that the top-performing clinical units were vibrant, vital, dynamic, self-aware, and small-scale clinical enterprises that were led with

Table 2. Scope of Nine Success Characteristics and Illustrative Underlying Principles

Scope of Success Characteristic	Illustrative Underlying Principle
Leadership The role of leadership for the microsystem is to maintain constancy of purpose, establish clear goals and expectations, foster positive culture, and advocate for the microsystem in the larger organization. There may be several types of leaders within the microsystem, including the "formal" leaders, "informal" leaders, and "on the spot" leaders.	The leader balances setting and reaching collective goals with empowering individual autonomy and accountability.
Culture There is a pattern of values, beliefs, sentiments, and norms that reflect clinical mission, quality of staff work life, and respectful patterns of interpersonal relationships.	Shared values, attitudes, and beliefs reflect the clinical mission and support a collaborative and trusting environment.
Organizational Support The larger organization provides recognition, information, and resources to enhance and legitimize the work of the microsystem.	The larger organization looks for ways to connect to and facilitate the work of the microsystem. The larger organization facilitates the coordination and hand-offs between microsystems.
Patient Focus The primary concern is to meet all patient needs–caring; listening; educating; and responding to special requests; innovating against need; providing smooth service flow; and establishing a relationship with community and other resources.	We are all here for the same reason–the patient.
Staff Focus There is selective hiring of the right kind of people, integrating new staff into culture and work roles, and aligning daily work roles with training competencies. Expectations of staff are high regarding performance, continuing education, professional growth, and networking.	There is a "human resource value chain" that links the microsystem's vision with real people on the specifics of hiring, orienting, continuously educating, retaining, and providing incentives for staff.
Interdependence of Care Team The interaction of staff is characterized by trust, collaboration, willingness to help each other, appreciation of complementary roles, and a recognition that all contribute individually to a shared purpose.	A multidisciplinary team provides care. Every staff person is respected for the vital role he or she plays in achieving the mission.
Information and Information Technology Information is key; technology smoothes the linkages between information and patient care by providing access to the rich information environment. Technology can facilitate effective communication, and multiple formal and informal channels are used to keep everyone informed all the time, help everyone listen to everyone's ideas, and ensure that everyone is connected on important topics.	Information is *the* connector–staff to patients, staff to staff, needs with actions to meet needs. The information environment has been designed to support the work of the clinical unit. Everyone gets the right information at the right time to do his or her work.

Continued

Table 2. Scope of Nine Success Characteristics and Illustrative Underlying Principles *(continued)*

Scope of Success Characteristic	Illustrative Underlying Principle
Process Improvement An atmosphere for learning and redesign is supported by the continuous monitoring of care, use of benchmarking, frequent tests of change, and a staff that has been empowered to innovate.	Studying, measuring, and improving care are essential parts of our daily work.
Performance Patterns Performance focuses on patient outcomes, avoidable costs, streamlining delivery, using data feedback, promoting positive competition, and frank discussions about performance.	Outcomes are routinely measured, data is fed back to the microsystem, and changes are made based on the data.

intelligence and staffed by skilled, caring, self-critical staff. Although each clinical unit was extraordinary and unique in many respects, each nevertheless shared nine success characteristics that interact with each other dynamically and over time to produce superior, efficient care and services.

The success characteristics were generally consistent with the preceding IOM study, but there was one important difference—the emergence of leadership as a key success factor at the microsystem level.[1] Careful review of the IOM study findings and discussion with its lead investigator (J.J.M; phone conversation with E.C.N., Nov 2001), however, reveals that leadership was threaded through many of the eight dimensions and was strongly present in the high-performing microsystems that were studied, but the results were classified differently by the investigators.

The results from this study differ from Quinn's *Intelligent Enterprise* findings, which were based on world-class service organizations outside the health care sector. Quinn's senior leaders had a laser-like, strategic, and tactical focus on the smallest replicable units within their organizations.[15] They viewed those units as the microengines that generated quality and value for their customers, as the vital organs that linked customers with the organization's core competency through the actions taken by front-line service providers at what has been called the "sharp end." Given the importance that they placed on these units, they iteratively designed, improved, provided incentives for, monitored, and replicated units throughout the enterprise. In contrast, the senior leaders of the larger delivery systems in which the 20 high-performing health care microsystems were embedded were, for the most part, not focused on supporting excellence in the front-line clinical units. These system leaders showed some recognition of outstanding performance and some degree of special assistance for the unit, but they lacked a strategic focus on creating the conditions to generate excellent performance in all the microsystems that comprised their health system. In short, they did not make the attainment of microsystem excellence a basic pillar of their management strategy.

We briefly summarize some of the most important limitations of this microsystem study.

Reality and reductionism. The reality of clinical microsystems and the health system in which they are embedded is immensely complex. To study it and learn about it, we inevitably must reduce, enormously, the actual reality to a relatively small number of features, dimensions, and interactions. Much is lost in this reduction. By focusing down on "this" we tend to ignore all of "that."

Methods. The case study approach adopted for this study offers the opportunity to gain scope and depth of analysis but also tends to be biased in several ways. For example, the point of view of the investigators will create insights in some areas and cause blind spots in others. Some of the staff interviewed may be inclined to place their organization in a somewhat more favorable light than warranted by actual conditions and may direct the investigators to learn more about its strength than the weaknesses.

Sample. The observations are based on a small sample of just 20 microsystems that were drawn purposefully from a universe of microsystems that numbers in the tens of thousands.

Data. The data used in the study were primarily of the subjective, qualitative variety. Only limited

Table 3. Specific Examples of the Nine Success Characteristics*

Success Characteristic	Specific Examples
Leadership	"Leadership here is fantastic, they outline the picture for us and provide a frame, then hand us the paint brushes to paint the picture" "I have been here for 25 years and it has allowed me to create a system that allows me the freedom to interact and manage the staff like human beings. I get to interact with them as real people and being highly organized allows that flexibility."
Culture	"The work ethic is very strong here. Many years ago the unit became a self-staffing unit. We scheduled ourselves. There is a work ethic. People work very hard. It's one of the cultural things here–and the ownership." "The initial entrance barrier is a bit higher because the culture is stronger here than in some of the other units I work in. So it's a bit harder to break into the unit or to be integrated since they have such a strong team. I feel respected and like I am a valuable member of the team."
Organizational Support	"We are not one of the top priorities so we have been left alone; I think that's been one of the advantages. We have a good reputation, and when we need something we get it. The larger organization is very supportive in that we get what we want, mostly in terms of resources." "One of the things that we do fight for quite often is the ability to create the protocols that fit our unit; the larger organization protocols don't work. We need to tweak them–and so we do."
Patient Focus	"At first you think you would miss the big cases that you had at a general hospital, and you do at first, but then after a while you realize they were just cases. Here you get to interact with the patient, and the patient is not just a case but instead is a person." "I think medicine had really come away from listening to the patient. People can come in here for a heart disease appointment and all of the sudden they will start to cry. You think, okay, let's see what else is going on. I'd like to think our clinical team is real sensitive to that….'My wife left me, I don't see my kids anymore, my job is going down hill.' Jeez and you're feeling tired? I wonder why….Our purpose is to set an example to those who have forgotten about what it means to be in medicine, which is to help people. It's not about what is the most expensive test you can order." "We created the unit for patients first. For instance, when we designed the new [unit], we didn't give up family room space."
Staff Focus	"We have high expectations about skills and how we hire new staff….When we hire new staff we look for interpersonal skills, and a good mesh with values and the mission. We can teach skills but we need [staff] to have the right attitude." "I like molding people into positions…. I would rather take someone with no experience and mold them than take someone who thinks they already know everything. We have a way of doing things here for a reason, because it works, so we want people to work here that can grasp this and be part of the organization." "They allow you here to spread your wings and fly. There are great safety nets as well. You can pursue initiatives. There are always opportunities. They encourage autonomy and responsibility."

Continued

Table 3. Specific Examples of the Nine Success Characteristics* *(continued)*

Success Characteristic	Specific Examples
Interdependence of Care Team	"Together, the team works. When you take any part away, things fall apart. It's really the team that makes this a great place to work." "We decided as a team that our patients needed flu vaccinations, so we all volunteered on a Saturday, opened the practice and had several hundred patients come through. We ended up doing quite a bit more than flu shots including lab work, diabetic foot checks and basic checkups."
Information and Information Technology	"We use face-to-face, e-mail, and telephone. All of us try to get to the five different clinics. We have about 250 people in our staff. I know all of them, and [the executive director] and [the director of disease care] know most of them. It's about staying in touch….And there is good documentation." "We have a system of electronic discharge. The computer is great. The physician anywhere in a satellite clinic has instantaneous access." "We have good information systems on labs, outpatient notes, immunization, pharmacy….For instance, the immunization record here is linked to the state database. So they can get that information directly."
Process Improvement	"It goes back to our processes. When we talk about how we do something in our office, we create a flow sheet. We get out the yellow stickies and we talk about every step in the process. And as a group we come up with this. Then we step back and we look at all this extra work that we make for ourselves, and then we streamline it." "Buried treasure. We are constantly on the lookout for tiny things that will improve care for our patients or our own lives, whether its financial, a system component that needs improvement, or a process change." "I can tell you when I was practicing by myself it was painful at times, to say, 'Here you've got to do this,' and you know we're going to shut down the practice for half a day to get people really up to speed in these principals. But I would say, if you look at industry, they've learned that…you have to do that. The Toyota plant out in Fremont California being one of the more prominent examples. The GM executives asked just exactly that. 'How can you afford to shut down the production line?' and they say, 'Well how can you afford *not* to shut down the production line?' "
Performance Patterns	"It takes a little over a minute for us to turn around an operating room. Since we do the same surgery and we know how many cases there will be in each room, we have shelves with operating packs that after a surgery can be replaced very fast with all the appropriate tools." "We have a very low disposable cost per case of around $17–$18, compared to an average hospital that has $250–$500 for a similar case." "We have the lowest accounts receivable in the entire system. We are very proud of this. What we did was basically look at every category of expense and worked through each detail to get to the most efficient care, for instance, scheduled drugs via the pharmacy. We got the drug to be reduced, and we got to reimburse for radiation treatment (a 68% discount which is at cost from the hospital)."

amounts of objective data were gathered and used in the research.

Analysis. The method of content analysis, although it is a conventional and time-honored research tool, requires classification of the raw data—in this case the text units from the interviews—by the researchers. A different research team analyzing the same raw interview content might arrive at different conclusions.

Time limited. The observations are cross-sectional and time limited. Although the microsystems themselves are likely to be changing in small and large ways over time and although each has its own developmental history and staging, the study "sliced" into the world of each microsystem and "biopsied" its structure, content, processes, outcomes, and patterns at a single point in time.

The methods that were used to learn about clinical microsystems were conventional and useful, but they are clearly imperfect and restricted in diverse, important ways. Much remains to be done to quantitatively validate these findings and to make them predictive for health system and clinical microsystem leaders.

Practical Implications

Before discussing the practical implications of two of the first things that leaders can do to improve the performance of small front-line clinical units, we offer a word of caution. Robert Galvin, the director of Global Health Care for General Electric, wrote this in a recent editorial:

> But there is a reason to be cautious. New ideas in health care have a tendency to oversimplify and overpromise. Whether it be managed care, continuous quality improvement, or defined contribution, proponents seem to subscribe to the "domino theory" of health policy: that is, if only this one new idea could be applied appropriately, the great stack of complicated issues in health care would fall into place one by one.[19(p 57)]

As discussed at the outset of this article, the health system is immense, complex, and able to deliver delightful and dreadful care. Change is subject to a linked chain of effect that connects individual patients, communities, and clinicians with small, naturally occurring front-line units, with countless large and small host organizations, all of which exist in a modulating policy, legal, social, financial, and regulatory environment. Oversimplification of the health system is as common as it is foolhardy.

Yet with this caution in mind, we believe that the critical role of these naturally occurring small clinical units, which represent a vital link in the chain of effect, has been largely ignored. For the most part, fundamental changes in the health system have been directed elsewhere—at clinicians, consumers, purchasers, large managed care organizations, reimbursement policymakers, and so on—and have, for the most part, ignored targeting the essential building blocks of the system.

The domino effect cannot ripple through the system if some of the dominoes are absent. Clinical microsystem thinking has been absent in health system reform. Once again we are reminded of Quinn's observation, "Critical to effective system design is conceptualizing the smallest replicable unit and its potential use in strategy as early as possible in the design process."[15(p 109)]

Practical Early Step 1: Build Self-Awareness by Doing Self-Assessments Within Individual Microsystems

The path to improvement often begins with awareness of the need for change.[20] This awareness can be fostered by using a simple method to take stock of the current reality. Based on our microsystem, we have developed a brief self-assessment survey that staff within clinical microsystems can use to evaluate their level of development on each of the nine success characteristics cited above.[13] (See Appendix 2, p 493, for a copy of the survey.) The survey builds on a self-assessment tool developed by one of the authors [J.J.M.] and has been used by many small clinical units in North America and Europe. Some suggested steps for this survey's use are now provided.

1. Introduce the clinical microsystem idea to staff.

2. Ask all staff in the microsystem, or at least representatives from each staff role, to complete the survey. For example, clinicians, nurses, medical assistants, technicians, paraprofessionals, clerical staff, and managers should all complete the survey (consider anonymity) and write down additional comments that are relevant. Consider asking others who may not be "inside staff" of the microsystem but who know it well (for example, patients, family members, referral sources, and discharge sources) to evaluate and comment on the microsystem.

3. Collate and summarize the survey results. Higher scores on each dimension indicate stronger performance. Note the dispersion of ratings within

Table 4. Illustrative Best Practices Used by High-Performing Clinical Microsystems*

Best Practice Category	Description of Best Practice
Leading Organizations	■ Annual retreat to promote mission, vision, planning, and deployment throughout microsystem ■ Open door policy by leaders of microsystem ■ Shared leadership within microsystem (eg, physician, nurse, manager) ■ Use of storytelling to highlight improvements needed and improvements made ■ Promotion of culture to value reflective practice and learning ■ Intentional discussions related to mission, vision, and values
People	■ Daily huddles to enhance communication among staff ■ Daily case conferences to focus on patient status and treatment plans ■ Monthly all staff ("town hall") meetings ■ Continuing education "designed into" staff plans for professional growth ■ Screening of potential hires for attitude, values, and skill alignment ■ Training and orientation of new staff designed into work of microsystem
Information and Information Technology	■ Tracking data over time at microsystem level ■ Use of "feed forward" data to match care plan with changing patient needs ■ Information systems linked to care processes ■ Inclusion of IT staff on microsystem team
Performance and Improvement	■ Use of benchmarking information on processes and outcomes ■ Use of "data walls" and display of key measures for staff to view and use to assess microsystem performance ■ Extensive use of protocols and guidelines for core processes ■ Encouragement of innovative thinking and tests of change

** IT, information technology.*

each dimension. Do all staff and "raters" tend to agree or disagree about the performance level of each of the nine characteristics? Which characteristics exhibit the most and least variation?

4. Identify the microsystem's areas of strength and developmental opportunities. List the ideas and themes most frequently mentioned in open-ended comments.

5. Discuss the results with microsystem staff. Use the findings to guide selection of aspects of the clinical unit that appear to be top priorities for recognition and those that appear to be critical for improvement. Develop a plan for change based on these results.

The steps listed above are provided as a general guide and should be modified to fit local conditions.

Practical Early Step 2: Leaders Take Action to "Grow" Microsystems' Capacity for Improvement

On the basis of this study and on our extensive experience with small and large health systems, we offer five suggestions for action for health system leaders.

1. Achieve superior microsystem results. Focus on improving the level of microsystem performance to achieve superior enterprisewide results—emphasize achieving essential outcomes at the individual microsystem level and smoothly linking together related microsystems to effectively and efficiently meet patient, community, and business needs.

2. Use simple rules with linked metrics. Provide a few simple rules to evaluate the success of microsystems (for example, accessible, patient centered, seamless, lean) and provide regular, data-based performance feedback at the microsystem level to gauge the level of performance.

3. Integrate information. Design an information environment, with appropriate technology, to support the work of each microsystem to provide needed high-quality, cost-effective care to patients and to make perfect hand-offs between microsystems to give seamless,

coordinated, well-rounded care that meets the changing needs of patients.

4. Communicate mission. Create a clear and compelling sense of organizational purpose and structure to promote, recognize, and reward high performance in microsystems, sound linkages across microsystems, and innovation in all parts of the enterprise to achieve the mission. Recognize the ways in which the culture of the setting encourages high performance and ways in which the prevailing culture may need to be enriched.

5. Decentralize accountability. To the greatest practical degree, push decision making, process ownership, and accountability out to the microsystems; provide "centralized" support services only in areas that microsystems cannot manage better and more efficiently within their own individual boundaries. As this is done, it will be important to be very clear about organizational support for the work and performance improvement of the microsystem.

An overarching suggestion for senior leaders is to recognize the fundamental nature and power of using microsystem-based approaches for strategic thinking, operating excellence, and deployment of change and innovation.[21] Using this framework to design care for defined patient populations will include building the finely tuned care processes, linking them, making them safe and reliable, and removing costs while adding quality. Moreover, it will incorporate shared purpose, cooperative leadership, performance goals derived from purpose, and mutual accountability for reaching goals and outcomes aligned with purpose.[22]

We hope that the remaining articles in this series on clinical microsystems will provide practical ideas and tools that readers can use to

- plan individual patient care and efficient services;
- create rich information environments; and
- promote the strategic spread of high-performing clinical microsystems that excel at meeting patients' needs and are stimulating work environments.

Conclusion

Clinical microsystems are the smallest replicable units in the health system. Health system redesign can succeed only with leaders who take action to transform these small clinical units to optimize performance to meet and exceed patient needs and expectations and to perfect the linkages between the units. A seamless, patient-centered, high-quality, safe, and efficient health system cannot be realized without this transformation of the essential building blocks that combine to form the care continuum. J

References

1. Institute of Medicine Committee on Quality in Health Care in America: *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC: National Academy Press, 2001.
2. Nelson EC, et al: Using data to improve medical practice by measuring processes and outcomes of care. *Jt Comm J Qual Improv* 26:667–685, 2000.
3. Kabcenell A, Roessner J: Pursuing Perfection: An interview with Don Berwick and Michael Rothman. *Jt Comm J Qual Improv* 28: 268–278, 2002.
4. Berwick DM: Every Single One (keynote plenary address presented at the Institute for Healthcare Improvement's 13th Annual National Forum). Orlando, FL, Dec 11, 2001.
5. Nelson EC, et al: Building a quality future. *Front Health Serv Manage* 15(1):3–32, 1998.
6. Capra F: *The Web of Life: A New Scientific Understanding of Living Systems*. New York: Anchor Books, 1996.
7. Zimmerman B, Lindberg C, Plsek P: *Edgeware: Insights from Complexity Science for Health Care Leaders*. Irving, TX: VHA, Inc, 1998.
8. Nelson EC, et al: Improving health care, Part 1: The Clinical Value Compass. *Jt Comm J Qual Improv* 22:243–258, 1996.
9. Deming WE: *Out of the Crisis*. Cambridge, MA: MIT, Center for Advanced Engineering Study, 1989.
10. Senge PM: *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Doubleday, 1990.
11. Wheatley MJ: *Leadership and the New Science: Learning About Organization from an Orderly Universe*. San Francisco: Berrett-Koehler, 1992.
12. Arrow H, McGrath JE, Berdahl JL: *Small Groups as Complex Systems*. Thousand Oaks, CA: Sage Publications, 2000.
13. Kelly K: *Out of Control: The Rise of Neo-Biological Civilization*. Reading, MA: Addison-Wesley, 1994.
14. Peters T: *Thriving on Chaos: Handbook for a Management Revolution*. New York: Harper & Row, 1987.
15. Quinn JB: *Intelligent Enterprise: A Knowledge and Service Based Paradigm for Industry*. New York: The Free Press, 1992.
16. Donaldson MS, Mohr JJ: Exploring Innovation and Quality Improvement in Health Care Microsystems: A Cross-Case Analysis. A technical report for the Institute of Medicine Committee on the Quality of Health Care in America. Washington, DC: Institute of Medicine, 2000.
17. Miles MB, Huberman AM: *An Expanded Sourcebook: Qualitative Data Analysis*. Thousand Oaks, CA: Sage Publications, 1994.
18. Godfrey MM, et al: *Clinical Microsystem Action Guide*. Hanover, NH: Dartmouth Medical School, Jan 2002.
19. Galvin RS: The business case for quality. *Health Aff (Millwood)* 20:57–58, 2001.
20. Kotter JP: *Leading Change*. Boston: Harvard Business School Press, 1996.
21. Weinstein JN, et al: Designing an ambulatory clinical practice for outcomes improvement: From vision to reality—The Spine Center at Dartmouth-Hitchcock, year one. *Qual Manag Health Care* 8(2):1–20, 2000.
22. Batalden PB, et al: Continually improving the health and value of healthcare for a population of patients: The panel management process. *Qual Manag Healthcare* 5(3):41–51, 1997.

Appendix 1. The 20 Sites Included in the Clinical Microsystem Study

Name of Microsystem	Location	Name of Macrosystem
Home Health Care		
Gentiva Rehab Without Walls	Lansing, MI	Gentiva Health Services
Interim Pediatrics	Pittsburgh	Interim HealthCare of Pittsburgh
On Lok SeniorHealth Rose Team	San Francisco	On Lok SeniorHealth
Visiting Nurse Service of New York, Home Care, Congregate Care Program Queens Team 11	New York	Visiting Nursing Service of New York
Inpatient Care		
Henry Ford Neonatal Intensive Care Unit	Detroit	Henry Ford Hospital, Henry Ford Health System
Intermountain Shock/Trauma/ Respiratory Intensive Care Unit	Salt Lake City	Latter-day Saints Hospital, Intermountain Health Care
Center for Orthopedic Oncology and Musculoskeletal Research	Washington, DC	Washington Cancer Institute, Washington Hospital Center, MedStar Health
Shouldice Hernia Repair Centre	Thornhill, Ontario, Canada	Shouldice Hospital
Nursing Home Care		
Bon Secours Wound Care Team	St Petersburg, FL	Bon Secours Maria Manor Nursing and Rehabilitation Center
Hospice of North Iowa	Mason City, IA	Mercy Medical Center North Iowa, Mercy Health Network
Iowa Veterans Home, M4C Team	Marshalltown, IA	Iowa Veterans Home, Veterans Commission
Primary Care		
Grace Hill Community Health Center	St Louis	Grace Hill Neighborhood Health Centers, Inc.
Massachusetts General Hospital Downtown Associates Primary Care	Boston	Massachusetts General Hospital, Partners Healthcare
Norumbega Evergreen Woods Office	Bangor, ME	Norumbega Medical, Eastern Maine Healthcare
ThedaCare Kimberly Office Family Medicine	Kimberly, WI	ThedaCare Physicians
Specialty Care		
Dartmouth-Hitchcock Spine Center	Hanover, NH	Dartmouth-Hitchcock Medical Center
Midelfort Behavioral Health	Eau Claire, WI	Midelfort Clinic at Luther Campus, Mayo Health System
Orthopedic Specialty Practice	Boise, ID	Intermountain Orthopedics
Overlook Emergency Department	Summit, NJ	Overlook Hospital, Atlantic Health System
Sharp Diabetes Self Management Training Center	La Mesa, CA	Grossmont Hospital, Sharp HealthCare

Appendix 2. Clinical Microsystem Assessment Tool

Clinical Microsystem Assessment Tool

Instructions: Each of the following characteristics (e.g., leadership) is followed by a series of descriptions. For each characteristic, please circle the description that best describes your current microsystem and delivery of care OR a microsystem you are MOST familiar with.

Characteristic	Descriptions			
Leadership	❑ The leadership here is more bureaucratic – telling everyone how to do their job and leaving little room for innovation and autonomy	❑ Leaders here struggle to find the right balance between reaching performance goals with empowering individuals and the microsystem	❑ The leadership of this microsystem clearly drives our success by clarifying our mission and vision and by empowering the clinical microsystem to take action.	❑ Can't Rate
Culture	❑ The culture here isn't supportive of learning at the individual level or at the microsystem level	❑ We have been talking about changing the culture, but we don't have any specific strategies for accomplishing cultural change.	❑ Our microsystem has shared values and beliefs that reflect our clinical mission and support a collaborative team context	❑ Can't Rate
Organizational Support	❑ We get very little support from the larger organization. In fact, we have been asking for "X" and they have not responded for quite some time.	❑ Getting help from the larger organization has been a mixed bag; sometimes we get what we ask for but sometimes we don't.	❑ The larger organization makes it easier for us to meet the needs of our patients and to work together as a team	❑ Can't Rate
Patient Focus	❑ Generic patient education materials are available to all patients.	❑ Standard med information is offered to all patients based on the diagnosis	❑ We offer comprehensive information to address patients' different learning styles. The information is customized to meet the patients' needs	❑ Can't Rate
Staff Focus	❑ Our turnover rate is a serious problem that we haven't found a way to improve	❑ We are making progress toward reducing staff turnover and increasing staff satisfaction	❑ We are very selective about hiring new people and integrating new hires into the culture. Developing the people who work here is important to our success	❑ Can't Rate
Interdependence of the Care Team	❑ Each person works solo and is responsible for their piece of work. There is unclear way of sharing information or communicating	❑ The care approach is multidisciplinary and we meet weekly to discuss topics, but we don't work together as a team on a daily basis.	❑ Care provided by a multidisciplinary team. Information is key to the relationship and there are clear ways to communicate.	❑ Can't Rate
Information and Information Technology	❑ I am always tracking down the information I need to do my work	❑ Most times I have the information I need, but other times, crucial information is missing and I have to go track it down	❑ I get the information at the right time to do my work. Structures and processes are in place to enhance staff-to-staff interaction and communication.	❑ Can't Rate
Process Improvement	❑ The training and resources are not available for working on improvement.	❑ The resources (training, $$, time) are available for working on improvement – and we occasionally use them	❑ Studying, measuring and improving care is an essential part of our daily work. Furthermore, the resources are available to support improvement work.	❑ Can't Rate
Performance Patterns	❑ We don't track results of the care we provide on a regular basis.	❑ We systematically collect data on the results of the care we provide	❑ Outcomes (financial, satisfaction, clinical process, technical, safety) are routinely measured. We feed data back to providers, and make changes based on data	❑ Can't Rate