Systems-Based Practice: Improving the Safety and Quality of Patient Care by Recognizing and Improving the Systems in Which We Work

Julie K. Johnson, MSPH, PhD; Stephen H. Miller, MD, MPH; Sheldon D. Horowitz, MD

Abstract

As the complexity of health care delivery has increased, it has become essential for physicians to understand how individual practices relate to the larger system of care.[1] It is within this context that the Accreditation Council for Graduate Medical Education (ACGME) and the American Board of Medical Specialties (ABMS) identified systems-based practice (SBP) as one of the six core competencies in which physicians must be proficient to deliver patient care that is safe and high in quality. SBP is challenging to define, incorporate into training and practice, and evaluate. Competency in SBP requires that physicians understand how patient care relates to the health care system as a whole and how to use the system to improve the quality and safety of patient care. Systems thinking is the cornerstone of SBP. Fostering the ability to recognize the contribution of the system is important for medical students, residents, and practicing physicians. However, current efforts in medical education focus on mastering knowledge of disease, diagnostic skills, and treatment at the level of the physician-patient interaction. As a result, there is a preoccupation with system components, while the system as a whole and its effect on the quality and safety of care remain invisible. To clarify the definition of SBP and to develop effective strategies for teaching and assessing SBP, it is necessary to provide a broad awareness of systems within a context of systems thinking. Patient safety is a good entry point into SBP because the concepts of safety, errors, and harm all place the individual, whether patient or provider, within the framework of a system.

Background and Rationale

The Accreditation Council for Graduate Medical Education (ACGME) and the American Board of Medical Specialties (ABMS) identified six core competencies required of residents and physicians to deliver high quality medical care—patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice. Of these six, systems-based practice is one of the most challenging to define, incorporate into training and practice, and evaluate.

Systems-based practice can be thought of as an analytic tool, as well as a way of viewing the world, both of which can make caregiving and change efforts more successful. The focus is on understanding the interdependencies of a system or series of systems and the changes identified

to improve care that can be made and measured in the system. The metaphors “a village” and “a mirror” have been used to illustrate and differentiate the concepts of systems-based practice (SBP) and practice-based learning and improvement (PBLI). “SBP is like a village. A physician must work with a community of providers to deliver optimal patient care.”[2] This is contrasted with the core competency of PBLI, where the metaphor is “a mirror.” “PBLI is like holding up a mirror to ourselves to document, assess, and improve our practice.”[2]

In clinical settings, we can operationalize these concepts by asking two separate but related questions:

1. The PBLI question: “How can I improve the care for my patients?”
2. The SBP question: “How can I improve the system of care?”

Since the landmark Institute of Medicine (IOM) report focused national attention on patient safety, it has been generally agreed that the systems we work within are at the root of many of our patient safety problems.[3] Safety is a property of systems. Many of our patient safety initiatives belong to the system. Furthermore, certain patient safety issues are especially relevant to system solutions. These include the World Health Organization’s list of “High 5” patient safety initiatives—managing concentrated injectable medicines, assuring medication accuracy at transitions in care, communicating during patient handovers, improving hand hygiene to prevent infections associated with health care, and performing correct procedures at correct body sites[4]—and The Joint Commission’s patient safety goals, which are updated yearly.[5]

Although an understanding of systems is essential to improve the quality and safety of patient care, training in SBP falls outside the scope of traditional training. As result, undergraduate medical institutions, residency programs, specialty boards, and societies may have difficulty effectively teaching and evaluating SBP. In addition, although SBP is required by the ACGME as one of the core competencies that residents must demonstrate, there is a lack of literature about how to integrate the theory of systems and systems thinking into medical education.

The common program requirements for SBP, as approved by the ACGME in February 2007,[6] are outlined as follows: Residents must demonstrate an awareness of and responsiveness to the larger context and system of health care, as well as the ability to call effectively on other resources in the system to provide optimal health care. Residents are expected to:

- Work effectively in various health care delivery settings and systems relevant to their clinical specialty.
- Coordinate patient care within the health care system relevant to their clinical specialty.
- Incorporate considerations of cost awareness and risk-benefit analysis in patient and/or population-based care as appropriate.
- Advocate for quality patient care and optimal patient care systems.
- Work in interprofessional teams to enhance patient safety and improve patient care quality.
- Participate in identifying system errors and implementing potential systems solutions.

The aim of this paper is to further refine the definition of SBP by providing a broad awareness of systems within a context of systems thinking and to highlight the importance of teaching SBP as part of any program focused on improving the quality and safety of care.

Definition of a System

Implementing and evaluating SBP in a medical context requires a broader understanding of what constitutes a "system," coupled with an understanding of systems thinking. Bertalanffy, the founder of the scientific, mathematical "Theory of Systems," defined a system as a set of interacting, interrelated, or interdependent elements that work together in a particular environment to perform the functions that are required to achieve the system's aim.[7] The importance of understanding systems as interrelated parts of a whole cannot be overstated. Systems can be continually improved, but one must consider how its products are created, why they are created, and how they can be improved. Comprehending the assembly of the system as a whole can inform the work of those who are trying to create successful, interdependent systems.[8] Learning to see interrelationships, rather than linear cause-and-effect chains, and grasping the phenomenon of change as a process, rather than as a snapshot, are essential for understanding systems.[9]

Systems have certain rules (or principles) that help us predict how they will behave:[10, 11]

- The whole has one or more defining functions.
- Each part can affect the behavior or properties of the whole.
- Each part is necessary but alone is insufficient to carry out the defining function of the whole.
- Behavior and properties of one part of the system depend on the behavior and properties of at least one other part of the system.

Systems thinking is the cornerstone of how "learning organizations" think about their world.[9] Learning organizations are those that measure outcomes and strive for improvement. Many fields outside health care—including education, telecommunications, and aviation—use systems theory to better serve their clients, understand applicable research, improve outcomes, and ensure quality and safety. Recognizing feedback from the system and using that feedback for design and redesign of services is an inherent element of systems thinking.

Competence in SBP necessitates that physicians understand how patient care and other practices relate to the health care system as a whole and how to use the system to improve patient outcomes, safety, and quality. SBP is care that is sensitive to the context in which it is delivered. Fostering the ability to recognize the contribution of the system is important for medical students, residents, and practicing physicians because care is never delivered in a vacuum—there is always a powerful context.

However, current efforts in medical education focus on mastering knowledge of disease, diagnostic skills, and treatment at the level of the physician-patient interaction, resulting in preoccupation with system elements, while the system as a whole and its effect on patients remains invisible. The context is what has been minimized as educators try to standardize the experience for trainees. Systems thinking and the application of systems thinking through SBP provide an opportunity to look at the context.

> *"The systems we work in often can be difficult to identify and define. Although we work in numerous systems all day, every day, it's difficult to 'see' a system. It's like asking fish to describe water—it's easier to be aware of the system when the system fails" (P. Batalden, personal communication, 2005).*

Health care is composed of a large set of systems—e.g., ambulatory care centers, physician office practices, inpatient hospital units, home health care, laboratories, and pharmacies—all interacting with one another. Each of these systems is connected via individuals and teams, regulations and rules, and technology.[12] Understanding how one functions within the system as a whole, and how one's actions affect all other aspects of the system, is the key to unlocking an effective SBP strategy.

The concept of systems, in general, often brings up images of "well-oiled machines." However, health care systems are often cumbersome, unwieldy, unfriendly, and opaque to their users—patients, physicians, nurses, and staff. Health care systems are best described as complex adaptive systems. As such, they are a collection of individuals who are free to act in ways that are not totally predictable. The organizational boundaries are "fuzzy" in that membership changes and providers can simultaneously be members of other systems. Furthermore, given the complexity of these systems, the actions of individuals are interconnected so that the actions of one changes the context for all the others.[13, 14]

One organizational construct that operationalizes the concept of a complex adaptive system is the clinical microsystem, which can be defined as a group of clinicians and staff working together with a shared clinical purpose to provide health care for a population of patients.[15, 16, 17] The clinical purpose and its setting define the essential components of the microsystem. These include the clinicians and support staff, information and technology, the specific care processes, and the behaviors required to provide care to its patients.

Microsystems evolve over time, responding to the needs of their patients, providers, and external pressures. They coexist with other microsystems within a larger (macro) organization. A health care organization is composed of multiple microsystems. Examples include a cardiovascular surgical care team, a community-based outpatient care center, and a neonatal intensive care unit. All of these have common core elements: a focused type of care, clinicians and staff with the skills and training needed to engage in the required care processes, a defined patient population, and a certain level of information and technology to support their work. What often differs across microsystems is the ability of individual caregivers to recognize their efforts as part of a microsystem, as well as the microsystem's level of functioning.

The microsystem construct makes explicit the caregiving system, yet builds on systems theory by recognizing that "important systems" characteristics include the system-environment boundary, input, output, process, goal-directedness, and interaction of the elements of the system."[7] In its "Crossing the Quality Chasm" report, the IOM identified multiple layers of the health care system that influence the ability to improve care: the experience of patients; the functioning of the microsystem; the functioning of the organizations that house or otherwise support microsystems; and the environment (e.g., policy, payment, and regulation), which shapes the behavior, interests, and opportunities of the organizations.[18] Efforts at each of the different levels

of the health care system and the interactions among them can influence the ability to achieve patient safety and quality of care objectives.

Systems and Outcomes

In addition to understanding what a system is, it is important to recognize how systems can contribute to or undermine outcomes, such as quality and safety of care. Patient safety is a good entry point into SBP because the concepts of safety, errors, and harm all place the individual, whether patient or provider, within a system. It is generally understood that patient safety is a systems issue and that interventions to improve patient safety should be made at the system level.[3] High-risk industries—such as chemical manufacturing, nuclear power, aviation, and defense—have developed well-defined systems that have resulted in improved safety. Similarly, the health care industry is complex and high risk, and clinical outcomes can be profoundly affected by lapses in the system or misunderstanding of how the system operates, both within the sphere of practice and across the continuum of care.

For several years, the health care industry has had a growing recognition of the important relationship between safety and well-functioning health care systems. In 1999, the IOM's Committee on Quality of Health Care in America published the report, *To Err is Human: Building a Safer Health System*, which included several recommendations to health care providers regarding patient safety in health systems.[3] The committee noted that the "most important barrier to improving patient safety is lack of awareness of the extent to which errors occur daily in all health care settings and organizations." Individuals in an organization must feel empowered to report errors, while organization leaders must implement ways to discover errors and make process improvements to reduce error. Part of the solution is to ensure that providers have the tools to address system issues.

> *"Every process is a system. Simple systems are individual processes; complex systems may be hundreds, thousands of processes. Processes are inherently hierarchical – you can drill down into each process, into each step of each process. Finally you hit the level at which people make decisions. This drives where you link outcomes measurement and the data system. Outcomes, like processes, are hierarchical. Managers tend to go high up on the outcomes chain, but we need to drill down to the decision level. Goals need to be set around front line decision making – then roll them up to senior leaders and the Board." – B. James, MD, Intermountain Health Care.* (*Personal communication, 2005*).

Recognizing that one works within a system and understanding how that system functions are only the beginning. Physicians and other health care providers must be empowered to change aspects of the system they recognize as failed. Often, well-meaning providers are not sure how to effectively design and test cycles of change; they lack the authority or power, and they lack the time. As regulatory agencies continue to set goals [e.g., Health Plan Employer and Data Information Set (HEDIS®) measures for comprehensive diabetes care, the Joint Commission standards for accreditation] that affect the organization, there is a need to understand the underlying processes and systems at work at the local level, where patients and providers meet at the "sharp end" of health care.

Systems-Based Practice Across the Continuum of Medical Education

As educators begin to include SBP in their curricula, it is important that they have a common understanding of what SBP means, how it should be incorporated throughout the educational continuum, and how it can best be evaluated. Work is needed across the continuum of medical education—from medical school curricula for the student learner to opportunities for life-long learning for the practicing physician.

> *"In 1935, Lawrence Henderson wrote about the Henderson Hasselbach equation. He also wrote that patients and doctors are part of the same system. Students are required to learn the equation, but not about his observation about systems." – P. Batalden, MD, Dartmouth Medical School.*[15]

Systems-based practice is the deeply fundamental link as we seek to prepare physician learners for participating in and improving systems of care. SBP unlocks insight into the dynamics of the change that is necessary.

The ACGME states that competency in SBP is "manifested by actions that demonstrate an awareness of and responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide care that is of optimal value."[19] Compared to medical schools, residency programs have been the most active in developing and assessing SBP curricula. However, similar to most undergraduate medical education programs, residency programs often lack a clear definition of SBP, as well as a consistent and reliable means of assessment. Progress is being made on this front, and the ACGME solicits current efforts through annual conferences, which are then disseminated via the Council's Web site and through their publications.[19, 20] Without a common understanding of SBP and consistent methods of evaluating competency in SBP, educators cannot hope to effectively incorporate SBP into the daily work of patient care.

Many programs train residents in SBP through brief seminars, courses, or field trips to managed care organizations. There does not seem to be a concentrated effort to integrate SBP into residents' clinical training, although systems issues are prevalent in academic inpatient settings.

Residents work in the system everyday, but systems-based practice requires cross-disciplinary conversations that are often overlooked by today's busy residents. Furthermore, residents don't feel empowered to address the system symptoms because they lack the tools and required skills to change daily practice. This is manifested as a "workaround." As residents are immersed in the system in which they are trainees, they become experts at finding ways to work around the most problematic system issues. A workaround, which is jargon taken from computer programming, is a temporary fix used to bypass or otherwise avoid a bug or "misfeature" in some system.

Workarounds, as a method for navigating system inefficiencies, are present at all levels of training and professional roles and across disciplines. Theoretically, workarounds are intended as quick fixes and are replaced by solutions that address the system problems. In practice, people often find themselves living with workarounds for long periods of time, with residents sharing detailed knowledge of workarounds with the next generation of residents. Adopting workarounds as part of one's clinical practice suggests a failure to perform an appropriate analysis of the system's failures or to truly understand systems failures that lead to the workarounds.

Often, even the most experienced individuals in the system do not recognize the destructive cycle of the workaround. It is only after a serious breakdown in the system occurs, (e.g., an adverse event), that an investigation might reveal the workaround. For faculty, a key opportunity is to learn to recognize the workarounds their residents adopt because they provide multiple opportunities to tease out and address the system issues.

Surfacing workarounds can be a Pandora's box—we need to assure that the organization can support the improvement work that would be required once the system issues have been identified.[21] Some suggestions include:

- **Provide an easy avenue to report problems as they occur:** Give people an easy avenue to report and communicate issues.
- **Ensure that feedback is part of reporting:** Let providers and staff know they have been heard and that the issue will be addressed.
- **Identify appropriate institutional leaders who are willing to work with providers and staff to tackle system issues:** Identifying system problems is only the first part of any solution. It is critically important that institutional leaders be willing to tackle these issues with physicians and staff.
- **Provide feedback on what is being done to fix the problem:** Once system issues have been identified and reported, provide feedback about how the problem is being solved.

Overall, there is a need for generalizable methods and tools for teaching about the system and the effect of the system on the caregiving process.

Systems-Based Practice for the Board Certified Physician

In 2000, ABMS began to promote a replacement for recertification known as Maintenance of Certification™ (MOC), which when fully developed, will assess the continuing competencies of physicians. It is based on four components:

1. Professional standing, e.g., unrestricted license, hospital privileges, and peer and patient ratings.
2. Commitment to lifelong learning, e.g., self-assessment, CME, and simulations.
3. Cognitive expertise, e.g., secure exam.
4. Evaluation of performance and improvement in practice, e.g., an ability to demonstrate that care is safe, effective, patient-centered, timely, efficient, and equitable, and that one has incorporated quality improvement as a habit of practice.

The competency of SBP fits within both the second and the fourth components of MOC. A few medical specialty boards have indicated that they plan to include assessment of SBP in their certification and recertification exams in the near future. The Practice System Survey, which is part of the American Board of Internal Medicine's Web-based Practice Improvement Modules (PIMs), assesses SBP and could be a useful prototype for other specialty boards.[22] The PIM is ABIM's prototype tool for evaluating the fourth component of its MOC program, physician practice performance. As SBP is incorporated into medical education at the undergraduate, graduate, and practicing physician levels, it will also become an integral part of the certification

and recertification process. However, the medical specialty boards can take a leadership role in providing guidance for understanding and evaluating SBP.

Medical specialty boards, in collaboration with specialty societies, can act as a catalyst to help define assessment modalities for SBP and, thus, promote appropriate and effective education and training for SBP. By requiring physicians to be proficient in SBP for certification and MOC, specialty boards are sending a clear message across the continuum of medical education about the importance of learning about SBP.

Discussion

Implementing and evaluating SBP in a medical context require an understanding of what constitutes a "system," coupled with an understanding of systems thinking. Despite the best intentions of health care providers, misunderstanding about how the system in which one operates can break down or succeed can interfere with the delivery of health care. Undergraduate medical education, residency programs, and ABMS member boards are making progress toward training physicians in SBP. However, it is clear that current curricula and training have gaps. The major gaps in SBP curricula identified in this paper include:

1. No clear, common understanding of SBP.
2. Lack of assessment methods.
3. Lack of understanding of the relationship of SBP to patient outcomes and safety.
4. Lack of integration into daily practice.

Educators must develop clear, universally accepted definitions of SBP that are consistent with the medical profession's understanding of it as a necessary competency. It might be helpful for each specialty to consider how daily aspects of their clinical practice relate to systems. Once a clear definition has been established, educators must train students, residents, and practicing physicians to recognize how they interact with systems, how systems affect their daily medical activities, and how they can change ineffective systems. Understanding the relationship between systems and outcomes of care will help increase the relevance for physicians as they master SBP.

Paul Miles, MD, vice president of the American Board of Pediatrics, delineates questions that every practicing physician, from recent graduates to the established physician, should be able to answer regarding SBP:[23]

1. Can you define a system?
2. How do you describe the system you work in? (Can you draw a picture?)
3. How well does the system work?
4. How would you analyze and diagnose where the system can be improved?
5. How would you identify and prioritize change?
6. Do you participate in an interdisciplinary team?
7. What are the different systems your system interacts with, and how does your system interact with these systems?
8. How is your system financed?

9. How are new members of the team trained? (How does the system renew itself?)
10. If your system is involved in medical education, how is medical education done successfully?

SBP involves all aspects of a physician's practice of medicine. Opportunities for identifying system failures and successes, as well as how these failures and successes can affect patient outcomes and safety, should be integrated into clinical training. Faculty need effective tools for teaching and assessing SBP as part of daily practice.

Competency in SBP must be measured in a systematic way that assesses how knowledge of SBP contributes to improving quality and safety of care. Explicit strategies are needed for teaching SBP in clinical settings. By focusing on objective criteria and specific skills that relate to SBP, educators can design effective evaluation tools that truly measure physicians' knowledge and skills in SBP.

Acknowledgments

We thank the following people who agreed to be interviewed about their thoughts on Systems Based Practice: Paul Batalden, MD; Don Berwick, MD, MPP; Jeff Davis, MD; Daniel Duffy, MD; Robert Galbraith, MD; Eric Holmboe, MD; David Leach, MD; Paul Miles, MD; and Greg Pawlson, MD, MPH.

We would also like to acknowledge the contributions made by those who met to discuss Systems Based Practice: Linda Headrick, MD; Paul Miles, MD; Eugene Nelson, ScD; Roger Resar, MD; Paul Schyve, MD; and Susan Swing, PhD. The need for this paper was identified from that meeting.

Author Affiliations

University of Chicago Department of Medicine, Chicago, IL (Dr. Johnson); American Board of Medical Specialties, Evanston, IL (Dr. Miller, retired; Dr. Horowitz).

Address correspondence to: Julie K. Johnson, MSPH, PhD, University of Chicago, Department of Medicine, 5841 S. Maryland Ave., W216, MC 2007, Chicago, IL 60637; telephone: 773-834-8596; fax: 773-834-2238; e-mail: jjohnso2@medicine.bsd.uchicago.edu.

References

1. Helmreich R. On error management: Lessons learned from aviation. Br Med J 2000; 320: 781-785.
2. Ziegelstein R, Fiebach N. "The mirror" and "the village": A new method for teaching practice-based learning and improvement and systems-based practice. Acad Med 2004; 79: 83-88.
3. Kohn LT, Corrigan JM, Donaldson MS, eds. To err is human: Building a safer health system. Washington, DC: National Academies Press; 1999.
4. The World Health Organizations' first global patient safety challenge "Clean care is safer care"; 2007. Geneva, Switzerland: World Health Organization. Available at: www.who.int/gpsc/resources/newsalert/dec2007/en/index.html. Accessed April 13, 2008.

5. National patient safety goals 2007. Oakbrook Terrace, IL: The Joint Commission. Available at: http://www.jointcommission.org/PatientSafety/NationalPatientSafetyGoals/07_npsgs.htm. Accessed April 12, 2008.

6. Bingham JW, Quinn D. Linking outcomes of care and the ACGME core competencies: A matrix solution. Chicago, IL: Accreditation Council for Graduate Medical Education. Available at: www.acgme.org/outcome/implement/MatrixTutorial.pdf. Accessed April 13, 2008.

7. Bertalanffy LV. General system theory: Foundations, development, applications. New York: George Braziller, Inc; 1968.

8. Batalden P, Mohr J. Building a knowledge of health care as a system. Qual Manag Health Care 1997; 5: 1-12.

9. Senge P. The fifth discipline. New York: Doubleday; 1990.

10. Ackoff R. Redesigning the future. New York: John Wiley & Sons; 1974.

11. Ackoff R. The democratic corporation. New York: Oxford University Press; 1994.

12. Van Cott H. Human errors: Their causes and reduction. In: Bogner MS, ed. Human error in medicine. Hillsdale, NJ: Lawrence Erlbaum Associates; 1994.

13. Plsek PE, Greenhalgh T. Complexity science: The challenge of complexity in health care. Br Med J 2001; 323: 625-628.

14. Plsek PE, Wilson T. Complexity, leadership, and management in healthcare organisations. Br Med J 2001; 323: 746-749.

15. Batalden PB, Mohr JJ, Nelson EC, et al. Continually improving the health and value of health care for a population of patients: The panel management process. Qual Manag Health Care 1997; 5: 41-51.

16. Mohr J. Forming, operating, and improving microsystems of care. Hanover, NH: Center for the Evaluative Clinical Sciences, Dartmouth College; 2000.

17. Nelson EC, Batalden PB, Mohr JJ, et al. Building a quality future. Front Health Serv Manage 1998; 15: 3-32.

18. Berwick D. A user's manual for the IOM's "Quality Chasm" report. Health Aff 2002; 21: 80-90.

19. Accreditation Council for Graduate Medical Education. Accreditation Council for Graduate Medical Education Outcomes Project: General Competencies. Available at: http://www.acgme.org/outcome/project/glossary2.asp. Accessed April 12, 2008.

20. ACGME Bulletin. Chicago, IL: Accreditation Council on Graduate Medical Education; 2007. Available at: www.acgme.org/acWebsite/bulletin/bu_index.asp. Accessed April 13, 2008.

21. Mohr J, Arora V. Break the cycle: Rooting out the workaround. ACGME Bulletin; 2004 Nov. Available at: www.acgme.org/acWebsite/bulletin/bulletin11_04.pdf . Accessed April 10, 2008.

22. Improve your practice with PIMs. Philadelphia, PA: American Board of Internal Medicine. Available at: www.abim.org/pims/group.aspx. Accessed June 10, 2008.

23. Miles P. Systems-based practice: What every physician should know. Rosemont, IL; 2004.