Emergency Medicine Quality Improvement and Patient Safety Curriculum

John J. Kelly, DO, Elaine Thallner, MD, MS, Robert I. Broida, MD, Dickson Cheung, MD, MPH, Helmut Meisl, MD, Azita G. Hamedani, MD, MPH, Kevin Klauer, DO, Shari J. Welch, MD, and Christopher Beach, MD

Preface

All of us who have worked on this curriculum are career emergency physicians (EPs) who have become leaders with a focus on emergency medicine (EM) quality and safety.

About 2 years ago, I approached my colleagues of the American College of Emergency Physicians Quality Improvement and Patient Safety (ACEP QIPS) Section and dreamed an idea of creating an EM quality and safety curriculum: an outline that would explain a topic few EPs understand. That outline would be used as a curriculum to teach our EM residents (and even our attendings, physician's assistants, and nurse leaders) about EM quality and safety.

My goal is for this curriculum to become an integral part of every EM residency program and department. We know that quality and safety in patient care does not happen by accident. We must teach these concepts to everyone on our emergency department (ED) team. The safety of our patients depends on this.

I would like to thank each of the authors who spent many months on this project, along with the ACEP QIPS Section and ACEP Quality and Performance Committee.
Also, I would like to thank ACEP staff Angela Franklin and Idania Lorenti for their help in getting this project to completion. I must also sincerely acknowledge the early work and ideas generated by Drs. Shari Welch and David John: their contributions clearly helped shape this article.

—John J. Kelly, DO

ACADEMIC EMERGENCY MEDICINE 2010; 17:e110–e129 © 2010 by the Society for Academic Emergency Medicine

Keywords: quality improvement, patient safety, education

From the Department of Emergency Medicine, Albert Einstein Medical Center (JJK), Philadelphia, PA; the Emergency Services Institute, Cleveland Clinic Health System (ET), Cleveland, OH; Emergency Medicine Physicians, Ltd. (RIB), Canton, OH; Emergency Services, Sky Ridge Medical Center (DC), Lone Tree, CO; the Department of Emergency Medicine, Good Samaritan Hospital (HM), San Jose, CA; the Division of Emergency Medicine, University of Wisconsin (AH), Verona, WI; the Department of Emergency, Medicine MSUCOM (KK), Canton, OH; Intermountain Healthcare, Institute for Health Care Delivery Research (SJW), Salt Lake City, UT; and the Department of Emergency Medicine, Northwestern University–The Feinberg School of Medicine (CBB), Glenview, IL.

Received April 24, 2010; revision received June 18, 2010; accepted June 25, 2010.

Disclosures: The authors have no disclosures or conflicts of interest to report.

Supervising Editor: Nicole DeIorio, MD.

Address for correspondence and reprints: John J. Kelly, DO; e-mail: kellyj@einstein.edu.

INTRODUCTION: QUALITY AND SAFETY IN EMERGENCY MEDICINE DOES NOT HAPPEN BY ACCIDENT

Mission

This core curriculum for quality and safety in emergency medicine (EM) will serve as a reference outline to educate emergency physicians (EPs). Such knowledge will optimize the ability of EPs to reliably deliver high-quality (safe, effective, efficient, equitable, timely, and patient-centered) emergency care.

Definition of Quality and Safety

Quality is defined as value divided by cost and includes both medical outcomes and patient satisfaction. The quality of a health care system is a function of the quality of care provided within each contributing microsystem plus the quality of the handoffs and integration between microsystems. Safety is a subset of quality, and one of the six Institute of Medicine (IOM) aims detailed in their report, *Crossing the Quality Chasm.*[1]

ISSN 1069-6563
PII ISSN 1069-6563583

doi: 10.1111/j.1553-2712.2010.00897.x

Safety is more difficult to measure, as incident identification often depends on self-reports by providers.

Explanatory Notes for the Reader

The first part of this curriculum outlines the history, key reports, organizations, and the current complex landscape of the quality movement in health care. The next section delves into the core concepts of quality improvement (QI): challenges faced, opportunities to improve using core methodologies, and useful quality tools. Subsequently, EM quality management and emergency department (ED) information systems are addressed. Finally, the sections on clinical microsystems, disclosure of medical error, and patient satisfaction as a surrogate marker for quality elaborate on overarching quality concepts. A glossary of stakeholders with websites (Appendix A) and additional references (Appendix B) round out this proposed curriculum. All topics with an asterisk are considered advanced topics.

HISTORY OF THE MODERN QUALITY MOVEMENT IN HEALTH CARE—AS OUTLINED BY KEY HISTORICAL FIGURES

Ernest A. Codman, MD (1869–1940): Importance of End Results/Outcomes

Dr. Codman, a surgeon at the Massachusetts General Hospital (MGH) in Boston, Massachusetts, was credited as one of the first physicians to insist on recording and reporting on individual physician outcomes. His insistence on an ''end results system'' to monitor the quality of physician and hospital care made him unpopular among his peers and led to his eventual loss of admitting privileges at MGH. Dr. Codman's interest in QI led to the establishment of the American College of Surgeons (ACS) and its Hospital Standardization Program. Dr. Codman is also credited as one of the first to institute morbidity and mortality conferences.[2]

Avedis Donabedian, MD, MPH (1919–2000): Structure/Process/Outcome

Dr. Donabedian was a physician at the University of Michigan's School of Public Health. He has been called the ''father of outcomes research'' and is credited with introducing the quality triad as a paradigm for evaluating the quality of health care delivered by an organization. Using Donabedian's paradigm, quality can be measured by examining organizational structure, the care delivery process, and the resulting outcomes.[3]

W. Edwards Deming (1900–1993): Process Control

Dr. William Edwards Deming, an engineer, statistician, and business consultant, is best known for applying statistical process control principles (i.e., controlled and uncontrolled variability of production processes) to nonmanufacturing environments. He believed that ''the consumer is the most important part of the production line'' and that continual improvement of quality through statistical methods was the key to business success. After World War II, he taught statistical process control methods to Japanese business leaders, who embraced his ideas and credited him for Japan's manufacturing dominance in the decades to follow. Years later, his ideas were finally valued among American businessmen when a U.S. documentary, ''If Japan Can ... Why Can't We?'' became the most successful documentary in television history.[4]

Joseph M. Juran (1904–2008): Total Quality Management

Joseph Moses Juran, an electrical engineer and management consultant, began his career at the famous Western Electric Company Hawthorne plant and is best known for ''total quality management.'' He believed that ''cultural resistance'' was at the root of quality issues. His ''trilogy process'' includes quality planning, quality control (reducing chronic waste), and QI.[5]

John (Jack) Wennberg, MD, and Elliott Fisher, MD, MPH: Regional Variability in Clinical Practice Patterns

Dr. Wennberg, a Dartmouth physician, was the first to introduce the concept of regional variability in health care back in the 1970s. His sentinel *Science* publication showed that regional variations in patterns of care (and health care expenditures) were not evidence-based and did not influence patient outcome.[6] Dr. Wennberg founded the Dartmouth Atlas of Health Care project in the late 1980s. He was an influential mentor to Dr. Elliott Fisher, also a Dartmouth physician and current lead of the Dartmouth Atlas project. Dr. Fisher jettisoned research in regional variation into mainstream health care policy conscience with the publication of two articles in 2003.[7,8] These two articles conclude that patients in higher spending regions of the country receive 60% more care, but quality of care is no better (and at times worse) in these higher-spending regions than in lower-spending regions.

Donald Berwick, MD, MPH: Business Applications of Quality Management to Health Care and the Institute for Healthcare Improvement

Dr. Berwick, a Harvard pediatrician, was one of the first to experiment with business applications of quality management in health care, as detailed in his book *Curing Health Care*.[9] His sentinel paper in 1988 highlighted the difference in effectiveness of quality management focused on ''bad apples'' as opposed to ''bad systems.''[10] Dr. Berwick was an influential author of the second IOM report, *Crossing the Quality Chasm*.[1] In addition, Dr. Berwick is the founder and current CEO of the Institute for Healthcare Improvement (IHI). The IHI is an independent, nonprofit organization that assists health care organizations in actively implementing QI strategies. Successful programs of the IHI have included the Breakthrough Series Collaborative, the 100,000 Lives Campaign, and most recently, the 5 Million Lives Campaign.[11,12] Given his role with the IOM report and the IHI, Dr. Berwick is viewed by many as the father of the present-day QI movement in health care. In July 2010, he was named administrator of the Centers for Medicare and Medicaid Services.

Brent James, MD: Intermountain Healthcare Research on QI

Brent James is a surgeon and a statistician. He founded the Intermountain Institute for Health Care Delivery Research. This is a research organization, think tank, and education center focused on QI in health care. Dr. James trains physicians and health care leaders in QI strategies in a course called the Advanced Training Program. Leaders from all over the world come to learn his methodologies. He also has undertaken large studies at Intermountain Healthcare examining pneumonia and sepsis care, standardization in diabetes and coumadin care, and reducing morbidity and mortality among women and newborns through standardized care plans.[13]

Lucian Leape, MD: Patient Safety Movement

Dr. Lucian Leape, a pediatric surgeon, is considered the father of the modern-day patient safety movement.[14] His landmark 1994 publication *Error in Medicine* provided momentum for the patient safety movement.[15] His research demonstrated applying systems theory to prevent adverse drug events. He also advocated for the nonpunitive systems approach to prevent medical errors.

Peter Provonost, MD: Checklist

Dr. Pronovost is an anesthesiologist and critical care physician at Johns Hopkins. Both a clinician and an academic researcher, he translates the science of quality and patient safety to the bedside and has successfully implemented system changes on a state and national level. He is a pioneer in large-scale improvements focusing on quality measures, intensive care unit physician staffing, safety culture, error reporting, ventilator-associated pneumonia, and sepsis treatment, among others. He is best known for creating a simple ''checklist'' that resulted in dramatic decreases in infection rates when starting a central venous catheter.[16]

HISTORY OF THE QUALITY MOVEMENT IN HEALTH CARE—AS OUTLINED BY KEY REPORTS AND ORGANIZATIONS

Minimum Standards of Hospitals Evolve to Become The Joint Commission

Based on the influence of Ernest Codman, MD, the ACS developed the minimum standards of hospitals and began on-site inspections of hospitals around 1918. The ACS evolved this program and joined other groups in the 1950s to form the Joint Commission on Accreditation of Hospitals (JCAH). This organization was established as an independent nonprofit organization, whose primary purpose was voluntary accreditation of hospitals. JCAH extended the scope of health care facilities it reviewed and, as such, changed its name to the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) in 1987. Now known as ''The Joint Commission,'' this organization continues to be an influential force in many hospital-based health care QI activities. The group established sentinel event reporting in the late 1990s, and National Patient Safety Goals (NSPG) in the early 2000s. Meeting NSPGs has been the main focus of many health care organizations' QI activities.[17]

Institute of Medicine Reports

The two IOM reports—*To Err Is Human*[18] and *Crossing the Quality Chasm*[1]—were released in 1999 and 2001, respectively, and are credited with precipitating mainstream awareness of medical errors and suboptimal quality of care. *To Err Is Human* reports that between 44,000 and 98,000 Americans die each year as a result of medical errors, citing medical errors as the eighth leading cause of death in the United States. *Crossing the Quality Chasm* reports that ''between the health care we have and the health care we could have, lies not just a gap, but a chasm.'' This report is also known for its delineation of six aims of high-quality health care: safe, effective, patient-centered, timely, efficient, and equitable.

Centers for Medicare and Medicaid Services

As the largest purchaser of health care, Centers for Medicare and Medicaid Services (CMS) is integrally involved in the quality movement. While CMS has experimented with a variety of demonstration projects aimed at improving quality and managing (or decreasing) expenses, its most widely recognized initiative is the Physician Quality Reporting Initiative. The 2006 Tax Relief and Health Care Act required the establishment of such a physician quality reporting system, and this program has been in place since 2007. Currently, physicians receive a bonus for reporting on at least three quality measures for at least 80% of their patients. Many believe that while current program payment is tied to reporting and is voluntary, in the future, it will be tied to performance and likely mandatory.

National Quality Forum

The National Quality Forum (NQF) is a private, nonprofit multi–stake holder organization with more than 350 members representing every sector of the health care system. NQF is best known as a voluntary consensus setting body. NQF-endorsed quality measures are viewed as ''criterion standards'' that can be used by a variety of governmental and private groups. NQF has endorsed more than 500 measures for subsequent use in a variety of QI programs.

Institute for Healthcare Improvement

Please reference earlier notes under Dr. Donald Berwick.

Leapfrog

The Leapfrog Group is a major health care purchaser group working to improve U.S. health care. They believe that big leaps in health care safety, quality, and customer value are possible and should be recognized and rewarded. Leapfrog works to encourage transparency and easy access to health care information, reduce preventable medical mistakes, encourage public reporting of quality and outcomes, and rewarding hospitals with a proven record of high quality care.

Physician Consortium for Performance Improvement

The AMA-Physician Consortium for Performance Improvement (PCPI) is composed of more than 170 national medical specialty societies, state medical societies, the American Board of Medical Specialties and member boards, and other relevant organizations. The group has taken the lead in developing, testing, and maintaining evidence-based performance measures. In fact, in the past 10 years of its existence, PCPI members have helped create 270 measures spanning 42 clinical areas.

THE CURRENT QUALITY MOVEMENT IN HEALTH CARE

Focus on Public Reporting, e.g., Hospital Compare

In 2005, the U.S. Department of Health & Human Services launched the Hospital Compare website in an effort to publicly report hospital outcomes on ''core measures'' related to pneumonia care, congestive heart failure care, and acute myocardial infarction care. Since its beginnings, many more measures have been added, including public reporting of surgical care, asthma care, patient satisfaction, hospital readmission rates, and hospital mortality rates. It is unclear to what extent patients rely on this website in determining where to seek care. Nonetheless, U.S. hospitals are investing significant resources into their QI infrastructure to be able to perform well on specified measures. This trend in increased public reporting of quality measures is likely to continue to grow.

Focus on Pay for Performance or Value-based Purchasing (VBP)

Value-based purchasing has become the most recent buzzword in health care reform. Instead of paying for health care based on volume (regardless of quality), the CMS is now committed to reimbursing providers based on value. VBP is thought to link payment more directly with quality and allow CMS to be a more active purchaser of health care. The extent to which health care finance reform will transform reimbursement toward VBP remains to be seen.

Attention to regional variability

Dr. Eliott Fisher and others involved in the Dartmouth Atlas project have continued to publish regular studies analyzing regional variability in health care expenditures and quality of care outcomes. For example, a recent study[8] looked at the association between health care costs and hospital performance on ''core measures.'' As in other studies, no correlation was found. At times a negative correlation has been documented, leading the authors to conclude there is a ''paradox of plenty.''

Denial of payment for ''never events'' and ''hospital-acquired conditions''

As CMS looks to decrease unnecessary health care costs and improve quality of care, it has focused on decreasing payments for inferior care. As such, CMS announced in 2008 that it will not pay for certain 'never events' and certain hospital-acquired conditions. Hospitals still are paid for hospitalizations but are not allowed to code and charge for ''complicating conditions'' if they develop during a patient's stay. The list of conditions that will not be paid for has been expanded, and is controversial. Many believe that it is unrealistic to expect complications to never happen even when following standard care. Hospitals now have to document whether certain conditions are 'present on admission.' More recently, there has been a movement towards CMS not paying for hospital readmissions for congestive heart failure and other chronic conditions. Over 20% of hospitalized patients are readmitted within one month of a hospital discharge. The Medicare Payment Advisory Commission (MedPac) has recommended that CMS lower payments to hospitals with high rates of risk-adjusted readmission rates.

End-of-life Care

End-of-life care consumes an inordinate amount of health care dollars and nearly 50% of Americans die in a hospital bed. Studies in regional variability have shown that there is significant variation in costs associated with treating patients at the end of life. Health care systems that focus on end-of-life planning (e.g., Gundersen-Lutheran Health System in LaCrosse, WI, where 95% of elderly patients have signed advanced directives on end-of-life care) have lower costs. Our ability, as a society, to grapple with appropriate allocation of limited resources at the end of life may hold the key to our health care spending crisis.

Future Quality Trends With Payment Ramifications

The CMS is also interested in testing ''bundled payments'' in which hospitals and physicians receive a single payment for providing all of the services associated with a specified procedure. This concept has also been phrased as ''acute episode of care'' and ''global'' payments. The overriding goal is to encourage hospitals and physicians to work closely and efficiently together to improve care while decreasing costs. How these single payments are to be divided between the hospital and the various involved physicians remains to be seen.

Business Case for Quality

An improvement culture shows an increase in ''hard green dollars'' through operational performance enhancement and ''soft green dollars'' from workforce, patient, medical staff, and hospital board satisfaction. Successful QI programs result in decreased costs and increased revenues.

THE DISCIPLINE OF QI

Human Factors Engineering*

Human factors engineering is the scientific discipline concerned with understanding interactions between humans and other elements of a system. This profession applies theory, principles, data, and other methods to design to optimize human well-being and overall system performance.[19]

Reason's Swiss Cheese Model

In 1990, James Reason published what is known as the Swiss cheese model of accident causation. This model is used in the risk analysis and management of human systems. In this model, defenses against failure are stacked front to back like slices of Swiss cheese with holes representing either active or latent failures (weaknesses in the system). In an ideal system there would be impenetrable barriers without holes. However, should these holes (failures) align, catastrophic events are possible. Reason defines the accident trajectory as "… the rare conjunction of a set of holes in successive defenses, allowing hazards to come into damaging contact with people and assets."[20]

Latent and Active Errors

The terms "active" and "latent" as applied to errors were coined by Reason as well. Active failures are errors that are likely to have a direct effect on a patient or system, such as ignoring a beeping monitor revealing ventricular tachycardia. These frequently involve frontline workers and are described as the "sharp end" of error promulgation. Alternatively, latent failures or conditions, described as "blunt end" errors, are often the result of poor system design, training shortfalls, undetected defects, etc. These are frequently unintended violations that may go unnoticed for a period of time before they penetrate defensive layers. One example would be laboratory specimen processing and delays to definitive diagnosis due to specimen mislabeling or mishandling. It is the combination of both that most commonly results in patient threat. Active failures generally occur at the human–system interface and are usually immediately noticed. Latent failures often begin in the system or procedural design and can remain dormant until the right set of circumstances brings them to light.[21]

High-reliability Organizations*

High-reliability organizations (HROs) have their foundation in one simple ideal—fewer failures. In the 1990s, Weick and Sutcliffe[22] and Rochlin et al.[23] used their research to understand how various industries created and maintained high reliability, thereby mitigating accidents. Others have noted a number of important shared traits of HROs. First, HROs expect failure and work to avoid it through training, redundancy, and resilience. Second, when failure occurs, HROs recognize it earlier and respond efficiently. Damage is limited before it can propagate downstream resulting in larger system failure. HROs consider the organization and its individuals and build safety into the operation based on these experiences, becoming more resilient. Overall, reliable organizations value and cultivate safety in their organizational culture. They are defined by a variety of factors, including preoccupation with failure, reluctance to simplify, sensitivity to the operation, resilience under duress, and reference to expertise. Each factor relies on communication and human interaction. Successful HROs value open flows of information, continually reassess the practice environment, and continually test their redundant systems. Within this model, individual decision-making is highly valued and supported by organizational knowledge and vigilance. This inevitable human variability is a contradiction to reliability. However, it is one of the strengths of HROs—enabling individuality within a culture of mindfulness. Mindfulness is attained when individuals and groups act and then reflect. They move forward with the understanding that not all is known and thoughtfully contemplate new pathways, choices, and alternatives as they arise. Using this information, mindful groups and individuals effectively and sometimes instinctively choose the most sensible path.[22,23]

Reliability and Resiliency

Safety has been termed "a dynamic nonevent." It is dynamic because stability is maintained by continuous adjustment to the system. It is a nonevent because seamless functioning of the system is maintained. Reliable organizations and people maintain seamless functioning by anticipating events, maintaining resilience in the face of events and applying fluid decision-making to events. Resilient individuals and organizations are capable of recognizing incidents and mitigating propagation. Inevitably errors will occur. Diminishing the damage these errors pose, particularly in health care, is challenging. Required for this purpose are many skills previously mentioned, in addition to vigilance, improvisation, rapid response, and coordinated learning.[22,24,25]

Statistical Process Control Charts*

The two most important principles that must be brought to the analysis of data that are relative to operations are variation and context. When measuring processes in a complex system, there are a multitude of factors that influence data, and lead to large variations in day-to-day measures. Variation must be taken into account to understand whether data reflect a significant change, or *noise* (routine variation), inherent in the process. By accounting for variation, the change measured is put in context. All too often data are presented to the reader as a limited comparison—one national deficit compared to another, one month of car sales compared to another. There is no context for the data points. You cannot tell if the difference between the two data points is due to variation or due to real change. Statistical process control is simply the best way to look at operational performance data in the ED.[26]

CHALLENGES IN QI

Data Limitations: Administrative Databases Versus Clinical Chart Abstraction

Results of quality measures based on administrative data are often felt to be erroneous, as the accuracy of these data is limited to the accuracy of medical documentation and subsequent medical coding. Specifically, data from administrative databases often are not appropriately risk-adjusted, as full clinical information is often not appropriately documented. While clinical data based on chart abstraction (often by a clinician) are viewed as significantly more accurate and representative of care provided, the labor costs involved in gathering such clinical data can be prohibitive. It is hoped

that electronic medical records will allow capture of clinical data to be greatly facilitated.

Case Attribution

With increased reporting of physician-specific or institution-specific quality measures, it has come to light that determining who is responsible for a patient population can be difficult. For example, primary care physicians are provided reports on the percentages of their patients who are not screened for a variety of preventive care measures. Often, their individual patient lists include patients whom they have never seen or patients who have had only tangential contact with them.

Culture of Medicine

Medicine in the 19th and 20th centuries functioned essentially as a guild populated by craftsmen. Medicine's promise was that if an individual physician was well-trained and knowledgeable, and put the best interests of his patients first, he or she could deliver quality care. Unfortunately that promise did not deliver.

This culture of medicine as one of individual physician responsibility and autonomy in fact often leads to bad patient outcomes. The profession always believed that self-regulation was sufficient, and a ''blame and shame'' culture would adequately motivate ''outliers'' to provider better patient care.

Quality management in many health care organizations is still focused on case reviews and individual physician involvement, as exemplified in morbidity and mortality conferences. When there is a punitive component to case reviews (e.g., cases are recorded in individual physician files), the amount of peer or self-reporting significantly diminishes. The modern-day quality movement in health care, however, has effectively argued that focusing on improving system defects will go further toward improving the care of all patients than a more narrowed focus on case-finding based on individual patient cases and individual bad outlier physicians.

By contrast, a ''just culture'' refers to a way of thinking that promotes a questioning attitude, is resistant to complacency, is committed to excellence, and fosters personal accountability and corporate self-regulation in safety matters. Such a culture, then, is both attitudinal and structural, relating to both individuals and organizations. In such a just culture, people are encouraged (even rewarded) for providing essential safety-related information. Such a culture of safety is exemplified by increased event reporting, even self-reporting. Nonetheless, the drastic swing away from bad apples and a blame and shame culture toward bad systems and a just culture has been tempered in the past few years as some thought leaders in the quality movement have argued that at a certain point individuals need to be held accountable for their willingness to comply with best practice (e.g., hand hygiene).

Dominance of Physician Autonomy

Due to the great variability that exists in clinical practice (Wennberg and Gittelsohn[6] and the work of Fisher et al.[7]), a great deal of effort was placed into clinical guidelines development, much funded by organizations such as the Agency for Healthcare Quality (AHRQ). Clinical guidelines have been criticized for a variety of reasons, including minimizing individual patient preference and often providing conflicting recommendations for patients with multiple comorbidities. Clinical guidelines have also been disparaged as reducing physician autonomy. A culture that strongly values physician autonomy works against any efforts to standardize care across the spectrum of underutilization and overutilization. A strong culture of physician autonomy exists despite evidence that Americans, on average, only receive 55% of recommended care.[10,27]

Risk Adjustment

The results of quality measures are often discredited by physicians as not meaningful, since most believe that their patients are ''sicker and poorer.'' Many risk-adjustment models have been proposed for a variety of conditions. The American College of Cardiology and the Society of Thoracic Surgeons are among the pioneer groups to maintain risk-adjusted databases for the care provided by their physicians.

Science of Quality Does Not Necessarily Use Standard Methods and Statistics

Quality improvement as research may embrace a wider range of scientific methodologies. QI research may not need the same thresholds (''p-values'') for action on the evidence found. Assessment techniques developed in engineering and used in QI—statistical process control, time series analysis, simulations, and factorial experiments—have more power to inform about mechanisms and contexts than do randomized controlled trials. A central idea in improvement is to make changes incrementally, learning from experience while doing so: plan-do-study-act (PDSA). This is captured in the plan-do-check-act (PDCA) cycle.

Unintended Consequences of Quality Measure(s)

With multiple quality organizations and federal agencies creating health care quality measures, ''flawed'' performance measures appear to be common. An honest attempt to craft a quality measure may create unintended consequences of more clinical work and documentation burden for the clinicians and overtreatment and overtesting for the patient and in the end may have no evidence basis. The Pneumonia Core Measure presented the most relevant ''flaws'' among EPs.[28,29] Core measures are best crafted by the subspecialty organizations that have full knowledge of their system and their evidence-based medicine literature and what they can feasibly improve.

OPPORTUNITIES TO IMPROVE THE QUALITY OF CARE DELIVERED

Credentialing

Credentialing is primarily granted by hospitals and is specific to each institution. Hospitals may accept standards promulgated by entities such as certifying boards (e.g., American Board of Emergency Medicine), but they are not required to do so. The main purpose of credentialing is to ensure a physician's competency in his or her practice, including the necessary

knowledge to perform new techniques or use new equipment.

Team Training

Interdisciplinary teamwork has been identified by the IOM and others as an essential skill to reduce preventable medical error and promote quality patient outcomes. Relevant research in this area includes an EM teamwork definition, program planning, implementation and evaluation, effectiveness, its role in continuing education, and opportunities for evidence-based research.[30–34]

Crew Resource Management

Crew resource management has been used in the aviation industry for more than 20 years and only recently has been incorporated into a variety of health care settings. Its key components are fatigue management, team building, communication, recognizing adverse events, team decision-making, and performance feedback.[35,36]

Simulation

Simulation-based training has been used in areas where experience with live patients may be infrequent or potentially dangerous. These include training practitioners in new procedures, and promoting improved teamwork and communication. Simulation is also used to provide a ''standard'' patient for purposes of training and evaluation. It has been used to promote improved teamwork and communication for EM residents, and a research agenda has been developed.[37–39]

Safety Surveys

To further a ''culture of safety and quality improvement,'' in 2004, the AHRQ sponsored the development of patient safety culture assessment tools for hospitals, nursing homes, and ambulatory outpatient medical offices. The goal of the survey was to create a tool for institutions to evaluate how well they have established a culture of safety in comparison to other similar hospitals. The Hospital Survey on Patient Safety Culture 2009 Comparative Database Report represents change over time for 204 hospitals that submitted survey data more than once and provides hospitals comparative with results in efforts to establish, improve, and maintain a culture of patient safety in their institutions.

Creation of an Open and Fair Culture*

Recognize that human errors and human drift from what we are taught summarizes the fallibility of any human enterprise. Creating a culture where we can admit our mistakes further develops learning, openness, and fairness. However, distinct categories must be defined between human error, at-risk behavior (drift), and reckless behavior. All must be accountable for each behavior. A middle ground between punitive reaction and blame-free culture that balances individual accountability has been recommended by the just culture community.[40]

Design of Safe Systems*

Design systems that facilitate good decisions and anticipate human error, capture errors before they become critical, and recover when critical consequences reach the patient.

Management of Behavioral Choices

Culture within an organization may drift into an unsafe condition. Leaders must constructively coach care providers to follow safety-critical procedures, to report when they see hazards or when they make safety-critical mistakes, and to promote reliable behaviors. Recognize that remedial, disciplinary, or punitive actions must follow human error, drift, or reckless behavior.

Knowledge of Change Management

It is estimated that 70% of change efforts fail to achieve their objectives. Knowledge of change management should increase the odds of attaining and maintaining a favorable result.

Kotter and Cohen[41] have developed an eight-step process for leading large-scale change: 1) tension for change—establish a sense of urgency based on the realities of the market, crises, opportunities, and so forth; 2) coalition—create a guiding coalition with enough power to lead the change; 3) vision—develop a vision and strategy that can direct the change effort, together with strategies for achieving that vision; 4) communication—communicate the change vision, using multiple modalities and vehicles for communication, and have the guiding coalition model the behaviors sought; 5) empowerment—empower broad-based action while encouraging risk-taking and removing barriers, obstacles, and undermining forces; 6) early success—generate short-term wins and recognize those wins and the people who contributed to making them; 7) expanding change—consolidate gains and produce more change to extend the vision for change beyond the initial targets and people; and 8) grounding—anchor the new approaches in the culture of safety.

Boyatzis and McKee[42] identify successful leadership characteristics of renewal: mindfulness, hope, and compassion. General leadership styles are authoritative, affiliative, coaching, coercive, democratic, and pacesetting,[43] and a leader's ability to match his or her leadership style to the situation (leadership flexibility) is a most valuable skill. Leaders can be very effective for their organizations when they encourage others to think deeply about an issue.

In business, the organizational culture and how people feel about it can account for almost 30% of business performance. In ''servant leadership'' a positive organizational environment develops that allows and encourages others to excel and achieve through a focus on purpose, building on strengths and raising the bar.

QUALITY IMPROVEMENT METHODOLOGIES AND TOOLS

Examples of QI Project Methodologies: DMAIC (Define, Measure, Analyze, Improve, Control), Six Sigma Methodology, Lean Manufacturing Principles, etc.

There are a number of methodologies for conducting QI studies in service industries and in medicine.

QI studies are gaining credibility within the specialty of EM.

Six Sigma is a business management strategy for identifying waste and defects in a process, originally developed by Motorola. Manufacturing and service industries have now used this methodology successfully. Six Sigma uses a series of quality and statistical methods to facilitate improvement in a systematic way. Formalized training is involved, and levels of demonstrated expertise and formal certification can be obtained (for example, green belt, black belt, and so forth). Six Sigma offers two pathways to improvement depending on whether the process is dysfunctional, or the process does not exist in a coherent, recognizable way.

Define, measure, analyze, improve, control (DMAIC) is used to improve an existing process that is suboptimal. Define, measure, analyze, devise, verify (DMADV), also known as Design for Six Sigma (DFSS), creates a new process.

Lean is a methodology that began in manufacturing and has been used successfully for many years, particularly in Japan. The approach is driven by the concept of value stream mapping and requires less training and infrastructure than Six Sigma to launch. Physicians learn by doing, and projects are short in length (1 to 3 weeks) and are based on best practices. The basic premise is that anything that does not add value to the patient's care should be eliminated. Lean methodology seeks to weed out waste in health care processes.

Value stream mapping is an integral part of the Lean methodology. With value stream mapping, the team examines every process and operation from the perspective that each step should add value to patient care. It is traditional flow mapping with an eye toward eliminating waste and adding value. If a step on the flow map does not add value to the process, methods are sought to eliminate the unsuccessful step(s) from the process. The goal is to drive out waste so that all steps add value and serve the patient's needs.

Selecting Methodology

As above, there are a number of methodologies for conducting QI projects, and each has a set of devoted followers, but the most important requirement, according to Intermountain Healthcare, is that the organization adopts a methodology and trains all leaders in its utilization. Regardless of the methodology chosen, all QI work must meet these requirements: 1) a carefully defined aim statement, 2) stretch goals describing explicitly what the project will try to do and over what time frame, and 3) a defined measure(s) for tracking improvement. In addition, it is important to consider ''change management'' (e.g., first securing buy-in from a team of key stakeholders), conduct a pilot study, and provide feedback to workers on results.[44]

Plan-Do-Check-Act

Plan-do-check-act is a structured approach to a rapid cycle test of change. It follows a scientific method to QI and is most often used to improve relatively simple processes that are amenable to quick transformation. ''Plan'' refers to setting clear objectives, metrics, and processes. Implementation of the strategy occurs in the ''do'' phase. The ''check'' phase studies the results of the new process and compares it to the expected outcome. The final ''act'' phase analyzes the discrepancies in outcomes. A key feature of the PDCA cycle is that it is an iterative process. Ideally, learning and improvement occurs with each successive PDCA cycle. This structured approach is also known as PDSA.[45]

Sentinel Event and Incident Reporting

Patient safety reporting systems attempt to capture the spectrum of medical errors to make data-informed improvements. Incidents can result in potential, minor, or major harm. A sentinel event is an unanticipated event resulting in serious injury or death. The Joint Commission requires reporting on a specific list of occurrences (e.g., unexpected death of a full-term infant) as well as other sentinel events defined by the accredited organization. Each sentinel event must be followed by an analysis of causal factors (see ''Root Cause Analysis'') that focus on systemic issues and an action plan to prevent future occurrences. The facility's accreditation status is contingent on an adequate response to the sentinel event. The Joint Commission monitors, collects, analyzes, and disseminates the reports in ''sentinel event alerts.'' The ideal system would encourage providers to report incidents of any magnitude, including near misses. Features that may encourage reporting include ease of use, anonymity, and feedback regarding any interventions.

Root Cause Analysis

Root cause analysis (RCA) is a class of problem-solving methods aimed at uncovering the underlying cause(s) of a defect. The basic underlying assumption is that unless the ''root'' of the problem is exposed and corrected, the system is vulnerable to similar errors in the future. In health care, RCAs are often deployed only after a major medical error resulting in serious harm, such as a sentinel event. The ideal analysis would include a description of the causal relationships of the problem, as well as a focus on systemic deficiencies.

Cause and Effect Analysis

The root cause(s) of a problem is often hidden. Cause and effect analysis aims to uncover them through the use of visual aids (often called fish or fishbone diagrams) and a series of iterative questions (often referred to as the ''5 Whys'' or ''Why-Because'' analysis). The assumption is that obvious answers and superficial responses will only address the symptoms and not the underlying etiology of a problem. Although cause and effect analysis is a structured approach to problem solving, it still depends on asking the ''right'' questions, and is subject to the experience of the analysts.

Failure Mode and Effects Analysis

Failure mode and effect analysis is a tool of operations management to analyze potential failure modes. It is popular because traditional means of learning from mistakes are both costly and potentially catastrophic. It is usually used before the start of a new operation, process, design, or equipment, to prospectively evaluate,

predict, and mitigate failures before they occur. Failure mode and effects analysis (FMEA) is often a part of a larger process improvement effort, e.g., Six Sigma. The components of an FMEA analysis are broken down into the ability to detect a failure mode, the severity of the failure if it occurs, the probability or frequency of failure, and then analyses including the ability to mitigate the outcome by early detection.[46,47]

EMERGENCY MEDICINE AND QUALITY MANAGEMENT

ED Benchmarking

Increasingly, EDs are using performance data to track the efficiency of their operations. This is called benchmarking and is predicated on the ability to identify the appropriate cohort with which to compare each facility. For instance, a low-volume community hospital will have performance metrics that look quite different from a Level I trauma and tertiary care center. By using demographic data like annual census, admission rate, the availability of trauma services, patient Emergency Severity Index (ESI) distribution, admission rates, and so forth, a department can characterize itself for appropriate benchmarking. Commonly used performance metrics like length of stay for all patients, admitted and discharged patients, patients who left without being seen, door-to-physician time, and other time interval metrics, complaint ratios, and performance on clinical measures can be used to benchmark similar hospitals against one another.[48,49]

Scope of ED Quality Management

A robust quality management program for an ED includes the following five elements in an ongoing fashion: 1) census data (who is coming and what do you do to them, for them, and with them); 2) metrics (as discussed above in the benchmarking section); 3) operational data (more granular data on specific ED operations like laboratory and x-ray utilization and performance); 4) focused audits on particular projects; and 5) provider specific data.[50,51]

ED Data Collection Strategies: (see ED Information Systems below)

As EDs move toward increased information technology support and an electronic health record (including patient tracking, physician order entry, and physician documentation), much data for benchmarking will be retrieved from data warehouses that capture data from an electronic whiteboard. Until then, needed data can be retrieved through small sample audits done by hand and from a paper ED log and chart reviews.[52]

Solicitation of Cases from Within the ED and From Other Services

Solicitation of cases remains a common model for ''harvesting'' important quality cases. This model may be used, but must be conducted in a complete no-blame/no-shame manner and led by senior department leadership. Using this strategy, even in the most objective forum, remains potentially problematic for ''blame-free'' quality management. Use of the ''Joint Commission Learning from Defects Tool'' may keep this case-review process objective and standardized.[53]

ED Focused Audits

The most creative part of a program, focused audits, may focus on high-risk clinical entities, high-volume cases, sentinel events, complaints, or aberrant data noted in other sections of the quality management program. Peer review of sentinel cases may be included as part of this program, but is also often included as part of a risk management program.

ED Quality Dashboard/Scorecard

There are many ways to organize quality data, but the development of a standardized data dashboard for studying performance metrics is part of the foundation of a comprehensive program. Use of the five elements mentioned above (under ''Scope of ED Quality Management'') is one method that is becoming popular. Census data included on the dashboard help a department understand the needs of the community it serves and how they may be changing.[54]

ED Provider Data

Almost any data that can be tracked by a department can be tracked by a physician. Physicians are competitive, and typically the mere provision of data, even in a blinded fashion, will move individual providers toward the mean. Most often, physician behavior can be changed by simply sharing the data of the group. Many progressive groups will study the strategies of the top performers in their group and share them with the group at large.

ED Resource Utilization Studies*

Utilization data are important to be sure that capacity matches demand in the department. Resource utilization can be studied by department and by provider, but until patient acuity, census, and workload can be quantified for ''risk-adjustment'' purposes and until ''best practice'' is unequivocal, it is impossible to mandate utilization ratios, because this will lead to unintended consequences. For example, in the past, in certain communities, where head computed tomography utilization rates were tracked for primary care physicians, a change in practice pattern occurred where primary care physicians more readily sent patients to the ED when diagnostic imaging was needed. In this way, computed tomography ''utilization'' would not be counted against the primary physician, but rather the EP.

ED INFORMATION SYSTEMS

Emergency department tracking systems have been evolving for the past two decades. Regardless of the level of sophistication of such a system, tracking patient movement, departmental flow, ED volume, and critical operational metrics, such as door to provider and length of stay, are essential elements for the minute-to-minute, hour-to-hour, and daily management of a busy ED. Traditionally, tracking systems, even the archaic but cost-effective grease board, were designed to inventory and categorize patients in the ED. This

function expanded to identify patient movement or specific pending or completed actions such as pending physician evaluation, awaiting x-ray or lab, etc. As the need and desire to track additional operational data and processes of care, and to affect the care provided with real-time intervention (e.g., forcing functions) has become desirable and necessary, the sophistication demanded from these systems has increased exponentially.

Although tracking systems were first used to inventory and categorize patients, operational metrics were easily obtained from systems that could acquire data points as patients reached critical steps in the ED course. Subsequently, the value of measuring processes of care beyond time-specific flow measures was recognized. For instance, there is value in confirming the timing of performance of an electrocardiogram (ECG), the number of ECGs performed, and that aspirin was provided in all acute coronary syndrome patients. Furthermore, some processes are so critical that the system may prompt a provider to carry out a task (such as renewing a restraint order that has expired). Such functions are referred to as forcing functions.[54,55]

Electronic Medical Record

Although many confuse an electronic medical record (EMR) with a tracking system or full ED information systems, an EMR is simply an electronic version of the medical record. EMRs provide benefit in reducing paper moving through a busy system, often associated with inefficiencies. EMRs provide prompting for data collection for coding and for risk management, as well as a means for improved access and portability of health information. Unfortunately, to date, such ease of access is limited to specific health care delivery systems or hospitals and does not provide universal access, regardless of where the patient enters the health care system.

Two issues identified with the quality of some EMRs are the accuracy and readability of the final product. Many mix the nursing, physician, and operational data throughout the record, making it difficult to determine what care was delivered by whom and in what sequence. Most EMRs use drop-down boxes or macros (standard, common phrases) that can be invoked by a mouse click. On occasion, these statements can be inadvertently included in the medical record. Although EMRs theoretically reduce the cost of documentation via discontinuation of traditional documentation systems (e.g., transcription), their weakness continues to be lost productivity due to the increased time it takes to document an encounter in many, if not most, of the available systems.[52,56–59]

Computer Physician Order Entry

Computer physician order entry (CPOE) is designed to remove steps from the logjam of processes needed to care for any given patient in the ED and provide less opportunity for error to be introduced in the order entry process. Traditionally, a provider writes orders on a paper chart and that document is passed off to a clerk to enter the orders into the hospital's operating system. This hand-off allows for delays and potential errors. Theoretically, if the provider is able to input his or her own orders into the operating system, an entire layer of the process is removed. In addition to the goal of improved efficiency, CPOE systems have included safeguards to avoid adverse drug reactions from allergies and medication interactions. Some systems perform well to both ends. However, many add additional layers to the ordering process, resulting in so much additional burden being placed on the provider that their efficiency and productivity suffer. It has been questioned whether using a highly compensated provider for such tasks is a cost-effective proposition.[60–64]

Decision Support

Decision support systems are real-time software interventions that accompany CPOE systems. Commonly, such systems will aid with reducing adverse drug reactions by identifying potential allergies, drug interactions, or medications at high risk for adverse events in certain patient populations (i.e., the elderly). Decision support also addresses even more complex ordering decisions, such as guidance through calculation of pretest probability of a patient suspected of having a pulmonary embolus. Decision support systems are most advantageous with clinical decisions of great complexity or high frequency of error or that include risk stratification from a computation based on a defined set of risk factors or a decision rule. Such systems have proved successful in reducing medical error and practice variation, while improving utilization and patient outcomes.[65,66]

MEDICAL ERROR: COGNITIVE PSYCHOLOGY OF PERFORMANCE IN THE ED*

There are various levels of a system at which medical error might occur: individual level, interpersonal level, individual–technology interface level, social–technological level, organizational structure level, institutional level, and society level. This section reviews errors that can occur at the individual level and is important because understanding the human cognitive psychology of error can lead to the development of systems of work that are adapted to a human's cognitive strengths and weaknesses.

Reason defines human error as the failure of a planned sequence of mental or physical actions to achieve the intended outcome when this failure cannot be attributed to chance.[21] He divides this into two categories: 1) ''slips,'' the result of the incorrect execution of the correct action sequence, and 2) ''mistakes,'' the result of the correct execution of an incorrect action sequence.[67]

Shortcuts in reasoning are referred to as ''heuristics'' by cognitive psychologists.

- *Availability errors* occur when the physician chooses the most likely diagnosis based on the condition he or she is most familiar with, thus limiting the consideration of other possibilities. For example, many EDs overdiagnose pelvic inflammatory disease and can fail to consider other causes of low abdominal pain in young women.

- *Context errors* occur when the physician inappropriately limits the set of diagnostic possibilities instead of considering others. For example, an ECG may be delayed or not performed in a patient with abdominal pain.
- *Anchoring heuristics* (or premature closure) is another shortcut in reasoning that can lead a clinician to stick with his or her initial impression and thus fail to check for disconfirming evidence. An example would be not considering an abdominal aortic aneurysm in a patient with a history of kidney stones presenting with back pain.

How information is presented can lead to markedly different decisions. This is known as the *framing effect* and can influence decision-making both by the patient and by the physician. For example, how a physician describes (frames) a lumbar puncture has an influence on whether or not the patient will agree to the procedure. Conversely, a patient who arrives with a plausible diagnosis in his or her mind can lead a physician to limit the choice of diagnostic possibilities. For example, a patient may have assumed that their headache was a ''migraine'' because that is what her or she was told previously, when in fact it could actually be something more serious. It takes a great deal of clinical skill to both collect clinical data and frame it.

Another focus area is selective versus undivided attention, especially in the context of the continual interruptions inherent in the ED. A simple aid, like a ''to-do list,'' may help overcome this. Understanding human memory is helpful. Humans have a temporary memory in which they store information for a very short time period and also a longer-term memory. Because of the amount and speed of information processing (and the need to ''delete'' some short-term memory stores), it is possible to ''forget'' about an admitted patient who experiences an extended ED stay because of delays in the admission process. Again, lists or some form of reminder system may prove helpful.

In recent years, much attention has been directed to identifying and preventing medical errors. The 1999 IOM report *To Err is Human,*[18] coupled with several high-profile media cases highlighting medical errors, catapulted the issue of errors in medicine into the consciousness of the public and policymakers.[1,68]

In 2001, the Joint Commission stated that ''patients and, when appropriate, their families are informed about the outcomes of care, including unanticipated outcomes.'' This may include an apology (where responsibility is taken for a mistake), which is different from an expression of empathy (''I am sorry''). An apology should be offered only after a thorough investigation and ideally with the collaborative support of the legal and risk management teams. While traditional risk management focuses on self-protection, or reducing the risk of financial loss, a disclosure (or ''early resolution'') approach focuses on addressing the needs (financial and emotional) of the patient and family and offers support to the involved practitioners. It is hoped that this approach will enable participants in the health care system to learn from errors and ''near misses'' to improve the delivery of care. There is early evidence that institutions that have a strong disclosure policy have reduced liability payouts. It is unknown whether or not these early financial successes are sustainable if the nation's economic conditions remain challenging.[20,67,69–73]

QUALITY PITFALLS IN EM

Caution: Limitations of Clinical Judgment in Ruling Out Serious Illness

According to some theories, clinical impressions formed and decisions made during the first five seconds of the patient encounter are more reliable than further examination and test results. Based on pattern recognition, many highly seasoned, experienced EPs seem to instinctively know the true situation in the diverse clinical scenarios faced. Critical, subtle differences are more easily picked up by experienced providers having seen many similar cases (e.g., myocardial infarctions, pulmonary emboli). However, the vast majority of problematic quality cases involve atypical presentations where the bias of clinical judgment has the power to fly in the face of the facts. Once biased toward a specific diagnosis, the physician often rationalizes the data and more heavily weighs evidence that supports the presumed diagnosis and can ignore evidence that does not.

Caution: Failure to Listen to and Take Into Consideration Family Recommendations

Frequently EPs are faced with a patient with altered mental status. Baseline mental status and functioning are critically important pieces of information that only family members can at times provide; it is very important to take cues from family members who know the patient and the home situation better than the health care staff. Family members often provide information that the patient and the emergency medical services personnel cannot. It is very important for the EP to seek out the family and listen carefully to their concerns, explain the medical reasoning for decisions, and reassess the situation as more information becomes available.

Caution: Inappropriate Deference to Consulting Services Who Have Not Assumed Patient Responsibility

Emergency physicians often rely on the telephone advice of a consultant who has not seen the patient in person. When an adverse outcome occurs, the memory of both parties in that conversation becomes more favorable to their position and the conversation can be misrepresented. It is advisable to carefully document all conversations clearly on the chart. If there is a difference of opinion between the EP and the consultant, it is important that the consultant be asked to evaluate the patient in person. Most critically, the EP should not allow a consultant to talk him or her out of an admission, as discharged patients carry the highest risk.

Caution: Communication and the Art of the Hand-off

Communication errors are likely the root cause in about 70% of medical errors. Implementing a standardized approach to ''hand-off ''communications, including an opportunity to ask and respond to questions, is a

national patient safety goal. Effective hand-offs in EM require well-designed tools, procedures, and communication.[74]

CLINICAL MICROSYSTEMS*

True Structure of the System

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. However, the system that the patients experience varies widely; systems may work well together or not at all. 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 are the primary place where quality and value of care are produced. Microsystems improvement can transform health care at the front line of service delivery.[75]

Embedded Systems

Microsystems evolve over time and are often embedded in larger organizations. They are complex adaptive systems. A clinical microsystem is a small group of people who work together on a regular basis to provide care to a subpopulation of patients; it has clinical and business aims, linked processes, and a shared information environment, and it produces performance outcomes.

The Need to Transform Front Lines

Top-performing clinical microsystems are vibrant, vital, dynamic, self-aware, small-scale enterprises led with intelligence and staffed by skilled, caring, and self-critical personnel. The fundamental nature and power of using microsystem-based approaches for strategic thinking, operations excellence, and creating change and innovation can transform front-line care.

PATIENT SATISFACTION: SURROGATE MARKER OF QUALITY

As health care institutions and practices strive to manage the trends demanding increased accountability, patient satisfaction data[76] have become more important, and some argue that it is a surrogate marker of quality. An obstacle to using patient satisfaction scores is the variation in measurement tools and difficulty with getting a large enough sample to be statistically useful. Other challenges are attaching weight (or value) to these measures in comparison to process or outcome data. The most common measurement tool is the Press Ganey survey. Some health plans use the federal Consumer Assessment of Health Plans Survey. However, this tool is not physician- or practice-specific. Some physicians bonuses are partially based on patient satisfaction data. Health care organizations are struggling with how to improve their measures, as these data are beginning to be publicly reported. There is a strong link between patient satisfaction and provider satisfaction. Patients who are satisfied with their care may be more likely to be compliant with their treatment regimen. It is wise to serve both communities when considering how to improve patient satisfaction by striving to create a positive, purposeful, results-oriented learning environment.

References

1. Institute of Medicine, Committee on Quality of Health Care in America. Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, DC: National Academies Press, 2001.
2. Mallon B. Ernest Amory Codman: The End Result of a Life in Medicine. Philadelphia, PA: W. B. Saunders, 2000.
3. Donabedian A. Evaluating the quality of medical care. Milbank Mem Fund Q. 1966; 44:166–206.
4. The W. Edwards Deming Institute. W. Edwards Deming biography. Available at: http://deming.org/index.cfm?content=61. Accessed Jul 20, 2010.
5. Defeo JA, Juran JM. Juran's Quality Handbook. The Complete Guide to Performance Excellence, 6th ed. New York, NY: McGraw-Hill, 2000.
6. Wennberg JE, Gittelsohn A. Small area variations in health care delivery. Science. 1973; 182:1102–8.
7. Fisher ES, Wennberg DE, Stukel TA, et al. The implications of regional variations in Medicare spending. Part I: the content, quality, and accessibility of care. Ann Intern Med. 2003; 138:273–87.
8. Fisher ES, Wennberg DE, Stukel TA, et al. The implications of regional variations in Medicare spending. Part 2: health outcomes and satisfaction with care. Ann Intern Med. 2003; 138:288–98.
9. Berwick DM, Godfrey AB, Roessner J. Curing Health Care: New Strategies for Quality Improvement. Hoboken, NJ: Wiley/Jossey-Bass, 1990.
10. Berwick DM. Continuous improvement as an ideal in health care. N Engl J Med. 1989; 320:53–6.
11. McCannon CJ, Hackbarth AD, Griffin FA. Miles to go: an introduction to the 5 Million Lives Campaign. Jt Comm J Qual Patient Saf. 2007; 33:477–84.
12. Berwick DM, Calkins DR, McCannon CJ, Hackbarth AD. The 100,000 lives campaign: setting a goal and a deadline for improving health care quality. JAMA. 2006; 295:324–7.
13. Leonhardt D. Making Health Care Better. The New York Times, 2009, November 3rd. Available at: http://www.nytimes.com/2009/11/08/magazine/08Healthcare-t.html?_r=2&ref=magazine. Accessed Jul 20, 2010.
14. Wachter RM. Understanding Patient Safety. New York, NY: McGrawHill, 2008.
15. Leape LL. Error in medicine. JAMA. 1994; 272:1851–7.
16. Provonost P, Needham D, Berenholtz S, et al. An intervention to decrease catheter-related bloodstream infections in the ICU. N Engl J Med. 2006; 355:2725–32.
17. Joint Commission. Approved: 2010 National Patient Safety Goals. Some changes effective immediately. Jt Comm Perspect. 2009; 29:1, 20–31.
18. Kohn LT, Corrigan JM, Donaldson MS (eds). To Err is Human: Building a Safer Health System. Washington, DC: National Academies Press, 1999.
19. International Ergonomics Association. What is Human Factors/Ergonomics? Available at: http://www.

hfes.org/web/AboutHFES/about.html. Accessed Jul 20, 2010.
20. Reason JT. Managing the Risks of Organizational Accidents. London: Ashgate Publishing, 1997.
21. Reason JT. Human Error. New York, NY: Cambridge University Press, 1990.
22. Weick KE, Sutcliffe KM. Managing the Unexpected: Assuring High Performance in an Age of Complexity. Hoboken, NJ: Wiley/Jossey-Bass, 2001.
23. Rochlin GI, La Porte TR, Roberts KH. The self-designing high-reliability organization: aircraft carrier flight operations at sea. Naval War College Rev. 1987; Autumn.
24. Nolan T, Resar R, Haraden C, Griffin F. Improving the Reliability of Health Care. Innovation Series White paper. Boston, MA: Institute for Healthcare Improvement, 2004.
25. Welch SJ, Jensen K. The concept of reliability in emergency medicine. Am J Med Quality. 2007; 22:50–8.
26. Wheeler DJ. Understanding Variation: The Key to Managing Chaos. Knoxville, TN: SPC Press, 2000.
27. Kilo CM. Educating physicians for systems-based practice. J Contin Educ. 2008; 28(Suppl 1):S15–8.
28. Horn SD. Performance measures and clinical outcome. JAMA. 2006; 296:2731–32.
29. Wachter RM, Flanders SA, Fee C, Pronovost PJ. Public reporting of antibiotic timing in patients with pneumonia: lessons from a flawed performance measure. Ann Int Med. 2008; 149:29–32.
30. Fernandez R, Vozenilek JA, Hegarty CB, et al. Developing expert medical teams: toward an evidence-based approach. Acad Emerg Med. 2008; 15:1025–36.
31. Fernandez R, Kozlowski SW, Shapiro MJ, Salas E. Toward a definition of teamwork in emergency medicine. Acad Emerg Med. 2008; 15:1104–12.
32. Salas E, Diazgranados D, Weaver SJ, King H. Does team training work? Principles for health care. Acad Emerg Med. 2008; 15:1002–9.
33. Baker DP, Salas E, King H, Battles J, Barach P. The role of teamwork in the professional education of physicians: current status and assessment recommendations. Jt Comm J Qual Patient Saf. 2005; 31:185–202.
34. Morey JC, Simon R, Jay GD, et al. Error reduction and performance improvement in the emergency department through formal teamwork training: evaluation results of the MedTeams project. Health Serv Res. 2002; 37:1553–81.
35. Grogan EL, Stiles RA, France DJ, et al. The impact of aviation-based teamwork training on the attitudes of healthcare professionals. J Am Coll Surg. 2004; 199:843–8.
36. Pizzi L, Goldfarb N, Nash D. Crew resource management and its applications in medicine. In: Shojania KG, Duncan BW, McDonald KM, Wachter RM (eds). Making Healthcare Safer: A Critical Analysis of Patient Safety Practices. Rockville, MD: Agency for Healthcare Research and Quality, 2001, Evidence Report/Technology Assessment Number 43. AHRQ Publication 01-E058.
37. Bond WF, Lammers RL, Spillane L, et al. The use of simulation in emergency medicine: a research agenda. Acad Emerg Med. 2007; 14:353–63.
38. Rosen MA, Salas E, Wu TS, et al. Promoting teamwork: an event-based approach to simulation-based teamwork training for emergency medicine residents. Acad Emerg Med. 2008; 15:1190–8.
39. Shapiro MJ, Gardner R, Godwin SA, et al. Defining team performance for simulation-based training: methodology, metrics, and opportunities for emergency medicine. Acad Emerg Med. 2008; 15:1088–97.
40. Outcome Engineering, LLC. Just Culture Training for Healthcare Managers. Plano, TX: Outcome Engineering LLC, 2007, P 7.
41. Kotter J, Cohen D. The Heart of Change: Real-life Stories of How People Change Their Organizations. Boston, MA: Harvard Business Press, 2002.
42. Boyatzis R, McKee A. Resonant Leadership. Boston, MA: Harvard Business School Press, 2005.
43. Goleman D, Boyatzis R, McKee A. Primal Leadership. Boston, MA: Harvard Business School Press, 2002.
44. Langley GL, Nolan KM, Nolan TW, Norman CL, Provost LP. The Improvement Guide: A Practical Approach to Enhancing Organizational Performance. San Francisco, CA: Jossey-Bass, 1996.
45. Speroff T, O'Connor GT. Study designs for PDSA quality improvement research. Qual Manage Health Care. 2004; 13:17–32.
46. VA National Center for Patient Safety. The Basics of Failure Mode and Effects Analysis. Available at: http://www.va.gov/ncps/SafetyTopics/HFMEA/HFMEAIntro.pdf. Accessed September 1, 2010.
47. DeRosier J, Stalhandske E, Bagian JP, Nudell T. Using health care failure mode and effect analysis: the VA National Center for Patient Safety's prospective risk analysis system. Jt Comm J Qual Improv. 2002; 28:248–67.
48. Welch SJ, Augustine J, Reese C, et al. Performance measures and benchmarking summit: a consensus statement. Acad Emerg Med. 2006; 13:1074–80.
49. Chan TC, Killeen JP, Kelly D, Guss DA. Impact of rapid entry and accelerated care at triage on reducing emergency department patient wait times, lengths of stay, and rate of left without being seen. Ann Emerg Med. 2005; 47:491–7.
50. Welch SJ. Quality Matters: Solutions for a Safe and Efficient Emergency Department. Chicago, IL: Joint Commission Resources Publishing, 2009, pp 39–84.
51. Welch SJ, Jones SS, Allen T. Mapping the 24 hour ED cycle to improve patient flow. Jt Comm J Qual Patient Saf. 2007; 33:247–55.
52. Husk G, Waxman D. Using data from hospital information systems to improve emergency department care. Acad Emerg Med. 2004; 11:1237–44.
53. Provonost PJ, Holzmueller CQ. A practical tool to learn from defects in patient care. Jt Comm J Qual Saf. 2006; 32:102–8.
54. Griffey RT, Wittels K, Gilboy N, McAfee AT. Use of a computerized forcing function improves performance in ordering restraints. Ann Emerg Med. 2008; 53:469–76.

55. Chen CI, Choy CS, Chu TB, et al. Safety portal: the safest goes through the air–ubiquitous high-risk reminders bridging out the patient safety in emergency department. Stud Health Technol Inform (Netherlands). 2006; 124:77–82.
56. Yamamoto LG, Khan AN. Challenges of electronic medical record implementation in the emergency department. Pediatr Emerg Care. 2006; 22:184–91.
57. Scott JT, Rundall TG, Vogt TM, et al. Kaiser Permanente's experience of implementing an electronic medical record: a qualitative study. Br Med J. 2005; 331:1313–6.
58. Likourezos A, Chalfin DB, Murphy DG, et al. Physician and nurse satisfaction with an electronic medical record system. J Emerg Med. 2004; 27: 419–24.
59. Davidson SJ, Zwemer FL, Nathanson LA, et al. Where's the beef? The promise and the reality of clinical documentation. Acad Emerg Med. 2004; 11:1127–34.
60. Garg A, Adhikari NK, McDonald H, et al. Effects of computerized clinical decision support systems on practitioner performance and patient outcomes: a systematic review. JAMA. 2005; 293:1223–38.
61. Campbell EM, Sittig DF, Ash JS, Guappone KP, Dykstra RH. In reply to: e-Iatrogenesis: The most critical consequence of CPOE and other HIT. J Am Med Inform Assoc. 2007; 14:389.
62. Banet GA, Jeffe DB, Williams JA, et al. Effects of implementing computerized practitioner order entry and nursing documentation on nursing workflow in an emergency department. J Healthc Inf Manag. 2006; 20:45–54.
63. bBNET. Leapfrog: quality assurance required with CPOE systems. Healthcare Benchmarks Qual Improv. 2008; 15:123–5.
64. Classen DC, Avery AJ, Bates DW. Evaluation and certification of computerized provider order entry systems. J Am Med Inform Assoc. 2007; 14:48–55.
65. Handler JA, Feied CF, Coonan K, et al. Computerized physician order entry and online decision support. Acad Emerg Med. 2004; 11:1135–41.
66. Cuggia M, Rossille D, Arnault A, et al. Towards a decision support system for optimising clinical pathways of elderly patients in an emergency department. Stud Health Technol Inform (Netherlands). 2007; 129(Pt 2):840–4.
67. Schenkel S. Promoting patient safety and preventing medical error in emergency departments. Acad Emerg Med. 2000; 7:1204–22.
68. Saathoff A. Human factors considerations relevant to CPOE implementations. J Healthc Inf Manag. 2005; 19:71–8.
69. Fordyce J, Blank FS, Pekow P, et al. Errors in a busy emergency department. Ann Emerg Med. 2003; 42:324–33.
70. Kassirer JP. Diagnostic reasoning. Ann Intern Med. 1989; 119:893–900.
71. Moscop JC, Geiderman JM, Hobgood CD, Larkin GL. Emergency physicians and disclosure of medical errors. Ann Emerg Med. 2006; 48:523–31.
72. Leape L, Berwick DM, Dates DW. What practices will most improve safety? Evidence-based medicine meets patient safety. JAMA. 2002; 288:501–7.
73. Wojcieszak D, Saxton J, Finkelstein M. Sorry Works! Disclosure, Apology, and Relationships Prevent Medical Malpractice Claims. Bloomington, IN: AuthorHouse, 2008.
74. Cheung DS, Kelly JJ, Beach C. Improving handoffs in the emergency department. Ann Emerg Med. 2010; 55:171–83.
75. Godfrey MM, Nelson EC, Wasson JH, Mohr JJ, Batalden PB. Microsystems in health care: Part 3: planning patient-centered services. Jt Comm J Qual Safe. 2003; 29:159–70.
76. Boudreaux ED. The use of performance improvement methods to enhance emergency department patient satisfaction in the United States: a critical review of the literature and suggestions for future research. Acad Emerg Med. 2006; 13:795–802.

APPENDIX A

Glossary of Stakeholders/Resources

Abbreviation	Name	Description	Type	Website
AHRQ	Agency for Healthcare Research and Quality	Health services research agency of HHS	Public	http://www.ahrq.gov/
AMA	American Medical Association	Physician membership association	Private	http://www.ama-assn.org/ama/home/index.shtml
ANA	American Nurses Association	Nurse membership association	Private	http://www.nursingworld.org/
CCHIT	Certification Commission for Health Information Technology	Certification body inspecting electronic health records and health information exchanges	Private	http://www.cchit.org/
CMS	Centers for Medicare & Medicaid Services	Federal agency responsible for administering the Medicare and Medicaid programs	Public	http://www.cms.hhs.gov/
HHS	U.S. Department of Health and Human Services	Principal U.S. health agency	Public	http://www.hhs.gov/
Hospital Compare	Hospital Compare	Public reporting of hospital performance	Public	http://www.HospitalCompare.hhs.gov
HQA	Hospital Quality Alliance	Public–private partnership that has developed hospital quality measurement and public reporting at the Hospital Compare website	Private	http://www.hospitalqualityalliance.org/
IHI	Institute for Healthcare Improvement	Helps accelerate change in improving patient care	Private	http://www.ihi.org/ihi
IOM	Institute of Medicine	Health arm of the National Academy of Sciences—provides unbiased/authoritative advice to decision-makers and the public	Private	http://www.iom.edu/
JCAHO (JCAH)	Joint Commission on Accreditation of Health-care Organizations	Health care accreditation organization (now known as The Joint Commission)	Private	http://www.jointcommission.org/
Leapfrog	The Leapfrog Group	Health care purchaser group working to improve safety, quality, and affordability of health care	Private	http://www.leapfroggroup.org/
NCQA	National Committee for Quality Assurance	Health insurance plan quality and performance	Private	http://www.ncqa.org/
NGC	National Guideline Clearinghouse	Public resource for evidence-based clinical practice guidelines	Public	http://www.guideline.gov/
NIH	National Institutes of Health	Biomedical research agency of HHS	Public	http://www.nih.gov/
NPP	National Priorities Partnership	32 public/private organizations working to influence America's health care system	Private	http://www.nationalprioritiespartnership.org/
NQF	National Quality Forum	Private/public partnership to develop continuous quality improvement solutions	Private	http://www.qualityforum.org/
NQMC	National Quality Measures Clearinghouse	Public repository for evidence-based quality measures and measure sets	Public	http://www.qualitymeasures.ahrq.gov/
PCPI	Physician Consortium for Performance Improvement	American Medical Association group working to enhance quality care and patient safety through the development, testing, and maintenance of evidence-based clinical performance measures	Private	http://www.ama-assn.org/ama/pub/physician-resources/clinical-practice-improvement/clinical-quality/physician-consortium-performance-improvement.shtml
TJC	The Joint Commission	Health care accreditation organization	Private	http://www.jointcommission.org/

APPENDIX B

Additional References

1. Adams J, Feied C, Gillam M, et al. Emergency medicine information technology consensus conference: executive summary. Acad Emerg Med. 2004; 11:1112–3.
2. Adams JG, Biros MH. The Elusive Nature of Quality. Acad Emerg Med. 2002; 9:1067–70.
3. Altman DE, Clancy C, Blendon RJ. Improving patient safety–five years after the IOM report. N Engl J Med. 2004; 351: 2041–3.
4. Adams J, Feied C, Gillam M, et al. Emergency medicine information technology consensus Anonymous. Clean beds, less-crowded. State-of-the-art bed tracking leads to shorter ED wait and faster turn-arounds. Health Manag Technol. 2008; 29:26–7, 37.
5. Anonymous. Duke University Hospital uses rapid deployment to implement CPOE, clinical decision support. Perform Improv Advis. 2005; 9:44–6, 37.
6. Anonymous. Pay for performance linked to better care for some primary care patients in UK. Br Med J. 2007; 335:121–b.
7. Asaro PV, Sheldahl AL, Char DM. Embedded guideline information without patient specificity in a commercial emergency department computerized order-entry system. Acad Emerg Med. 2006; 13:452–8.
8. Aspden P, Corrigan JM, Wolcott J, Erickson SM (eds). Patient Safety: Achieving a New Standard for Care: Data Standards for Patient Safety. Washington, DC: National Academies Press, 2004.
9. Baker GR, Norton PG, Flinntoft V, et al. The Canadian Adverse Events Study: the incidence of adverse events among hospitalized patients in Canada. Can Med Assoc J. 2004; 170:1678–86.
10. Barron WM, Kuczewski MG. Unanticipated harm to patients: deciding when to disclose outcomes. Jt Comm J Qual Safe. 2003; 29:551–5.
11. Barthell E, Coonan K, Finnell J, et al. Disparate systems, disparate data: integration, interfaces and standards in emergency medicine information technology. Acad Emerg Med. 2004; 11: 1142–8.
12. Bataldin P, Davidoff F. Teaching QI to residents: the devil is in the details. JAMA. 2007; 298:1059.
13. bBNET. Study: implementation of CPOE can raise mortality. Healthcare Benchmarks Qual Improv. 2006; 13:16–7.
14. bBNET. Stunning CPOE study spurs immediate action in Massachusetts. Healthcare Benchmarks Qual Improv. 2008; 15:37–40.
15. Berwick DM. Public performance reports and the will for change. JAMA. 2002; 288:1523–4.
16. Bierly PE, Spender JC. Culture and high reliability organizations: the case of the nuclear submarine. J Manage. 1995; Winter.
17. Bierman AS, Clark JP. Performance measurement and equity. Br Med J. 2007; 334:1333–4.
18. Boger E. Electronic tracking board reduces ED patient length of stay at Indiana Hospital. J Emerg Nurs. 2003; 29:39–43.
19. Boonyasai RT, Windish DM, Chakraborti C, et al. Effectiveness of teaching QI to clinicians: a systematic review. JAMA. 2007; 298:1023–37.
20. Bratzler DW, Nsa W, Houck PM. Performance measures for pneumonia: are they valuable, and are process measures adequate? Curr Opin Infect Dis. 2007; 20:182–9.
21. Brown MD, Reeves MJ, Glynn T, et al. Implementation of an emergency department based transient ischemic attack clinical pathway: a pilot study in knowledge translation. Acad Emerg Med. 2007; 14:1114–9.
22. Bullard MJ, Emond SD, Graham TA, et al. Informatics and knowledge translation. Acad Emerg Med. 2007; 14:996–1002.
23. Burt CW, Hing E. Use of computerized clinical support systems in medical settings: United States, 2001–03. Adv Data. 2005; 353:1–8.
24. Callen JL, Westbrook JI, Braithwaite J. The effect of physicians' long-term use of CPOE on their test management work practices. J Am Med Inform Assoc. 2006; 13:643–52.
25. Casalino LP, Alexander C, Jin L, et al. General internists' view on pay-for-performance and public reporting of quality scores: a national survey. Health Affairs. 2007; 26:492–9.
26. Champion R, Kinsman LD, Lee GA, et al. Forecasting emergency department presentations. Aust Health Rev (Australia). 2007; 31:83–90.
27. Chassin MR, Galvin RW. The urgent need to improve health care quality: Institute of Medicine National Roundtable on Health Care Quality. JAMA. 1998; 280:1000–5.
28. Chassin MR, Brook RH, Park RE, et al. Variations in the use of medical and surgical services by the Medicare population. N Engl J Med. 1986; 314:285–90.
29. Choi YF, Wong TW, Lau CC. Triage rapid initial assessment by doctor (TRIAD) improves waiting time and processing time of the emergency department. Emerg Med J. 2006; 23:262–5.
30. Choudhry NK, Letcher RH, Soumerai SB. Systematic review: the relationship between clinical experience and quality of health care. Ann Intern Med. 2005; 142:260–73.
31. Cone DC, Nedza SM, Augustine JJ, et al. Quality in clinical practice. Acad Emerg Med. 2002; 9:1085–1090.
32. Connelly LG, Bair AE. Discrete event simulation of emergency department activity: a platform for system-level operations research. Acad Emerg Med. 2004; 11:1177–85.
33. Davis P, Lay-Yee R, Briant R, Ali W, Scott A, Schugs S. Adverse events in New Zealand public hospitals I: occurrence and impact. N Z Med J. 2002; 115:U271.
34. Dekker S. Just Culture: Balancing Safety and Accountability. Farnham, UK: Ashgate, 2007.
35. Donabedian A. Explorations in Quality Assessment and Monitoring. Definition of Quality and Approaches to Its Assessment. Ann Arbor, MI: Health Administration Press, 1980.

36. Dong S, Bullard M, Meurer D, et al. Emergency triage: comparing a novel computer triage program with standard triage. Acad Emerg Med. 2005; 12:502–7.
37. Dong S, Bullard M, Meurer D, et al. Reliability of computerized emergency triage. Acad Emerg Med. 2006. 13:269–75.
38. Dong SL, Bullard MJ, Meurer DP, et al. Predictive validity of a computerized emergency triage tool. Acad Emerg Med. 2007; 14:16–21.
39. Epstein AM. Pay for performance at the tipping point [editorial]. N Engl J Med. 2007; 356:515–7.
40. Evans R, Elwyn G, Edwards A. Review of instruments for peer assessment of physicians. Br Med J. 2004; 328:e1240.
41. Fernandez R, Kozlowski, SW, Shapiro, MJ, Salas, E. Toward a definition of teamwork in emergency medicine. Acad Emerg Med. 2008; 15:1–9.
42. Flanagan T. Charting a course for accuracy in the ED. A multi-hospital network rolls out electronic nurse charting. Health Manag Technol. 2007; 28:28–9.
43. Fonarow GC, Abraham WT, Albert NM, et al. Association between performance measures and clinical outcomes for patients hospitalized with heart failure. JAMA. 2007; 297:61–70.
44. Frohna W, King K, Photowala H. Improving time to antibiotics in pneumonia–does it save lives? Acad Emerg Med. 2007; 14: S161.
45. Gaba DM, Howard SK. Patient safety. Fatigue among clinicians and the safety of patients. N Engl J Med. 2002; 347:1249–55.
46. Gallagher TH, Studdert D, Levinson W. Disclosing harmful medical errors to patients. N Engl J Med. 2007; 356: 2713–9.
47. Gallagher EJ. How well do clinical practice guidelines guide clinical practice? Ann Emerg Med. 2002; 40:394–8.
48. Galvin RS, Delbanco S, Milstein A, et al. Has the Leapfrog Group had an impact on the health care market? Health Aff (Millwood). 2005; 24:228–33.
49. Garg AX, Adhikari NK, McDonald H, et al. Effects of computerized clinical decision support systems on practitioner performance and patient outcomes. JAMA. 2005; 293:1223–38.
50. Gillam M, Rothenhaus T, Smith V, et al. Information technology principles for management, reporting, and research. Acad Emerg Med. 2004; 11:1155–61.
51. Glickman SW, Schulman KA, Peterson ED, Hocker MG, Cairns CB. Evidence-based perspectives on pay for performance and quality of patient care and outcomes in emergency medicine. Ann Emerg Med. 2008; 51:622–31.
52. Glickman SW, Ou FS, DeLong ER, et al. Pay for performance, quality of care, and outcomes in acute myocardial infarction. JAMA. 2007; 297:2373–80.
53. Godfrey MM, Nelson EC, Wasson JH, Mohr JJ, Batalden PB. Microsystems in health care: part 3: planning patient-centered services. Jt Comm J Qual Safe. 2003; 29:159–70.
54. Gordon B, Asplin B. Using online analytical processing to manage emergency department operations. Acad Emerg Med. 2004; 11:1206–12.
55. Gorsha N, Stogoski J. Transforming emergency care through an innovative tracking technology: an emergency department's extreme makeover. J Emerg Nurs. 2006, 32:254–7.
56. Gotham IJ, Sottolano DL, Hennessy ME, et al. An integrated information system for all-hazards health preparedness and response: New York State Health Emergency Response Data System. J Public Health Manag Pract. 2007; 13:486–96.
57. Graber MA, Van Scoy D. How well does decision support software perform in the emergency department? Emerg Med J (England). 2003; 20: 426–8.
58. Graff L, Palmer AC, Lamonica P, Wolf S. Triage of patients for a rapid (5-minute) electrocardiogram: a rule based on presenting chief complaints. Ann Emerg Med. 2000; 36:554–60.
59. Graff L, Stevens C, Spaite D, et al. Measuring and improving quality in emergency medicine. Acad Emerg Med. 2002; 9:1091–107.
60. Graham TA, Bullard MJ, Kushniruk AW, et al. Assessing the sensibility of two clinical decision support systems. J Med Syst. 2008; 32:361–8.
61. Greene SE, Nash DB. Pay for performance: an overview of the literature. Am J Med Qual. 2008; 24:140–63.
62. Handel DA, Hackman JL. Implementing electronic health records in the emergency department. J Emerg Med. 2008; 38:257–63.
63. Henkind SJ, Sinnett JC. Patient care, square-rigger sailing, and safety. JAMA. 2008; 300:1691–3.
64. Henneman PL, Blank FS, Smithline HA, et al. Voluntarily reported emergency department errors. J Patient Safe. 2005; 1:126–32.
65. Higashi T, Wenger NS, Adams JL, et al. Relationship between number of medical conditions and quality of care. N Engl J Med. 2007; 356: 2496–504.
66. Holmboe ES, Lipner R, Greiner A. Assessing quality of care: knowledge matters. JAMA. 2008; 299:338–40.
67. Holroyd BR, Bullard MJ, Graham TA, et al. Decision support technology in knowledge translation. Acad Emerg Med. 2007; 14:942–8.
68. Inquilla CC, Szeinbach S, Seoane-Vazquez E, et al. Pharmacists' perceptions of computerized prescriber-order-entry systems. Am J Health Syst Pharm. 2007; 64:1626–32.
69. Institute for Healthcare Improvement. Going Lean in Healthcare. Innovation Series White Paper. Cambridge, MA: Institute for Healthcare Improvement, 2005.
70. Institute of Medicine. Committee on Quality Health Care in America. Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, DC: National Academies Press, 2001.
71. Institute of Medicine. Committee on Redesigning Health Insurance Performance Measures, Payment, and Performance Improvement Programs. Performance Measurement: Accelerating Improve-

ment. Washington, DC: National Academies Press, 2006
72. Institute of Medicine. Committee on the Future of Emergency Care in the United States Health System. Hospital-based Emergency Care: At the Breaking Point. Washington, DC: National Academies Press, 2006
73. Institute of Medicine. IOM report: Creating a Business Case for Quality Improvement Research: Expert Views, Workshop Summary. Washington, DC: National Academies Press, 2008.
74. Jaipaul CK, Rosenthal GE. Do hospitals with lower mortality have higher patient satisfaction? A regional analysis of patients with medical diagnoses. Am J Med Qual. 2003; 18:59–65.
75. Jaipaul CK. Rosenthal GE. Are older patients more satisfied with hospital care than younger patients? J Gen Intern Med. 2003; 18:23–30.
76. Jennings B, Baily MA, Bottrell M, Lynn J (eds). Health Care Quality Improvement: Ethical and Regulatory Issues. Garrison, NY: The Hastings Center, 2007
77. Jha AK, Orav EJ, Li Z, Epstein AM. The inverse relationship between mortality rates and performance in the hospital quality alliance measures. Health Aff (Millwood). 2007; 26:1104–10.
78. Jones SS, Thomas A, Evans RS, et al. Forecasting daily patient volumes in the emergency department. Acad Emerg Med. 2008; 15:159–70.
79. Kamerow D. The side effects of ''P4P.'' Br Med J. 2007; 334:0–a.
80. Kaushal R, Jha AK, Franz C, et al. Return on investment for a computerized physician order entry system. J Am Med Inform Assoc. 2006; 13:261–6.
81. Keim SM, Spaite DW, Maio, RF, et al. Establishing the scope and methodological approach to out-of-hospital outcomes and effectiveness research. Acad Emerg Med. 2004; 11: 1067–73.
82. Ketcham JD, Baker LC, MacIsaac D. Physician practice size and variations in treatments and outcomes: evidence from Medicare patients with AMI. Health Aff (Millwood). 2007; 26:195–205.
83. Kierzek G, Claessens YE, Pourriat JL, et al. Real time monitoring of crowding in emergency departments. Ann Emerg Med. 2008; 51:212–3.
84. Kilbridge PM, Welebob EM, Classen DC. Development of the Leapfrog methodology for evaluating hospital implemented inpatient computerized physician order entry systems. Qual Saf Health Care (England). 2006; 15:81–4.
85. Kizer KW. The emerging imperative for health care quality. Acad Emerg Med. 2002; 9:1078–84.
86. Klein G. Sources of Power: How People Make Decisions. Cambridge, MA: MIT Press, 1998.
87. Krumholz KM, Normand SL, Spertus JA, Shahian DM, Bradley EH. Measuring performance for treating heart attacks and heart failure: the case for outcomes measurement. Health Aff (Millwood). 2007; 26:75–85.
88. Leape L. Disclosing Medical Errors: A Guide to Effective Explanation and Apology. Foreword Chicago, IL: Joint Commission, 2007.
89. Leape LL, Berwick DM. Five years after To Err Is Human. What have we learned? JAMA. 2005; 1758–9.
90. Leatherman S, Berwick D, Iles D, et al. The business case for quality: case studies and an analysis. Health Aff (Millwood). 2003; 22:17–30.
91. Lee TH, Torchiana DF, Lock JE. Is zero the ideal death rate? N Engl J Med. 2007; 357:111–3.
92. Leenstra JL. Validation of a method for assessing resident physicians' quality improvement proposals. J Gen Intern Med. 2007; 22:1330–4.
93. Lehmann CU, Kim GR. Computerized provider order entry and patient safety. Pediatr Clin North Am. 2006; 53:1169–84.
94. Levin S, France DJ, Hemphill R, et al. Tracking workload in the emergency department. Hum Factors. 2006; 48:526–39.
95. Lewis MH, Gohagan JK, Merenstein DJ. The locality rule and the physician's dilemma: local medical practices vs. the National standard of care. JAMA. 2007; 297:2633–7.
96. Lewis S. New tracking systems improve patient flow. ED Manag. 2005; 17:91–2.
97. Lewis S. New computer network helps EDs to reduce redundant test orders. ED Manag. 2008; 20:133–4.
98. Liew D, Kennedy MP. Emergency department length of stay independently predicts inpatient length of stay. Med J Aust. 2003; 179: 516–7.
99. Lindenauer PK, Remus D, Roman S, et al. Public reporting and pay for performance in hospital quality improvement. N Engl J Med. 2007; 356:486–96.
100. Lindenauer PK. Public reporting and pay for performance in hospital quality improvement. N Engl J Med. 2007; 356:1782–3.
101. Lindsay P, Schull M, Bronskill S, et al. The development of indicators to measure the quality of clinical care in the emergency departments following a modified-delphi approach. Acad Emerg Med. 2002; 9:1131–9.
102. Lohr KN (ed). Medicare: A Strategy for Quality Assurance, Vol. I. Washington, DC: National Academies Press, 1990.
103. Longo D, Hewett JE, Ge B, Schubert S. The long road to patient safety. A status report on patient safety systems. JAMA. 2005; 294:2858–65.
104. Magid DJ, Rhodes KV, Asplin BR, et al. Designing a research agenda to improve the quality of emergency care. Acad Emerg Med. 2002; 9:1124–30.
105. McGlynn EA, Asch SM, Adams J, et al. The quality of health care delivered to adults in the United States. N Engl J Med. 2003; 348: 2635–45.
106. Meurer LN, Yang H, Guse CE, Russo C, Brasel KJ, Layde PM. Excess mortality caused by medical injury. Ann Fam Med. 2006; 4:410–6.
107. Mullen KM, Bradley EH, Mansi IA, et al. Public reporting and pay for performance. N Engl J Med. 2007; 356:1782–4.
108. Murff HJ, France DJ, Blackford J, et al. Relationship between patient complaints and surgical complications. Qual Safe Health Care. 2006; 15:13–6.

109. Musson DM, Helmreich RL. Team training and resource management in health care: current issues and future directions. Harvard Health Pol Rev. 2004; 5:25–35.
110. Nagurney JT, Brown DF, Sane S, Weiner JB, Wang AC, Chang Y. The accuracy and completeness of data collected by prospective and retrospective methods. Acad Emerg Med. 2005; 12:884–95.
111. Narins CR, Dozier AM, Ling FS, et al. The influence of public reporting of outcome data on medical decision making by physicians. Arch Intern Med. 2005; 165:83–7.
112. Nebeker JR, Barach P, Samore MH. Clarifying adverse drug events: a clinician's guide to terminology, documentation, and reporting. Ann Intern Med. 2004; 140:795–801.
113. Nelson EC, Batalden P, Godfrey M. Quality by Design: A Clinical Microsystem Approach. San Francisco, CA: Jossey-Bass, 2007.
114. Nelson EC, Batalden PB, Huber TP, et al. Microsystems in healthcare: Part 1. Learning from the high-performing front-line clinical units. J Qual Improv. 2002; 28:472–93.
115. Noon CE, Hankins CT, Cote MJ. Understanding the impact of variation in the delivery of healthcare services. J Healthc Manage. 2003; 48:82–98.
116. O'Brien SM, Peterson ED. Identifying high-quality hospitals: consult the ratings or flip a coin? Arch Intern Med. 2007; 167:1342–4.
117. O'Connor GT, Plume SK, Olmstead EM, et al. A regional intervention to improve the hospital mortality associated with coronary artery bypass graft surgery. JAMA. 1996; 275:841–6.
118. Ostbye T, Lobach DF, Cheesborough D, et al. Evaluation of an infrared/radiofrequency equipment-tracking system in a tertiary care hospital. J Med Syst. 2003; 27:367–80.
119. Oyler J, Vinci L, Arora V, Johnson J. Teaching internal medicine residents quality improvement techniques using the ABIM's practice improvement modules. J Gen Intern Med. 2008; 23:927–30.
120. Paladini M. Daily emergency department surveillance system — Bergen County, New Jersey. MMWR Morb Mortal Wkly Rep. 2004; 53(Suppl):47–9.
121. Patterson K, Grenny J, McMillan R, Switzler A. Crucial Conversations: Tools for Talking When Stakes are High. New York, NY: McGraw-Hill, 2002.
122. Patterson K, Grenny J, McMillan R, Switzler A. Crucial Confrontations: Tools for Resolving Broken Promises, Violated Expectations, and Bad Behavior. New York, NY: McGraw-Hill, 2005.
123. Petersen LA, Woodard LD, Urech T, Daw C, Sookanan S. Does pay-for-performance improve the quality of health care? Ann Intern Med. 2006; 145: 265–72.
124. Peterson ED. Optimizing the science of quality improvement. JAMA. 2005; 294:369–71.
125. Pines JM, Hollander JE, Lee W, Everett WW, Uscher-Pines L, Metlay JP. Emergency department operational changes in response to pay-for-performance and antibiotic timing in pneumonia. Acad Emerg Med. 2007; 14:545–8.
126. Pirmohamed M, James S, Meakin S, et al. Adverse drug reactions as cause of admission to hospital: prospective analysis of 18,820 patients. Br Med J. 2004; 329:15–9.
127. Powers R, Phipps J. Utilization of information systems for ED disaster registration and tracking. J Emerg Nurs. 2006, 32:497–501.
128. Quinn J, Durski K. A real-time tracking, notification, and web-based enrollment system for emergency department research. Acad Emerg Med. 2004; 11:1245–8.
129. Reason J. Human error: models and management. Br Med J. 2000; 320:768–70.
130. Romano PS. Improving the quality of hospital care in America. N Engl J Med. 2005; 353:302–4.
131. Rosenthal GE. Shannon SE. The use of patient perceptions in the evaluation of health-care delivery systems. Med Care. 1997; 35(11 Suppl):NS58–68.
132. Rosenthal MB, Adams DR. Pay for performance. Will the latest payment trend improve care? JAMA. 2007; 740–4.
133. Rosenthal MB, Frank RG, Li Z, et al. Early experience with pay-for-performance: from concept to practice. JAMA. 2005; 294:1788–93.
134. Saathoff A. Human factors considerations relevant to CPOE implementations. J Healthc Inf Manag. 2005; 19:71–8.
135. Sanders AB. Quality in emergency medicine: an introduction. Acad Emerg Med. 2002; 9:1064–6.
136. Schuster MA, McGlynn EA, Brook RH. How good is the quality of health care in the United States? Milbank Q. 1998; 76:517–63.
137. Schuur J, Justice A. Measuring syncope care in the ED: does choice of case definition bias outcomes? [abstract]. Acad Emerg Med. 2007; 14:S156.
138. Senge P. The Fifth Discipline: The Art and Practice of Organization. New York, NY: Doubleday Press, 2006.
139. Sibbritt D, Isbister GK, Walker R. Emergency department performance indicators that encompass the patient journey. Qual Manage Health Care. 2006; 15:27–38.
140. Silfen E. Documentation and coding of ED patient encounters: an evaluation of the accuracy of an electronic medical record. Am J Emerg Med. 2006; 24:664–78.
141. Simon LV, Matteucci MJ, Tanen DA, et al. The Pittsburgh Decision Rule: triage nurse versus physician utilization in the emergency department. J Emerg Med. 2006, 31:247–50.
142. Snyder C, Anderson G. Do quality improvement organizations improve the quality of hospital care for Medicare benefits? JAMA. 2005; 293:2900–7.
143. Speroff T, O'Connor GT. Study designs for PDSA quality improvement research. Qual Manage Health Care. 2004; 13:17–32.
144. Steele R, Green SM, Gill M, et al. Clinical decision rules for secondary trauma triage: predictors of

emergency operative management. Ann Emerg Med. 2006; 47:e135.
145. Steiger B. Polls find physicians very wary of pay-for-performance. Phys Exec. 2005; 31:6–11.
146. Szabo P. Bed-der than ever. Pittsburgh hospital uses automated bed tracking and control to speed efficiency in its ED. Health Manag Technol. 2003, 24:58–9.
147. Taylor D, Bennett DM, Cameron PA. A paradigm shift in the nature of care provision in the emergency department. Emerg Med J. 2004; 21:681–4.
148. Taylor TB. Information management in the emergency department. Emerg Med Clin North Am. 2004; 22:241–57.
149. Vonnegut M. Is quality improvement improving quality? A view from the doctor's office. N Engl J Med. 2007; 357:2652–3.
150. Wachter RM. Understanding Patient Safety. New York, NY: McGraw Hill, 2008.
151. Wang OJ, Wang Y, Lichtman JH, Bradley EH, Normand ST, Krumholz HM. America's best hospitals in the treatment of acute myocardial infarction. Arch Intern Med. 2007; 167:1345–51.
152. Weant KA, Cook AM, Armitstead JA. Medication-error reporting and pharmacy resident experience during implementation of computerized prescriber order entry. Am J Health Syst Pharm. 2007; 64:526–30.
153. Wears RL. A different approach to safety in emergency medicine. Ann Emerg Med. 2003; 42:334–6.
154. Weick KE, Sutcliffe KM, Obstfeld D. Organizing for high reliability: processes of collective mindfulness. Res Organizational Behav. 1999; 21:23–81.
155. Weick KE. Organizational culture as a source of high reliability. Calif Manage Rev. 1987; 29:112–27.
156. Weissman JS, Annas CL, Epstein AM, et al. Error reporting and disclosure systems: views from hospital leaders. JAMA. 2005; 293:1359–66.
157. Welch SJ, Allen TA. Data driven process improvement at a Level I teaching and tertiary care center. J Emerg Med. 2006; 30:269–76.
158. Welch WP, Miller ME, Welch HG, et al. Geographic variation in expenditures for physicians' services in the United States. N Engl J Med. 1993; 328:621–7.
159. Wennberg JE, Gittelsohn A. Small area variations in health care delivery. Science. 1973; 182:1102–8.
160. Wennberg JE, Freeman JL, Culp WJ. Are hospital services rationed in New Haven or over-utilized in Boston? Lancet. 1987; 1:1185–90.
161. Werner RM, Asch DA. The unintended consequences of publicly reporting quality information. JAMA. 2005; 293:1239–44.
162. Werner RM, Bradlow ET. Relationship between Medicare's Hospital Compare performance measures and mortality rates. JAMA. 2006; 297:1430–1.
163. Werner RM, Asch DA, Polsky D. Racial profiling: the unintended consequences of CABG report cards. Circulation. 2005; 111:1257–63.
164. Williams SC, Schmaltz SP, Morton DJ, Koss RG, Loeb JM. Quality of care in US hospitals as reflected by standardized measures. 2002-2004. N Engl J Med. 2005; 353:255–64.
165. Woods MS, Star JI, Healing Words: The Power of Apology in Medicine. Chicago, IL: Joint Commission Resources, 2007.
166. Xiao Y, Moss, J. Practices of high reliability teams: observations in trauma resuscitation. In: Human Factors and Ergonomics 44th Annual Meeting Minneapolis/St. Paul, MN, 2001, p 395.

URL Reference List

American Board of Emergency Medicine. EMCC Assessment of Practice Performance. Available at: ABEM Continuous Certification. Accessed Jul 28, 2010.
AHRQ. Glossary of Quality Improvement & Patient Safety Terms. Available at: http://www.psnet.ahrq.gov/glossary.aspx.
Baldrige National Quality Program. Health Care Criteria for Performance Excellence. Available at: http://www.quality.nist.gov./PDF_files/2006_HealthCare_Criteria.pdf
MacMillan J, Entin EE, Entin EB, Serfaty D. Structuring and training high-reliability teams. March 1994. Report # A309203. Available at: http://www.stormingmedia.us/30/3092/A309203.html. Accessed Jul 28, 2010.
Joint Commission. Behaviors that undermine a culture of safety. Joint Commission Medical Staff Standard. Available at: http://www.jointcommission.org/NewsRoom/PressKits/Behaviors+that+Undermine+a+Culture+of+Safety/app_stds.htm. Accessed Jul 28, 2010.
Klein KJ, Zeigert JC, Knight AP, Xiao Y. A leadership system for emergency action teams: rigid hierarchy and dynamic flexibility. Available at: http://knowledge.wharton.upenn.edu/papers/1282.pdf. Accessed Nov 21, 2004.
National Quality Forum Safe-Practice Guideline 2006. Available at: http://www.qualityforum.org/pdf/projects/safe-practices/AppealsDraft-Background-and-UpdatedSafePractices.pdf.
NCQA Online Report Cards on physicians and health plans. Available at: http://www.ncqa.org/tabid/60/Default.aspx
Nolan T, Resar R, Haraden C, Griffin F. Improving the Reliability of Health Care, Innovation Series 2004 White paper. Institute for Healthcare Improvement. Available at: http://www.ihi.org
Pennsylvania Healthcare Quality Alliance. Patient Tools page. Available at: http://www.phcqa.org/tools/patients/.
Spee JC. Training for high reliability: complexity and tight coupling in a helicopter fleet replacement squadron. Western Academy of Management 2001 Annual Meeting. Available at: http://newton.uor.edu/FacultyFolder/JSpee/trainingforhighreliability.htm. Accessed Dec 12, 2004.
VA National Center for Patient Safety. The Basics of Failure Mode and Effects Analysis. A videoconference course presented by the VA National Center for Patient Safety. Available at: http://www.va.gov/ncps/SafetyTopics/HFMEA/HFMEAIntro.pdf.