Practical QI:

THE BASICS OF QUALITY IMPROVEMENT EDUCATION

The Quality In-Training Initiative: An ACS NSQIP Collaborative

QUALITY QITI IN TRAINING

ACS NSQIP®

American College of Surgeons
Inspiring Quality:
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User's Guide

This manual is intended to be a primer for the study of quality improvement. Section I is a quick guide through the basics to introduce vocabulary and concepts. Section II contains a detailed explanation of how to approach a quality problem and design and "test" an improvement project. Beyond that, each section can be read independently to focus your learning on relevant issues to the patients for whom you care and the local opportunities for improvement. Each section has references; however, if you are looking for the most relevant sources for each topic consider the recommended readings located just below each section.

As the world of surgical quality and safety is constantly growing and evolving, our aim for this manual is to do the same. New editions will be released periodically as content is updated and added to. For the next edition, our plans include an increased number of case studies as well as additional examples of how various training programs have implemented quality curricula. We hope you find the current format helpful.

Overview: Making Sense of Quality and Safety from the Resident Perspective

OBJECTIVES

At the end of this section, the learner should be able to:

- Understand the vocabulary of quality improvement and patient safety
- Be familiar with regulations regarding quality and safety in surgery
- Be aware of the Quality In-Training Initiative, a national initiative designed to advance quality and safety in academic surgery

Quality improvement (QI) involves many different things. It encompasses safety, appropriateness, and efficiency. It relates to almost every facet of the human experience with the surgical profession. To illustrate the wide range of potential targets for quality improvement efforts, consider the common example of a patient with a postoperative fever. In order to minimize the risk of septic shock and death from an infectious cause, there are no less than 10 steps that present as potential opportunities for the care delivered to be excellent or poor (**Table 1, this page**).

The purpose of this section is to give you a basic understanding of the various techniques used to assess quality and safety, to help you examine your own results, and to provide an introduction to the regulatory world you will face as a practicing surgeon. Just as the skill set for a successful surgeon includes more than technical knowledge, surgical residency is no longer a matter of simply accruing five years and at least 750 cases. Optimal care of surgical patients includes not just performing technically sound procedures, but deciding when to operate and on whom, and ensuring patients receive appropriate care pre- and postoperatively. Increasingly, the performance of health systems, hospitals, and individual practitioners is being tracked and used to determine rewards or penalties for high and low performers. Surgical residents need to understand the standards and criteria they will be judged on once in practice. Safety and quality are not abstract concepts to be learned and forgotten. The concepts included in this manual will serve you for the rest of your career as you strive to become the best and safest surgeon you can be for your patients and yourself.

TABLE 1. Patient care steps required to properly manage a postoperative fever

- Detect the fever in a timely fashion
- Evaluate the patient, paying attention to patient complaints and physical signs
- Provide medical management for symptom control to maintain patient satisfaction, but avoid treating protective physiologic derangements like tachycardia
- Order the correct and appropriate tests without utilizing unnecessary resources
- Make sure tests are completed properly (including using the correct techniques for necessary diagnostic procedures ranging from lab draws to radiology studies, using the correct equipment, efficient transport of the patient or necessary samples, and correct performing of the actual tests to minimize errors)
- If the patient had an unavoidable adverse event during a test, was rescue available? Was it successful?
- Obtain the results of tests in a timely fashion
- Examine and correctly interpret the results of the tests
- Make an appropriate care plan in conjunction with the patient, family, and other providers
- Communicate with the patient and family so they understand the plan
- Communicate with other members of the care team
- Provide correct medical management to treat the cause in a timely fashion

A. KEY CONCEPTS

The disciplines of quality improvement and patient safety have roots in industrial manufacturing, aviation safety, and efforts to improve health care outcomes dating back to the early 1900s. The vocabulary can seem overwhelming and full of acronyms. While some of the tools and approaches seem simple, many of them have been rigorously developed over years (or decades) in fields such as business management and manufacturing. This section will briefly introduce the concepts and vocabulary that further sections of this manual will expand on.

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Broadly speaking, **quality** is the standard of something as measured against other things of a similar kind; the degree of excellence of something.[1] In the surgical profession, there are many ways of evaluating patient care that we can use to benchmark our performance against that of our peers or against universal standards. When these evaluations are turned into numbers (or quantified), we call them **measures**. When evaluating health services, measures have traditionally been divided into three categories: structure, process, and outcome.[2] **Structural** measures refer to the physical and organizational aspects of care settings (for example, number of hospital beds, nurse to patient ratios, academic versus private hospitals, volume of care provided, and so on). **Processes** of patient care refer to the type of care or way in which care is delivered (for example, appropriate use of preoperative antibiotics and correct ordering and administration of postoperative DVT prophylaxis). Process measures are often the best targets for the assessment of resident-directed quality improvement. **Outcomes** refer to what actually happens to patients, often as a result of the structures and processes of care. Mortality, postoperative complications, and functional outcomes are all examples of outcomes measures. A fourth type of measure, called a **balancing** measure, is used to track unintended consequences of quality improvement projects, such as an increased incidence of readmissions after the implementation of a fast-track enhanced recovery protocol for colorectal surgery patients.

The goal of quality improvement is to elevate the standard of surgical care. It is not an end game or something that is ever definitively achieved; it is a continuous process that uses **rapid cycle interventions** to perpetuate a constant effort to better the care that we provide to our surgical patients. Quality improvement is a science, with data and techniques that are used to design or plan "experiments" to fix problems. The trials or experiments are called quality improvement projects or initiatives. While the basic framework of the quality improvement process is the same as the scientific method, there are key differences in perspective that are important to understand. Unlike scientific research projects, which aim to establish fixed universal truths and discover new knowledge, quality improvement efforts focus on the implementation of established principles. Quality and safety efforts focus on the interactions between humans and organizational systems. As such, QI is deeply grounded in the local context; projects that succeed in one setting may not have the same impact in another institution. In general, projects should be run quickly, on the order of weeks or months rather than years, which allows multiple cycles of the process to occur within a short period. If the initial design of a project does not successfully correct the targeted quality defect, the project should be scrutinized to identify the reasons why success was not achieved and then modified in response to each "failure." Even after a project is successful, there should be continued monitoring and revisions. This ongoing cyclical process has many names, including trial and error, rapid cycle intervention, "fail fast forward," and "plan, do, study, act" or **PDSA**.

Quality improvement is frequently discussed simultaneously with patient safety. These concepts are related but not synonymous. The discipline of **patient safety** focuses on behavior and conditions that minimize the risk of harm to patients. It is tightly coupled to the principles put forth in the Hippocratic Oath: "first, do no harm." Alternatively, quality improvement posits that through attention to detail we can consistently improve upon the care that we deliver to help our patients. When combined, the two ideas are aimed at safeguarding patients from human error through systematic protections and automated processes developed by people. Investigations into the causes of medical errors have shown that they are rarely due to the failure of an individual person, but rather due to **systems failures**, or a series of breakdowns in overlapping processes. As a result, quality improvement efforts often aim to improve processes of care or address systemic issues to achieve better surgical outcomes. Although it can be helpful to examine outcomes or results at the level of an individual institution, care team, or provider, quality improvement efforts rarely focus on individual actions. Instead, quality improvement aims to change unsafe conditions, improve patterns of behavior, and enhance the culture of health care delivery in order to create a system that supports the needs of patients.

Quality improvement methodology is centered on **data**. Data are used to define problems, examine possible causes, and test the success of quality improvement initiatives. Sources of data and techniques to analyze data will be discussed in detail in Section II.

Teamwork and collaboration are required to succeed in quality improvement. As surgeons, we must learn to be leaders in the process so we can act as champions for our patients. Being a leader means we must be able to function effectively within interprofessional teams, foster open communication and mutual respect for other providers and patients, and share in decision-making to achieve quality patient care. The importance of a strong **safety culture** is becoming increasingly clear. Section III covers the existing state-of-the art knowledge in this realm.

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Leadership is the act of directing an organization or group of people. The leader is the person who leads or commands a group, organization, or country. There are many possible successful leadership strategies. Successful leadership styles likely vary across cultures and personality types and depend on the task at hand. In this manual, we will focus on leadership skills that have proven to be successful in quality improvement. The leadership style that has been most successful in quality efforts is quite different than the traditional stereotype of the surgeon as a flawless, never-to-be-questioned dictator. Within surgical quality improvement, the best leaders often spend 70 to 80 percent of their time listening and the rest of their time empowering their disciples to succeed. This switch in the surgical leadership style from dictator to humble leader is one of the most powerful changes that is going on in the surgical profession today. Inspiring leaders have vision, charisma, compassion, and emotional intelligence amongst other traits. However, these traits do not determine the effectiveness of a leader; action and the ability to inspire action in others to make sustainable change mark the success of a leader.

There are many barriers to achieving **buy-in** to quality improvement in the surgical profession (and other medical disciplines). The importance of an organizational culture that prioritizes safety is discussed in Section III of this manual. Having leaders at multiple levels throughout an organization is important. There are also practical problems. Health care is full of bureaucracy. Care systems are often underdeveloped and under resourced, so implementing and sustaining change can feel like a momentous task. Surgeons and surgical residents are often overworked and have multiple competing priorities. There can also be resistance to the principles of iterative change, or skepticism regarding the reliability of the data being used.

We hope this manual will help you overcome these barriers in your own institution. Most importantly, we hope it will introduce you to a way of approaching your own practice. Learn for yourself and apply the concepts to the way that you care for your patients. You will find others who are motivated and interested to join your mission. Over time, you will find that the quality improvement approach will make you a better surgeon, technically and as judged by your patient outcomes. The improvements in tangible and intangible measures will motivate you to continue to strive for quality improvement and your success will be infectious to those around you.

B. THE CURRENT STATE OF QUALITY IMPROVEMENT IN THE U.S.

Surgical patients are vulnerable. They entrust their bodies and lives to our care. Therefore, society provides protection for each patient in the form of rules and regulations from varied sources, both governmental and professional organizations. In the U.S., the modern patient safety and quality improvement efforts are often dated back to the Institute of Medicine publication, *To Err is Human: Building a Safer Health System* (1999) and *Crossing The Quality Chasm* (2001).[3,4] These reports concluded that between 44,000 to 98,000 people die each year as a result of preventable medical errors and identified six dimensions of health care that improvements should target: patient safety, care effectiveness, patient-centeredness, timeliness, care efficiency, and equity. As a result, a national focus on patient safety and quality improvement has resulted in a large number of new regulations in health care delivery. These regulations have been published by governing bodies at the national, local, and specialty levels.

The goal of this section is to introduce you to these policies and regulations. Understanding the regulations that exist will help you as a surgeon best perform your professional duty to protect your own patients and work to effect changes that will optimize patient care while preserving the surgeon patient relationship and providing opportunities for future advances in surgical care.

National Regulations

The trendsetter for many of these initiatives is the **Center for Medicare & Medicaid Services (CMS)**. CMS provides health care coverage or insurance for more than 100 million U.S. citizens. It is a government run insurance plan that also pays for graduate medical education, which means that your salary as a surgical resident is subsidized by CMS through the hospital that employs you. As a collective workforce, if your institution does not comply with CMS regulations or performs poorly on certain quality indicators, partial payment for your job may be withheld. Because of the multiple roles that CMS plays in health care, it has incredible influence on national standards, as described below.

The **Surgical Care Improvement Project (SCIP)** is an example of a CMS initiative. It was established in 2006 by CMS to reduce the rate of surgical complications. There are nine publicly reported SCIP measures, six of which focus on postoperative infection.[5] The measures include selection, timing, and discontinuation of preoperative antibiotics; appropriate hair removal practices;

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perioperative normothermia; and normoglycemia in selected patients. The final three measures include routine venous thromboembolism prophylaxis (ordering and administration) and perioperative use of beta blockers. These parameters are all process oriented and have been replaced in large part by **outcomes measures** such as the Patient Safety Indicators (PSIs), Hospital-Acquired Conditions (HACs), and readmissions.

The SCIP measures are an example of core measures. **Core measures** are indices established by CMS used to score or evaluate hospital and individual surgeon compliance with standards of care. They were designed to enable the measurement of the quality of care provided to patients. The measures cover multiple factors, including infection rates (especially catheter-associated urinary tract infections [CAUTI], central line-associated blood stream infections [CLABSI], and surgical site infections [SSI]), hand hygiene rates, readmission rates, and death rates.

Medicare is a federally funded insurance plan. As such, it is tightly regulated by the government, and payments issued to hospitals and physicians are controlled by the law. Recently, in the spirit of patient protection and cost containment, federal law mandated that hospitals cannot receive additional payment from Medicare or charge Medicare patients for treating them for hospital-acquired conditions.[6] **Hospital-acquired conditions** are preventable events occurring during a hospital stay. The HAC measures are calculations of how often a particular preventable event occurs at a given hospital among certain Medicare beneficiaries. CMS currently measures HACs considered to be rare or entirely avoidable events, including venous thromboembolic events (VTEs), CAUTIs, fractures resulting from a fall, certain SSIs, and pneumothorax following a central line placement. The calculation of HAC measures only includes patients who acquired the condition(s) during their hospital stay. Patients who arrived at the hospital with any of these conditions are not included, but documentation is necessary to prevent the problem being reported as a HAC. Presently, CMS also considers some HACs to be "never events," meaning they should, in theory, never happen in the process of patient care. In fact, reimbursement for these never events may be withheld from the hospital (and eventually, the surgeon). Never events include wrong site surgery, retained foreign objects, and decubiti.

In an effort to drive improvements in the overall patient experience, CMS helped to develop the **Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS)** measures to capture patient-reported outcomes of the medical and surgical care that they receive.[7] HCAHPS asks patients about their opinions regarding the quality of care provided by nurses and doctors, the hospital environment, and their overall care. HCAHPS includes an assessment of the clarity of the information they received at discharge, as well as an overall rating of the hospital and general demographics. Patients can view HCAHPS scores for individual hospitals online via Hospital Compare.

Beginning in October 2012, the information recorded in the HCAHPS survey was added to the measures used to calculate value-based incentive payments in the **Hospital Value-Based Purchasing** program. This program is a new system of reimbursement designed to pay hospitals for inpatient care based on their performance on core measures and patient satisfaction scores. It is an attempt to move from paying for the quantity of services performed to the quality of care provided.

As an extension of the Hospital Value-Based Purchasing efforts, the **Bundled Payments for Care Improvement (BPCI)** Initiative is a three-year trial designed to test four new models of payment for health care services. Each model defines the service provided differently and broadly links services, in unique combinations, in an attempt to identify the most cost-effective way to deliver medical services while factoring in health care-related outcomes and patient experiences. In one model, there will be one payment to the hospital for all care rendered during the hospitalization and for any subsequent hospitalizations during the 30 days following discharge. This means that any hospitalization within those 30 days will have to be paid for by the hospital and, furthermore, that the hospital will decide the physician payment schedule, not CMS.

CMS is also working to create financial incentives for physicians that are directly related to the outcomes of the patients they treat. In an effort to get an accurate measure of individual physician outcomes, the **Physician Quality Reporting Systems (PQRS)** was mandated by the Tax Relief and Health Care Act of 2006. The PQRS is a program that uses a combination of incentive payments and payment adjustments to promote reporting of quality information by eligible professionals.[8] To promote the reporting of individual quality information, an incentive payment was awarded to physicians in 2013 for self-reporting, and beginning in 2015 penalties were applied to physicians who failed to report their quality measures. The percentage penalty for not reporting is scheduled to grow to 4 percent in the future.

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Another financial incentive for quality reporting comes from the **Medicare Access and CHIP Reauthorization Act (MACRA)**, passed by Congress in April 2015. The foundation for MACRA was laid in the 1997 Balanced Budget Act, which put much of the financial burden of containing rising Medicare costs on physicians by imposing a limit on physician fees termed the Sustainable Growth Rate (SGR). Although it was never implemented, the SGR was strongly opposed by most physicians. MACRA replaced the SGR with a complicated formula intended to reward physicians with favorable outcomes while penalizing those who don't meet benchmarks. It establishes new tracks for Medicare Part B payments that require self-reporting of a surgeon's results and outcomes and is an example of how important it is to develop a system to log your own cases and outcomes, as it is widely anticipated that self-reported outcomes will be used in the future not only by Medicare but also private insurers.

On the horizon, many insurers, including CMS, will subject practices (and perhaps individuals) to "**quality tiering**." Quality tiering will determine if a group's performance is statistically better than, or the same as, or worse than the national mean. Quality tiering could result in a positive or negative payment adjustment.[9]

CMS is also increasingly interested in including **patient-reported outcomes**, discussed in detail in Section VI of this manual.

Many of the regulations described above rely on the principle that requiring public reporting of adverse event rates will drive local and national efforts to improve, which has necessitated the creation of an infrastructure for reporting and analyzing this data. As you will see throughout this manual, data play an incredibly important role in quality efforts. Quality assessment relies on the ability to triangulate data to get an accurate measure of organizational or individual performance. **Triangulating** data means validating the results by cross-verification from two or more sources. While CMS provides the core measures, other organizations have developed similar metrics for use in quality assessment.

The **Agency for Healthcare Research and Quality (AHRQ) Patient Safety Indicators (PSIs)** are quality measures previously based on International Classification of Diseases Ninth Revision Clinical Modification (ICD-9-CM) codes. In 2015, ICD-10 was introduced. ICD-10-CM codes are assigned at the time of hospital discharge by professional coders and abstracted from the physician documentation in the medical record. They reflect the patient diagnoses and, in conjunction with the procedural codes, determine the hospital payment for the care rendered to the patient during the acute hospitalization. **Patient Safety Indicators (PSIs)** measure complications for disease-specific areas by attempting to detect complications and adverse events using secondary diagnosis codes. Many PSIs have been shown to be unreliable in detecting preventable adverse events following a surgical procedure. At the provider level, however, the PSIs are being used to present a picture of patient safety within a hospital. The measure set covers a variety of areas such as selected postoperative complications, selected technical adverse events, technical difficulty with procedures, and obstetric trauma and birth trauma.[4] Examples of the PSIs include PSI-04 *Death in surgical patients with treatable complications*, PSI-09 *Postoperative hemorrhage or hematoma,* and PSI-14 *Postoperative wound dehiscence*. The latest PSIs (version six, published in 2016) now include PSI-10 *Postoperative acute kidney injury requiring dialysis*, PSI-11 *Postoperative respiratory failure*, and PSI-15 *Unrecognized abdominopelvic accidental puncture or laceration*. A compilation of PSIs, PSI 90, yields a risk-adjusted score that is reported regularly to CMS and published in several forms available to the public. The PSI measures are also utilized by CMS to reimburse hospitals. Precise documentation in the medical record by residents and attendings becomes extremely important, as coders can only submit what is in the medical record. Accidental use of the wrong term, such as "postoperative respiratory failure" for a patient admitted to the intensive care unit (ICU) intubated because of hypothermia and extubated the following morning, can have significant negative consequences for the hospital and even the individual surgeon. Despite well-documented limitations, PSIs are regularly reported to CMS for all acute hospitalizations.

As an alternative solution to the outcomes measured by CMS and AHRQ, the **American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP®)** provides physicians and hospital systems with data on the relative quality of care they deliver and highlights areas in which improvement might be considered. The program reports on a number of general surgical complications across multiple specialties and procedure-specific outcomes for a variety of individual procedures. The 30-day outcomes measured by ACS NSQIP are risk-adjusted and validated to measure and improve the quality of surgical care.[10] The collection process is standardized and captures data on a convenience sample of patients undergoing both inpatient and outpatient procedures. Work continues to develop specific ACS NSQIP datasets for subspecialties, such as

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vascular and pediatric surgery. There is now an extensive track record of publications demonstrating outcomes with ACS NSQIP, with more than 800 hospitals using the system and the outcomes of more than 3 million patients in the data base.

Institutional Regulations and Quality Structures

Health care institutions must meet not only the federal and insurance-driven regulations described above, but also standards put forth by accreditation organizations. These regulations include standards for credentialing or granting privileges to practitioners. In response to the myriad and often overlapping requirements of the different regulatory bodies, almost all hospitals, and many surgery departments, have robust quality and safety divisions or personnel that can serve as resources as you enter the realm of quality improvement.

U.S. health care organizations are accredited by **The Joint Commission on the Accreditation of Healthcare Organizations and Programs (JC),** an independent not-for-profit. A number of quality-related regulations are required by the JC. For example, individual hospitals are required to have a **Focused Professional Practice Evaluation Plan (FPPE)**. FPPE serves as a method for credentialing new physicians or examining the performance of physicians either at set intervals or when there is a question of competency.[11] The program for new surgeons may include proctoring and direct supervision, review of cases and indications for surgical procedures, or review of results from a limited number of cases. Each hospital and department or section determines the criteria for independent privileging, which is usually a time-restricted review with the monitoring dependent on the physician.

JC also mandates an **Ongoing Physician Performance Evaluation Plan (OPPE)**. The OPPE functions as a method to assess a medical practitioner for competency at an organizational level, either continuously or as needed. OPPE has also been termed "evidence- based credentialing."[12] It is usually a prerequisite for re-credentialing or changes in hospital privileges. Multiple factors can be incorporated into these evaluations, including performance on core measures, cost, professionalism, and patient feedback. Frequently, a hospital will appoint a **Peer Review Committee** at the department, section, or hospital level. This committee provides a process by which a designated peer group reviews the surgeon's outcomes to determine areas for process improvement or the need for FPPE for an individual practitioner.[13] In certain organizations, the OPPE will tier their physicians to motivate practitioners to reflect on the quality or cost of the care that they provide and initiate an improvement effort.

As a result of these requirements as well as the national focus on quality and safety, every hospital has annual quality targets or initiatives. As you are developing quality improvement expertise within your residency program, make sure you know what the institutional initiatives are. It can be very helpful to introduce yourself to the personnel directly working on quality improvement initiatives within your department. Your institution may have a patient safety officer or a chief quality officer. In many organizations, residents are not well integrated into the existing quality infrastructure. Sometimes, quality improvement initiatives are designed at the institutional level without soliciting input from house staff. As an integral part of the care team, and the true "front-line" workers, residents often have unique perspectives on institutional issues. If you have a deeper interest in developing quality improvement skills, this can be a great opportunity to distinguish yourself as a leader. You should approach your program director and discuss your interests. As a program, you may be able to ask for a brief report and update on the background and significance, implementation plan, and regular updates regarding the progress of the projects in achieving the goals. Residents should be empowered to ask "why" when processes of care are changed or new order sets become available in order to make sure that their voices and concerns are addressed. Many hospitals now have a house staff quality committee, which can be an excellent way for residents to become more integrated and influential in the organizational QI program. Section IV of this manual includes more details of various models of how surgery residency programs are developing expertise in quality improvement.

C. THE QUALITY IN-TRAINING INITIATIVE (QITI)

The Quality In-Training Initiative (QITI) is a national collaborative of academic hospitals working together to teach "applied" quality improvement to surgical house staff and encourage resident involvement in quality improvement. The QITI is sponsored by the ACS NSQIP. The initiative has three main goals:

1. To enable easy manipulation of complex data to provide standardized resident report(s).
2. To develop a quality improvement (QI) curriculum that integrates into the surgical curriculum and addresses real issues in surgical care.
3. To develop a new culture by training residents to be surgeons who are well versed in quality science through a collaboration among academic hospitals.

One part of the initiative is the delivery of resident-specific **outcomes reports**. These reports include summaries of 30-day patient outcomes that provide individual residents with longitudinal information on their patients, along with comparisons with residents of the same postgraduate year across institutions. Team reports with comparison data for the same team in the same program across time are also provided. The reports are a great way to start talking about quality of care.

Resident reports can be useful in many ways. With the implementation of milestones, discussion at the sixth-month meeting with the program director is a natural way to begin the dialogue. Reviewing the reports can provide information on the ability of residents to outline a strategy for addressing potential quality issues, perform self-assessment, and cope with outcomes with which they may not have been familiar due to discontinuous care. The team reports can be very helpful for team training exercises and team building. The principles put forth by the QITI embrace the spirit of continuous quality improvement. We are attempting to move residency training from a "to-do" checklist mentality to one where upon completion of the "to-do" list we pause to reflect upon what more could be done for each patient. Even for patients who experience good results, there are likely opportunities to move from good to better and capitalize on each case as a teachable moment.

As the QITI reports become more mature and procedural comparisons and risk-adjustment at the team level become possible, they can serve as a cornerstone to the identification of QI projects.

The principles of the QITI are meant to be applied locally. Work within your organization to identify data to describe variations in care. Share the data. Teach people how to critically evaluate the data. Work to improve. Quality improvement is infectious—once you get hooked, you will see opportunities to improve everywhere and then the real fun will begin.

RECOMMENDED READING

Makary MA, Wick E, Freischlag JA. PPE, OPPE, and FPPE complying with the new alphabet soup of credentialing. *Arch Surg*. 2011;146(6):642-644.

Kohn LT, Corrigan JM, Donaldson MS, eds. To err is human. Washington: National Academy Press; 1999.

Delaney CP. Quality improvement and efficiency of care: are acronyms really the way of the future? Seminars in Colon & Rectal Surgery. December 2011;22(4):192-196 (DOI: 10.1053/j.scrs.2011.06.002).

Health Care Leader Action Guide to Effectively Using HCAHPS. Health Research & Educational Trust. Chicago; March 2012. Available at: www.hpoe.org. Accessed May 29, 2014.

The field of quality improvement (QI) is not limited to health care. In fact, many of the modern tools and techniques of quality and safety were developed in outside industries ranging from aviation and manufacturing to nuclear energy. Over the past few decades, individuals and organizations within health care have worked to adapt and tailor these techniques for use in medicine. Applying these tools can lead to improved outcomes and reduced waste and inefficiencies in the medical process.

In this section, we will introduce one approach to the overall process of quality improvement as it is currently practiced within health care. We will also review some of the most common tools and techniques that have been developed and discuss the underlying methodologies. Finally, we will review the various sources of data that are available for quality initiatives.

A. INTRODUCTION TO THE PROCESS OF QUALITY IMPROVEMENT

OBJECTIVES

At the end of this section, the learner should be able to:

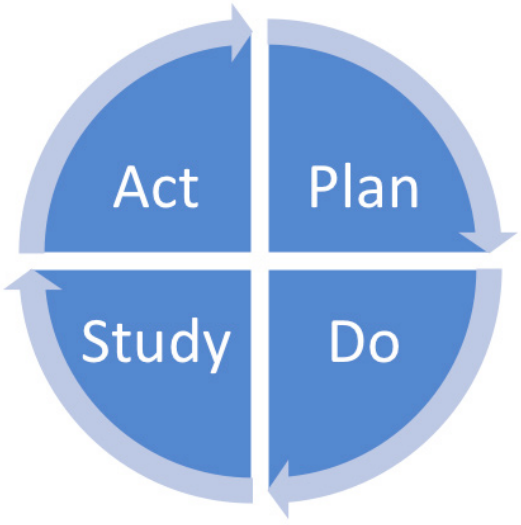
- Describe the overall steps to design and test a quality improvement project
- Identify and describe several quality improvement tools used in health care
- Explain the components of a SMART objective

As physicians, we have all been trained in the steps of the scientific method. The process of quality improvement follows a similar series of steps, including identifying a problem, gathering data, designing an intervention (also called a **countermeasure**), and monitoring results. As the concepts of quality improvement have been applied to various industries, individuals and organizations have developed a variety of methods to facilitate various steps in the process. These methods are commonly called tools and vary from simple visual cues to detailed multistep training programs.

This section provides a brief overview of common methods and tools to use in quality improvement. It is intended to give you an idea of what types of approaches are possible and what may work well for a given situation. We encourage you to seek additional information on these tools. There are a number of helpful online resources, including the Institute for Healthcare Improvement website (*ihi.org*) and the QI Toolbox put together by the Minnesota Department of Health (*health.state.mn.us/divs/opi/qi/toolbox/).*

One of the most versatile and widely recognized approaches to quality improvement is the "**PDSA cycle**" (**Figure 1, this page**). The acronym stands for four steps: Plan, Do, Study, Act. This cycle (also called the Shewhart or Deming Cycle after two of the founding figures of statistical process control methodology), encapsulates the iterative nature of process improvement. Every improvement cycle generates knowledge that leads to further improvements in the next cycle. While this cycle can be seen as the overall framework for a long-term **continuous improvement** project (over months to years), the concept can be even more transformational when used to structure **rapid cycle interventions**, where each cycle happens quickly (hours to days), allowing for quick phases of design, testing, and measurement. This mentality, referred to by the phrase "**fail fast forward,**" emphasizes that the goal of quality improvement is not to develop a perfect universal *solution*, but to create a continuously evolving *process*, by which a system can continuously adapt to changing conditions. To this end, many quality improvement methods focus on developing "countermeasures" or "tests of change" (small-scale, adaptable, cheap, allowed to fail) rather than implementing solutions (universal, final, expensive, perfected). While it may be necessary in some situations to implement a final version of an intervention, it is important to recognize that the system is dynamic and that a solution that works today may not always work. For this reason, quality and safety efforts focus on continuous improvement and rapid cycle interventions.

Figure 1. The PDSA cycle



Fundamentals of Surgical Quality Improvement

One challenge for learners new to quality and safety work is visualizing what these cycles look like in practice. Some practical examples can be seen in Section IV of this manual. In many situations, various parts of the improvement process overlap or occur in parallel. A useful tool to organizing these steps for a discrete project is the "**A3 document,**" a physical template named after the international standard term for an 11"x17" sheet of paper. This tool (**Figure 2, this page**), originally developed by process improvement teams at Toyota, gives a graphical outline for defining a problem, investigating the "current state," describing the desired "future state," and documenting the intervention.

The sections of an A3 can be mapped to another common acronym. DMAIC, part of the **Six Sigma** process improvement method originally developed at Motorolla, stands for Define, Measure, Analyze, Improve, Control.

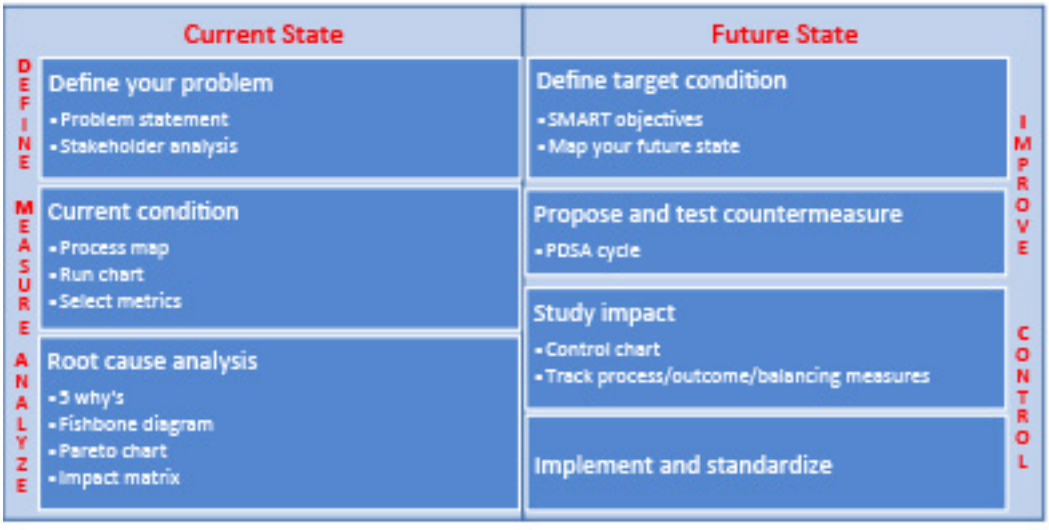
Below, we walk through the basic sections of an A3 and describe some additional tools that can be used at each step.

1. Finding and Defining a Problem

Finding, properly defining, or clearly articulating a problem within a quality improvement framework is a skill that takes time to develop. As frontline health care providers, residents are often acutely aware of many quality issues and areas of inefficiency within their health care system. But selecting a discrete problem that can be feasibly tackled is much harder. If you have an opportunity to select your own topic for a project, it is important to select an area that you personally believe in, but is also one that will have institutional backing. To clearly define the problem, you should write a formal **problem statement** that concisely describes the specific issue you are addressing. The problem statement must detail the "**current state**" of the problem. Note that you are NOT defining your aim (or "future state") at this point. Your problem statement should also avoid indicating what you think the cause of the problem is, unless you have already performed additional steps in the QI process, because often what you initially think is the cause is not in fact the ultimate problem! Your problem statement should have a **narrow scope**, be **patient centered**, and ideally include some **quantifiable impact** of the problem (complication rate, excess cost, and so on).

During this process, you should also be developing the **team** that will work together on the project. QI work cannot be done alone. Typically, a formal **stakeholder analysis** is useful to make sure you carefully think through all the individuals and groups that could be affected by your proposals. Depending on the institution, the focus of the initiative, and your relative experience in quality improvement, the role that you (either as a surgeon or a surgical resident) will play varies. One useful metaphor for the most important roles in a team comes from sports, where teams have a coach, a captain, and players. The team captain (which may by a surgeon) calls the shots but also plays harder than or as hard as all the other team members. The coach is frequently someone in a position

Figure 2. The A3 document



of authority who has the power to play a supportive role, influence the direction of the project, and provide resources to make the goals achievable. Key players likely include patients, physicians, residents, nurses, aides, technologists (radiology techs, surgical techs, and so on), administrative personnel, and other specialists who understand the components of the problem. The disciplines represented and specialists consulted will differ depending upon the initiative at hand, but should include representatives of all groups or stakeholders that will be affected by proposed changes. Several tools used to conduct a stakeholder analysis include social network analysis, stakeholder identification tool, stakeholder mapping, and power-interest diagrams.

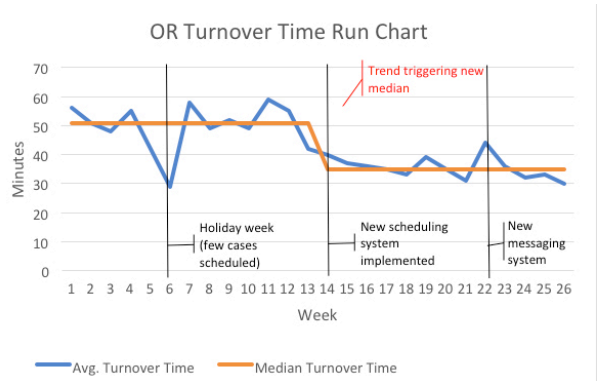
2. Describing and Measuring the Current Condition

This step is crucial to developing an effective project. Here, you want to collect as much data as possible so that you can subsequently analyze it to select a specific target for your countermeasure. Later in this section we discuss different sources of data, but you should make sure to not stop with existing event rates or chart reviews. Often, the true causes of a quality or safety problem are not evident in existing data, but require that you actually go in person and observe the process at work while collecting primary data. A number of tools and approaches have been developed to help guide this step.

Process maps are graphical representations of what a specific process entails. A process is defined as anything that has a clear beginning and an end. It can be something that occurs in one place at one time involving a relatively fixed group of individuals (for example, turning over an operating room [OR]) or can range over any of these variables (for example, dispensing inpatient medications, performing morning rounds, seeing a consult). Different types of process maps have been developed depending on what type of process is being analyzed. **Spaghetti charts** map the physical movements of individuals or objects when trying to reduce inefficiencies. A **swim lane diagram** can help you visualize how different individuals or teams work simultaneously or pass off parts of a process to each other.

Statistical process control (SPC) charts (also called Shewhart charts) are specific analytic tools used to track quantitative metrics that vary over time. An SPC chart could track metrics like number of operations performed each day, percent of patients who are readmitted each week, or number of in-patient mortalities each month. A slightly simplified version of an SPC chart is called a **run chart** (**Figure 3, this page**). SPC charts are used to analyze processes that inherently contain some degree of variation. A number of statistical rules have been developed to determine if changes that are seen are due to normal ("common cause") variation or unusual ("special cause") variation. They are also used to see if a process is in control, meaning that the degree of variation has been reduced to an acceptable level. While these charts can be used to track the result of countermeasures (step 6), at this point in a QI project they can be used to understand an existing process and identify extreme values that may point to underlying special causes of variation that could be targets for countermeasures.

Figure 3. Example of a run chart



Another important part of this step is exploring and eventually selecting the **metrics** that you will use to track your future implementation. Most processes are best measured using a "family" of related metrics that include both **process** and **outcome** measures. For example, if you are working to reduce perioperative site infections by improving perioperative antibiotic dosing, you may want to measure timing of antibiotic dosing (process), selection of the most appropriate antibiotic (process), and rates of surgical site infections (outcome). In addition, it is important to track **balancing metrics** that would alert you to unintended consequences (for example, rate of delayed cases and costs per case).

3. Performing a Root Cause Analysis

Once you have thoroughly described the current state, you need to select a single target for your first test of change. You have likely identified numerous potential issues that you could target, so this process requires an analysis of how these various issues contribute to the overall problem. One tool that is often used is the **fishbone diagram** (formally known as an Ishikawa diagram, named after Kaoru Ishikawa, a Japanese pioneer

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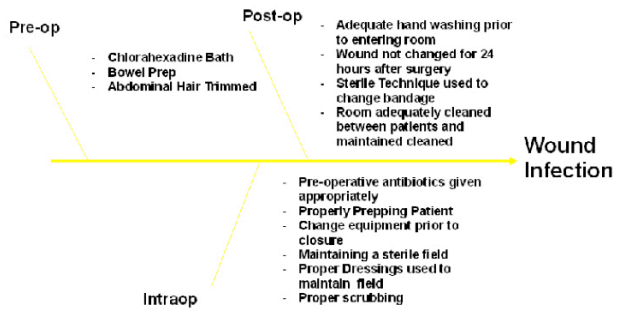
of quality improvement in the 1960s). This diagram is a tool used to help brainstorm and organize the cause and effect relationships in a quality issue (**Figure 4, this page**). Another tool is a **pareto chart**, which is designed to highlight the most important among a large set of contributing factors. Another useful technique called the **5 Why's** entails asking "why" multiple times to force a group to think beyond the apparent surface reasons for some problem and being to uncover the deeper reasons. Often several of these methods are used to analyze a single problem.

Figure 4. Example of a fishbone diagram



When you are at the stage of selecting what to focus your project on, an **impact matrix** can be useful (**Figure 5, this page**). This tool can help you think through in a systematic way what the relative impact and feasibility of each potential focus would be. The factors with the most impact that require the least amount of resources should be attempted first, with lower-impact or higher-resource projects being discarded.

Figure 5. The impact matrix

	High Impact	**Low Impact**
High Resource	Consider Implementing Later	Never Do
Low Resource	Should Attempt These Ideas First	Consider Implementing

SIDEBAR. TIPS FOR DESIGNING YOUR FIRST QI PROJECT

1. Identify a project that has a reasonable scope and addresses a real problem that you feel strongly about. **Start focused**. If you pick a broad area like reducing VTE rates, map it out and focus on one small piece of the project. If you discover that high-risk patients are not getting preoperative therapy or therapy after discharge you could focus on risk stratification or the administration of appropriate preoperative prophylaxis or extended prophylaxis in a specific surgical population. Pick something that seems easy (it probably will not turn out to be so!). Choose an area where you know you can easily identify a faculty sponsor or an issue that is already on the institutional radar.
    - How do you know you need to improve your quality? Check the data.
2. Make sure the concept is **measureable**. Pick something concrete. Try to use both a process measure and an outcome measure to track your progress. If you want to try to decrease postoperative VTE in colon surgery patients by improving adherence to guidelines for preoperative VTE prophylaxis and you only track VTE rates (an outcome measure), it may require a long time to see any effects of your efforts. If you also track compliance with the administration of preoperative prophylaxis (a process measure), you will see results more quickly.
    - How do you know you're improving? Follow a measure.
3. Assemble a multidisciplinary team, including a team leader with the ability to inspire change (YOU), a faculty sponsor, administrative support with access to data, frontline providers, and managers. Teams should include both frontline providers who understand how patient care is delivered and administrators who are capable of enacting changes within the system. Teams should make sure to include all **stakeholders**—those who may gain or lose from the proposed changes. Patients are impacted by any changes in clinical processes, so patient input should always be solicited.

SIDEBAR. TIPS FOR DESIGNING YOUR FIRST QI PROJECT (CONTINUED)

- Think about what it takes to run a successful meeting.
- Ask your faculty mentor if you can sit in on a few quality improvement meetings to get a sense for what works and what doesn't.
- As the leader, you should spend 70 to 80 percent of the time listening.

4. Get buy-in from all the potential stakeholders. This is one area where a faculty sponsor may be particularly helpful. If there are stakeholders you do not know how to contact, your sponsor should be able to guide you to the best way to get in contact and present your project in a way that will have meaning for each stakeholder.
5. Track your progress. Make sure to provide feedback on all progress to the team. **Share early wins**. Make sure you can **adapt quickly** if you don't see success where you expect it. Be sure to report out to the committee.
6. Measure your success.
    - How long does your improvement last? Continue to track your measure.

For practical examples, see Section IV.

Root cause analysis (RCA) is also used as a method to analyze the causes for a specific error retrospectively. In this meaning, an RCA is usually initiated when there is a significant adverse event (for example, wrong site surgery). The goals of a root cause analysis are to determine exactly what happened, why it happened, and what should be done to prevent it from happening again.[1] This analysis needs to be done in an organized, team-based manner.[2] While this type of RCA is not always performed within a larger process improvement framework, it should ideally lead to an ongoing PDSA-type cycle to prevent future errors.

4. Defining the Target Condition

Once you have thoroughly defined the current state and selected the target of your improvement project, it is time to write your formal **aim statement**. This process should be done in the format of a **SMART** objective:

- Specific—Precisely define the target population
- Measurable—Give exact goals for your target metrics
- Achievable/Agreed—Make sure you set goals that can be realistically achieved and have buy-in from necessary stakeholders
- Relevant—Patient centered and worth pursuing
- Time-bound—Set a clear deadline

Depending on the type of process you are targeting, it can also be important to actually map out what the future state will look like. If you used a process map to define the current state, how would that map change after your proposed initiative?

5. Proposing and Testing a Countermeasure

If you have done a thorough job moving through the previous steps, you should have a clear vision of what this step will entail. This is the "plan and do" part of the PDSA cycle. It is important to keep in mind that you are testing countermeasures, not implementing solutions. Your first proposed change may not work as intended. This is why having SMART goals and anticipating that you will "fail fast forward" is important. It is also important that you define success as not just the ultimate project goal (improving patient care), but also as achieving intermediate goals, including learning from mistakes. As such, the most successful quality improvement projects are designed to achieve early wins. An early win is a tangible improvement that can be appreciated by the quality improvement team in a reasonable amount of time. Enabling the team to feel the excitement of both improving the project and improving care makes the project fun and strengthens the team. If you have selected and recruited an appropriate team, then your countermeasures will include processes of care that are controlled by the team members, which helps create a sense ownership and pride in successful changes. These early wins should be acknowledged, celebrated, and used to create momentum for the next step.

6. Studying the Impact of the Countermeasure

This step is crucial to the actual success and forward movement of process improvement. You must carefully select the family of metrics that you will follow and create run charts or control charts to track your progress. In order to catch unintended consequences, you must make sure that you also include and track appropriate balancing

measures. For more details on the statistical rules for interpreting control charts, review *The Health Care Data Guide: Learning from Data for Improvement.*[3]

7. Implementing and Standardizing Countermeasures

This step entails standardizing your successful countermeasure so that it becomes part of the normal or standard workflow. If you started by testing in a small environment (for example, a single clinic, one patient unit, or an individual operating room cluster), this is when you expand to additional areas. However, it is important to remember that the countermeasure may require further refinement for each new implementation cycle.

B. COMMON QUALITY IMPROVEMENT METHODOLOGIES

While the prior section walked you through a specific approach to QI that we have found useful in the health care setting, it can be helpful to have a slightly broader understanding of the underlying quality and safety methodologies and how they were developed. For more detail on these techniques, see the recommended reading at the end of each section.

OBJECTIVES

At the end of this section, the learner should be able to:

- Describe the concept behind Six Sigma
- Understand what the steps of DMAIC are and how to use them to organize a process improvement project
- Describe a method used to identify areas and types of waste in surgical care
- Describe the concept of an Agile sprint

1. Six Sigma

Six Sigma is one of the most prominent process improvement methodologies. Six Sigma started as a process improvement methodology for Motorola in 1986.[4] Its success with Motorola, and then General Electric, brought it to national recognition in the 1990s.[5] Since then, the method has been applied to multiple industries throughout the world, including medicine.

Six Sigma is a process improvement technique that derives its name from its stated objective of reducing process errors to a rate of six standard deviations below the mean. This translates to a process being 99.99966% error free.[4] Most standard industrial processes start out at a rate of about 3.4 sigma, while most medical processes average between 3 and 4 sigma levels.[5,6] In the clinical setting, a sigma rate of 3.8 corresponds to 5,000 incorrect surgical operations (nationally) per week. Reducing the error rate to Six Sigma reduces that number to only 1.7 incorrect surgical operations per week.[7] As the complexity of the technical and medical processes of care increase, the cumulative effect on errors can become exponentially greater.

While many processes are quite complex with multiple steps, most industries have found that the majority of inefficiencies are within a select few individual steps. The idea dates back to the Pareto principle, where 20 percent of the processes contribute to 80 percent of the errors. Six Sigma takes advantage of this principle by trying to focus on those processes to improve their rate of error as much as possible.

Six Sigma accomplishes this by applying the steps outlined in the acronym DMAIC.[8] DMAIC stands for Define (D), Measure (M), Analyze (A), Improve (I), and Control (C).[9] The first step when applying DMAIC to quality improvement is to **Define** the problem.[7] The step goes much further than just narrowing in on a single problem (such as surgical site infections). The problem needs to be clearly defined. The process that one is looking at regarding that problem needs to be delineated. The scope of the project needs to be articulated. The members of the team need to be assigned and delegated appropriately. A time frame needs to be established.

The second step of the process is **Measure**. By using the definitions obtained in the Define step, data are collected.

The third step involves **Analysis** of the problem. Once the data are collected, they need to be rigorously analyzed. A process map is usually helpful in organizing the potential causes of the end problem. Once a process map is made with the corresponding data, a root cause analysis is usually done to help identify the top potential areas of problems. The intent is to identify the key steps that will have the greatest impact as outlined by the Pareto principle. A fishbone diagram can help illustrate areas of deficiencies to work on.[10] Careful analysis should reveal a few significant areas of errors. For example, it may be found that only 36 percent of patients received the proper intraoperative antibiotics and that these patients were a major contributor to the surgical site infection rate. Once the analysis is properly completed, the team should reconvene and brainstorm to identify the best way to improve each of these areas of weakness. Multiple improvements can be implemented at the same time for synergistic effect. It is critical that the results of this project are clearly recorded in order to document both the success of implementation and the overall outcome.

There are two overall ways to change a process in order to **Improve** an error rate. The first is to modify the overall process so the end metric of a particular step is improved.[7] One example would be to change the perioperative antibiotic regimen based on peer-reviewed data to reduce the overall risk of surgical site infections. The second way is by reducing variability in a process, which can be achieved by standardizing a practice. By doing so, there is also significant reduction in human error. One example would be to standardize a prepping procedure so the same method is in place for the entire service. The combination of these two methods can demonstrate significant changes in the overall outcome metric.

The final step of the process is **Control**. It is important to ensure that these measures remain in place and to not return back to the pre-intervention levels. This requires monitoring the process to help keep track of changes. Team members should be informed of any problems. One way to keep on target is to use American College of Surgeons National Surgical Quality Improvement Programs (ACS NSQIP®)-generated data for measures such as surgical site infection rates at the hospital.

In conclusion, Six Sigma can be used to find key areas that may be contributing to undesired outcomes. A team approach with membership from every service is ideal. It is a data-based process improvement strategy that can be used to help improve outcomes in a health care setting.

RECOMMENDED READING

Chassin R. The Six Sigma initiative at Mount Sinai Medical Center. *Mt Sinai J Med.* 2008 Jan-Feb;75(1):45-52.

Frankel HL, et al. Use of corporate Six Sigma performance-improvement strategies to reduce incidence of catheter-related bloodstream infections in a surgical ICU. *J Am Coll Surg.* 2005 Sep;201(3):349-358.

George M, et al. *What is Lean Six Sigma?* New York, NY: McGraw Hill Professional; October 27, 2003.

2. Lean

Lean process improvement is one of the most popular and successful methods of quality improvement today. Lean's origin comes from Toyota manufacturing in the 1970s.[11] The success of Toyota's method was brought to public attention in the 1990s by Womack, et al. in *The Machine That Changed the World*. Since that time, Lean has been applied to many different industries throughout the world, including medicine.

The purpose of Lean is to reduce excess waste in any process. Waste in Lean has a stringent definition. It is often replaced with the Japanese word for waste, *muda*.[8] Waste in Lean refers to the amount of work that does not directly impact what a customer deems important for the product. This concept is essential, because a company may see a step as important to a process when a customer does not.

Lean is important to the quality improvement process in surgical procedures, as resources (for example, the amount of time in the day for an intern to accomplish all of his or her tasks) are often scarce. Therefore, reducing inefficiency benefits the quality of the care provided. For example, decreasing the amount of time the intern spends babysitting a surgical patient after the operation is completed before the recovery room bed is available would enable the intern to spend more time with other patients and address their needs in a more timely fashion.

Waste has many different forms (**Figures 6 this page and Figure 7, page 16**). Some common examples are product defects, overproduction, excessive inventory, unnecessary steps or actions, and waiting time between steps.[12] An example in the surgical field would be having the operating rooms set up so each operating room is fully stocked with multiple gloves, sutures, and equipment for every surgical procedure that is performed in that operating room. Because many operating rooms are designed in a cell block fashion, if the stock supplies could be kept in the center section and only the supplies needed brought into the operating room prior to the operation, that would save a significant amount of space would be in each operating room and would cut down

Figure 6. An example of Taiichi Onno's seven wastes

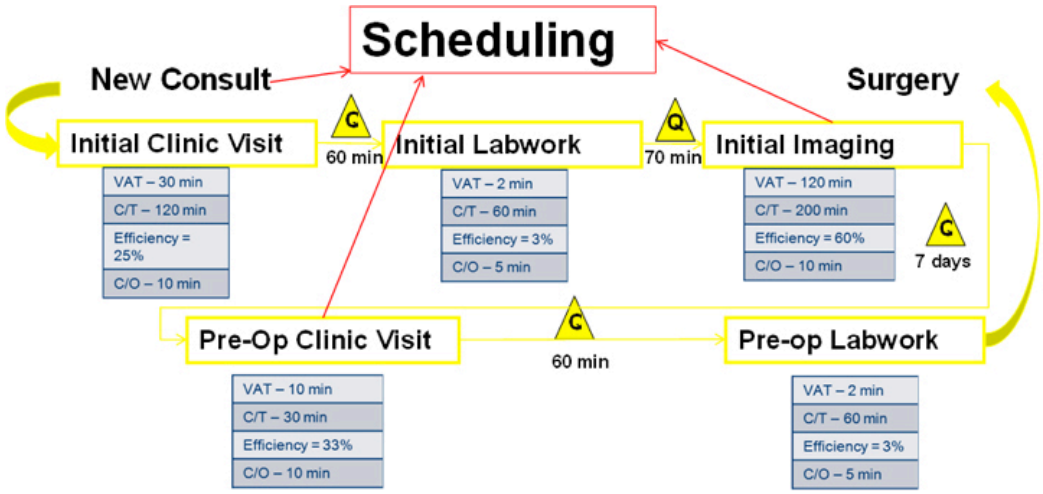
Figure 7. Clinical examples for each form of waste

significantly on inventory costs.

The primary way Lean solves the problem with waste is by using flow manufacturing, or "just in time" manufacturing.[8] Flow process involves streamlining the entire process and eliminating as much redundancy and waste as possible. This is accomplished by using pull, where the downstream process signals the need for further production.[13] Flow stands in contrast to the more traditional batch and queue process, popularized by Henry Ford. Batch and queue requires large batches of a single component in order to create massive quantities of a final product. In contrast, a Lean organization only produces what is needed for a given time. An organization must be very flexible in order to adapt to the changing signals from downstream demand. While this process may seem counterintuitive at first, the results can be quite striking. An example may be a hospital that keeps hundreds of different meshes for inguinal hernias. Instead of keeping the inventory fully stocked for any potential hernia (a batch and queue model), a Lean hospital may only have a limited supply of meshes and would only order the meshes when necessary a week or two in advance. Like the prior example, this method would cut down significantly on the amount of space necessary to hold inventory, along with the costs to maintain that inventory.

The best way to determine the initial flow of work is to conduct a value stream map, or a map that outlines the current flow of work (**Figure 8, this page**).[14] These maps include the amount of time that contributes to the overall process and the amount of time that contributes only to the value of the product as deemed by the customer. When constructing a map, it is important to include several features. It should include the amount of value-added time (VAT), or time that directly contributes to the value as defined by the customer.[8] VAT is in contrast to non-value-added time, which is time required for a project that does not directly contribute to value by the customer. Cycle time (C/T) is the amount of time one cycle of a step in the process takes, and change over time (C/O) represents the amount of time to change over from one cycle to the next. For example, in an operating room, the amount of time for a single case in the OR would be a

Figure 8. Value stream map: Outline of current work flow



cycle time, and the turnover time needed to be ready for the next operation would be a change over time. The time waiting between steps is represented by queue time (Q), which can often be a significant source of waste within a process. The value-added time divided by the total amount of time represents the efficiency of the process. Many overall processes are below 10 percent efficiency.

Once the entire process has been characterized, Lean process improvement focuses on simplifying the process in order to reduce waste.[14] Lean processes have fewer and more simplistic steps to reduce inefficiencies. Another feature of Lean is to allow adequate flexibility to correct errors as soon as they happen and not wait until the end of the process to fix them. Lean requires less inventory and space by encouraging pull manufacturing. Pull will require increased flexibility on the part of the worker.

The original Toyota manufacturing employed a system called 5S.[13] They stand for five Japanese words: Seiri, Seiton, Seiso, Seiketsu, and Shitsuke; however, the English counterparts are often used (sort, straighten, sweep, standardize, and sustain).[8,13] *Sort* refers to separating essential tools from the unessential tools and removing the unessential ones from the workspace. *Straighten* refers to arranging parts or supplies for ease of use. *Sweep* refers to maintaining a clean work environment. *Standardize* refers to conducting the former tasks frequently in order to maintain them. *Sustain* refers to transforming the former tasks into a habitual behavior. Together, these steps not only create a Lean process but also help form a lasting culture of waste reduction.

Taking the original process map, a team consisting of people from all steps of the process should come up with a new and improved work flow. By incorporating members from each step and all levels of management, the process has the best chance of becoming lean. A new, future stream map should be plotted with new functions of each step and how the new steps relate to each other (**Table 1, page 18**).[14] An example of a Future Stream Map is given in (**Figure 9, this page**).

An example of a Lean process would be focusing on streamlining the preoperative workup in a surgery clinic. A current state of the clinic from the initial consult until scheduling for a surgical procedure can be seen in (**Figure 8, page 16**.) A significant amount of time for the patient is nonvalue, requiring multiple office visits on different days. This could be eliminated by screening the patients before their initial visit so that patients with a high likelihood of a surgical procedure could have all of their preoperative workup the same day as the initial consult. An example of a future state to reduce this waste can be seen in (**Figure 9, this page**.) (**Table 1, page 18,** demonstrates)

Figure 9. Value stream map: Outline of future state

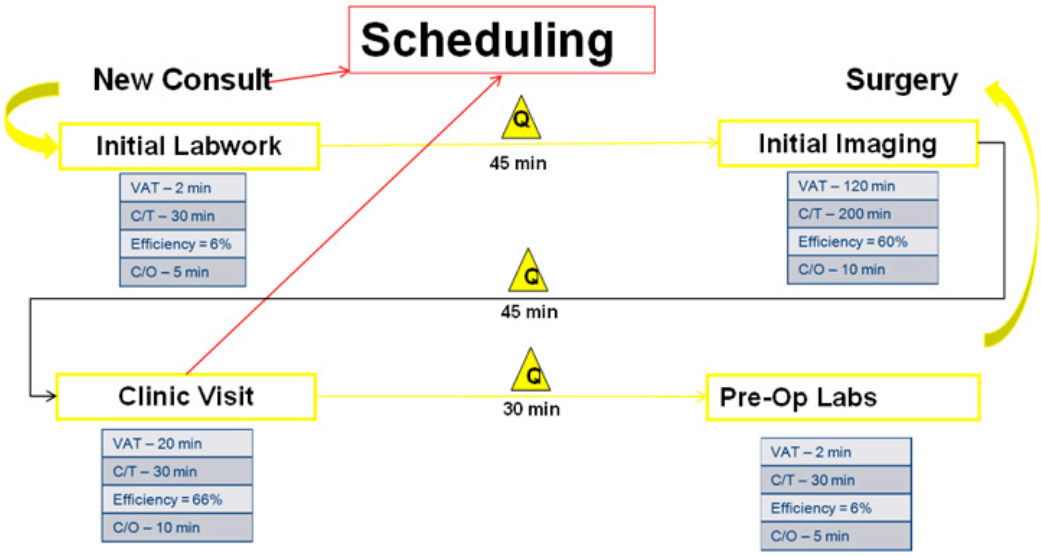


Table 1. Comparison of current and future states

	Current State	Future State
Value Added Time	164 minutes	144 minutes
Non-Value Added Time	306 minutes	146 minutes
Queue Time	10,270 minutes (7.1 days)	120
Lead Time	10,740 minutes	410 minutes
Efficiency	1.5%	35.1%

a reduction in overall waste and an improvement in the overall efficiency of the process. Similar process improvement projects have been successful in the surgical field.[13,15]

Like all process improvement plans, it is essential that there be a way to continually monitor the progress of the process improvement. Once improvements are documented, these changes must be instilled into the production team to prevent the team from reverting back to the early state. In addition, Lean is not a one-time change for an organization but rather a continual process to strive for as much waste reduction as possible.

Lean is a methodological process improvement strategy that can be used to help improve outcomes in a health care setting. It can be used to minimize waste and streamline the process for an efficient, safe process.

RECOMMENDED READING

Glasgow JM, Scott-Caziewell JR, Kaboli PJ. Guiding inpatient quality improvement: a systematic review of Lean and Six Sigma. *Jt Comm J Qual Patient Saf.* 2010 Dec;36(12):533-540.

Kim CS, Spahlinger DA, Kin JM, Billi JE. Lean health care: what can hospitals learn from a world-class automaker? *J Hosp Med.* 1:191-199. doi: 10.1002/jhm.68

Toussaint JS, Berry LL. The promise of Lean in health care. *Mayo Clinic Proceedings.* Elsevier. 2013;88(1).

3. Agile Process Improvement

One of the newer process improvement methodologies is called Agile. It was developed in the late 1990s within the information technology sector and is now being adapted to various other types of businesses. The basic idea is to set up small teams to focus on specific components of a larger overarching project. Each team undertakes short, focused "sprints" of complete process improvement cycles. For example, in the software industry, an accounting package would have one component developed, tested, and even marketed prior to other components being developed. If there are any issues, such as on the database design, they could be realized and corrected before larger resources had been used to develop the entire package.

Each sprint time frame lasts three to four weeks. At the beginning of each sprint, there is a meeting to brainstorm ideas. Every person has a clearly defined role in these teams and has set amounts of daily communication to trouble shoot and evaluate what the level of progress is. Meetings are usually capped at 15 minutes. At the end of each time block, the progress is evaluated and projects are assessed. Then a second block is started with projects left over from the previous block as well as new ideas.

Agile is an excellent way to deal with a large problem in a hospital setting requiring multiple of adjustments. For example, surgical site infections are a known problem within the health care field. There are multiple different causes of surgical site infections, such as sterile technique, proper antibiotic use, hand washing, perioperative normothermia, and normoglycemia that need to be addressed in order to reduce the infection rate. Each one of these areas can be a focus for a sprint. By only doing one month at a time, if a certain area does not work, there is a limit to the costs sunk into any one area. Over the span of multiple projects, the overall rate of surgical site infection can be tracked. After multiple sprints, the overall rate should show a significant decrease and should reveal new areas to target in future sprints.

RECOMMENDED READING

Ries M, Summers D. Agile Project Management: A Complete Beginner's Guide to Agile Project Management. CreateSpace Independent Publishing Platform. 2016.

C. DATA

OBJECTIVES

At the end of this section, the learner should be able to:

- Explain three different ways to categorize data
- List one advantage and one disadvantage of clinical registry data compared with administrative claims data
- Give two examples of how electronic health record data could be used in a quality improvement project

In 1966, Avedis Donabedian described the classic approach to quality assessment that we use in the surgical profession today. The central concept is that care can be divided into three domains. **Structural** measures refer to the physical and organizational aspects of care settings. **Processes** of patient care refer to what care is delivered and how. **Outcomes** refer to what ultimately happens to patients. When designing your quality improvement efforts, it is useful to categorize your data into these three domains as well. Although collecting data is only one essential component of the process and is not a solution to effect change, data is crucial to quality improvement. Having data allows us to see the baseline, know the standard, and set a goal. Different types of data can be used to identify a problem and help understand its cause. Ultimately, you will use data to detect the improvement you are striving for. For all of these uses, you must understand the basic principles of data, where it comes from, and what it means.

In addition to dividing data and metrics into categories of structure, process, and outcomes, there are at least two other ways of classifying data that are helpful. In this section we will review these broad categories and then discuss in detail the most common existing sources of data: administrative claims, national registries, and electronic health records.

One of the basic categorization of data is quantitative versus qualitative. Much of the data we work with are **quantitative**, or consisting of numbers. One of the simplest examples is a binary outcome measure such as inpatient mortality where there are only two possible outcomes (most commonly yes/no). Other types of quantitative data include measures involving time, dose, amount, or quantity. More broadly speaking, even patient diagnoses and procedures can be converted into quantitative data if you define enough codes and categories. The most commonly used systems to do this include the International Classification of Disease (ICD) codes for the assignment of medical diagnoses and ICD procedure codes or Common Procedural Terminology (CPT) codes for the assignment of procedures. Using these codes allows a patient's hospitalization to be summarized in a line of a spreadsheet.

As data become simpler, it is easier to analyze, especially when you have a very large number of records. However, you lose detail and complexity. Even within the realm of quantitative data, there are tradeoffs that must be considered. For example, we said the occurrence of inpatient mortality is captured well by a binary flag (yes/no). If, however, you were interested in targeting *preventable* in-patient mortality, a binary indicator may not be well suited. You could create a dichotomous variable of preventable death (yes/no), but many involved stakeholders may not trust the results. In this example, the definition of "preventable" is not clear. Stakeholders might be more comfortable if you instead created a variable with multiple categories of "preventability," such as unavoidable death (death in a 90-year-old admitted with a perforated bowel from a terminal malignancy and new massive MI), potentially preventable (death in an otherwise healthy 90 year old admitted for acute appendicitis who was septic upon arrival to the emergency department), and preventable death (death in otherwise healthy 90-year-old admitted for acute appendicitis with mild stranding around the appendix on CT scan and no physiologic derangements aside from a mild leukocytosis).

As you move into more nuanced classifications and categories, you eventually leave the realm of quantitative data entirely. **Qualitative** data relies on words and descriptions rather than numbers. For example, the actual content of a patient's complaint (as opposed to an analysis of the number of complaints), would be qualitative data. Unlike quantitative data, which often has a goal of being standardized and comparable across many different settings, the strength of qualitative data is to gain insight into a unique local environment. Frequently, successful hospitals have systematic ways to gather qualitative data, such as expert opinion and patient input.

The second way to categorize data is primary versus secondary sources. From the perspective of a quality improvement project, **secondary data** includes all data that has already been collected before you start, including patient charts, administrative databases and clinical registries (discussed later in this section), and previously collected patient comments or complaints. As you move forward in your quality improvement project, you should encounter a point where you have a question that cannot be answered with existing data. The next step is to

collect **primary data**. The data you are looking for may be quantitative ("How often does a transfer patient from an outside hospital arrive without a complete chart?") or it may be qualitative ("What are the current steps in the transfer process and who has the authority to accept a transfer?"). Depending on what your project is and what kind of data you need, the process of collecting primary data may include surveys, interviews, or direct observations. A number of tools have been developed that you can use to guide this process. These are discussed later in this section.

Finally, it is worth noting that data always come from a source, which can influence their reliability and accuracy. For example, data on the time of antibiotic administration taken from the nurse's progress note may be less accurate than data taken from the electronic medication dispenser that logs the time the nurse removed the medication. The key to selecting the appropriate data for quality improvement is finding a balance between availability, ease of abstraction, the ability to measure the process or outcome of interest, and feasibility of analysis.

1. Administrative Claims and Clinical Registries

To jumpstart the quality improvement process, programs frequently rely on data that have already been collected and stored in a dataset. The two types of datasets used most frequently are administrative claims databases and clinical registries.

Administrative claims datasets are a collection of information generated for billing. As a result, the information is collected after **coders** translate the clinical information into billable language. A coder is someone, usually employed by the hospital, who reads the medical record and assigns standardized codes (such as ICD codes) for each patient upon discharge from the hospital or ambulatory surgery center, or after an outpatient visit with a health care provider. Examples of claims databases include AHRQ Health care Cost and Utilization Project datasets, MEDPAR data from Medicare claims, and private insurance bills. By law, the bill can only include information documented in the medical record by a health care provider recognized as a treating physician or advanced practitioner. From the eyes of the payers, if it's not documented, it does not exist.

A major advantage of claims datasets is that they are very complete. For every patient treated, there is a claim filed to generate the bill for payment. However, due to inconsistent coding practices across institutions and inaccuracies or sparse documentation in the medical record, it can be challenging to make decisions regarding the actual quality of care provided by an individual practitioner, service, unit, hospital, or health system using claims alone. Furthermore, determining the sequence of events for diagnoses that occurred during an inpatient stay is very difficult or impossible. As such, the data can be inaccurate when trying to identify postoperative complications. For this reason, administrative claims are best used for discrete events such as death, readmission, or length of stay. They are also helpful for the initial identification of potential areas for improvement. The process of looking into such a problem is often referred to as a "deep dive" or "drilling down" on the data.

Clinical registries can be more reliable than claims data for examining particular surgical populations and outcomes. The best registries require a trained person with clinical experience to collect the data using strict definitions. Rigorous definitions make it possible to standardize the data collection process across hospitals. As such, the data are ideal for **benchmarking** or comparing outcomes or processes of care across organizations. One key difference between registries and claims databases is that in a registry, the data abstractor can use test results (for example, lab results and blood cultures) to support the presence or absence of a condition even without precise documentation by the care providers. These registries can be expensive to maintain due to the need for additional personnel. As such, they often rely on the collection of a sample of data or a portion of the population in lieu of the entire volume of patient encounters and the entire volume of patients. Another advantage is that registry data is frequently collected prospectively and can discriminate between preoperative comorbidities and postoperative occurrences. For these reasons, clinical data is typically preferred for informing quality improvement projects. The **ACS NSQIP** database is the best national, risk-adjusted, validated registry available for use in the assessment of surgical quality.

It is important to note that not all registries adhere to the best data collection methodology. Some registries collect data entered by the clinicians caring for the patients. In this setting, the data may be less reliable due to the innate conflict of interest when reporting clinical outcomes on one's own patients. Other data registries fail to provide comprehensive data definitions, making comparisons across centers or even providers difficult due to variability in the meaning of the data recorded. When considering the use of a clinical registry, it is important to review the data definitions and understand the data collection methodology in order to evaluate the quality of the data itself.

Here is a quick example to illustrate a subtle but meaningful difference in the data collected for claims compared with a robust clinical registry. During the postoperative period, a clinician treats a patient for a suspected pneumonia, documenting his or her suspicion in the chart. The subsequent workup, including a chest X ray and a CBC, are all normal and the clinician stops the antibiotic treatment but fails to update the chart to reflect the absence of the pneumonia. According to the hospital claims data, the patient would likely be recorded as suffering a postoperative pneumonia. Because registry data use independent definitions of pneumonia and other complications, the patients would not qualify as having pneumonia.

2. Electronic Health Records

Health information technology (HIT) has become a critical part of the everyday care of patients for almost all health care providers in the U.S., providing both a new platform for performing and documenting patient care, but also a rich source of data available for research and quality efforts. HIT is often thought of as referring specifically to computerized provider order entry (CPOE) platforms and electronic health records (EHRs), including clinical decision support systems (CDSS) frequently embedded within CPOE platforms. However, a broader definition of HIT also includes web-based tools such as the ACS NSQIP Surgical Risk Calculator (SRC) and the new frontier of apps such as the Carolinas Equation for Determining Associated Risks (CeDAR). In this section we will provide a brief overview of some of the tools available with the advent of HIT in different platforms and how they can be used to assess and improve quality.

Computerized Physician Order Entry

Although computerized physician order entry and electronic health records would probably have come to prominence on their own, the rate of adoption of these technologies was hastened by the 2009 enactment of the American Reinvestment and Recovery Act (ARRA) and the Health Information Technology for Economic and Clinical Health (HITECH) Act.[16] This legislation authorized billions of dollars to provide support for implementation and use of EHRs in the United States.[17]

Few studies have examined the impact of HIT on patient outcomes. One study published in 2010 demonstrated that the implementation of HIT had a positive influence on the rate of specific quality process measures (pneumococcal vaccination and the use of the most appropriate antibiotics) and had the biggest impact in academic hospitals.[18] The authors hypothesized that the more substantial impact seen in academic settings might have been due to investment in more sophisticated systems and treatment of more complex patients who benefited from the improved coordination. A separate literature review concluded that there was insufficient evidence to support the benefits of "eHealth."[19]

Downsides of EHRs have included misuse of "copy and paste" functionality, continued inability to share records between physicians in different systems, and being perceived as not user-friendly.[20-22] Copy and paste functionality has been shown to reduce the readability of discharge summaries and has numerous other risks to quality patient care.[20,21] At the same time, however, electronic systems have shown improved timeliness to completion and completeness of both discharge summaries as well as operative notes.[21,23]

Another benefit of electronic health systems is the greater ease of embedding clinical decision support systems, which have been shown to "improve prescribing practices, reduce serious medication errors, enhance delivery of preventative care, and improve adherence to recommended care standards."[24] In one systematic review the authors demonstrated that computer-based decision support was an independent predictor of improved clinical practice.[24] A more recent meta-regression concluded that decision support within electronic systems was a predictor of CDSS failure, possibly due to alert fatigue.[25]

Overall, the transition from paper to electronic formats for order entry, decision support, and medical documentation provides tremendous and often overwhelming opportunities for data analysis and quality improvement. Some hospital systems are creating centralized systems that coordinate "data pulls" from the EHR for research and quality purposes. As in all other research, but particularly for EHRs, a thorough understanding of data obtained from electronic records is critical for accurate conclusions. There remain many untapped opportunities for residents to utilize these data for quality improvement initiatives.

Surgical Risk Calculators

A paradigm shift is occurring within the framework of the U.S. health care delivery system as patients are becoming more proactive in their health care choices and decisions. A full understanding of the potential risks associated with surgery is beneficial for both the surgeon and patient, and all surgical procedures have the possibility of adverse outcomes ranging from minor complications to major disability or death.[26,27] Determining the frequency with which perioperative complications are likely to occur has previously been subjective, which can create barriers for surgeons in discussions with their patients.[28]

Fundamentals of Surgical Quality Improvement

Surgeons rely on their experience and published literature containing data aggregated across heterogeneous patient populations. While this is useful to estimate general surgical risks, determining the probability that a specific patient will experience a particular adverse outcome is more challenging.[27]

One of the fundamental skills that a surgeon strives to master is to know whether or not to operate.[28] There remains wide regional variation in surgical utilization rates.[28] The decision to operate sometimes falls into a discretionary gray area where the best treatment option is unclear and dependent on patient preferences. When there is uncertainty regarding the best treatment option,

Table 2. List of published surgical risk calculators

Authors (year)	Patient Population	Risk Factors	Outcomes	Model characteristics
Gupta, P. K., Franck, C., Miller, W. J., et al. (2011)	Bariatric surgery patients	Age, sex, race, recent MI/angina, dependent functional status, stroke, bleeding disorder, hypertension, BMI, and type of bariatric surgery.	30-day morbidity and mortality	Training dataset (2007): c-statistic 0.69 Validation dataset (2008): c-statistic 0.66
Gupta, P. K., Gupta, H., Sundaram, A., et al. (2011)	Surgical Patients in the 2007 NSQIP database	Type of surgery, functional status, creatinine, ASA class, and age	Postop cardiac risk myocardial infarction / cardiac arrest	Training dataset (2007): c-statistic 0.88 Validation dataset (2008): c-statistic 0.87 Revised Cardiac Risk Index (2008): c-statistic 0.75.
Parikh, P., Shiloach, M., Cohen, M. E., et al. (2010)	Pancreatectomy patients	Age, gender, obesity, functional status, ASA class, extent of surgery, dyspnea, sepsis, coronary heart disease, bleeding disorder	30-day mortality, serious morbidity, overall mortality	Mortality: c-statistic 0.74, hosmer-lemeshow 0.28 Serious morbidity: c-statistic 0.61, Hosmer-Lemeshow 0.61 Overall morbidity: c-statistic 0.61, Hosmer-Lemeshow 0.79
Cohen, M. E., Bilimoria, K. Y., Ko, C. Y., & Hall, B. L. (2009)	Colorectal surgery	ASA class, functional status, indication for surgery, surgical extent, wound class, disseminated cancer, emergency status, sepsis, age, obesity, dyspnea, COPD, albumin, creatinine, PTT	30-day mortality, serious morbidity, overall mortality	Ovearall morbidity: c-statistic 0.68 Serious morbidity: 0.72 Mortality: c-statistic 0.91
Bilimoria, K. Y., Liu, Y., Paruch, J. L., et al. (2013)	1,414,006 patients encompassing 1,557 unique CPT codes. A broad range of surgery across all surgical subspecialties (except transplant and trauma).	Age, sex, functional status, emergency case, ASA class, chronic steroid use, ascites, sepsis, ventilator dependent, disseminated cancer, diabetes, hypertension, previous cardiac event, CHF, dyspnea, smoking status, COPD, dialysis, acute renal failure, BMI class, and surgical procedure type.	8 surgical outcomes models were evaluated; mortality, morbidity, pneumonia, cardiac event, surgical site infection, urinary tract infection, deep venous thrombosis, and renal failure	Mortality: c-statistic 0.94; Brier score = 0.01 Morbidity: c-statistic = 0.82, Brier score = 0.07 6 additional complications (c-statistics > 0.8).
Ramanan B, Gupta PK, Gupta H, et al. (2012)	bariatric surgery for morbid obesity. 2006 – 2008 NSQIP dataset (n = 32,889) were divided into training (n=21,891) and validation (n=10,998) datasets in an approximate 2:1 ratio.	Age, sex, race, smoking status, alcohol consumption, renal disease, coronary artery disease, CHF, hypertension, peripheral vascular disease requiring revascularization or amputation, rest pain in lower extremity, COPD, neurologic event or disease, diabetes, chronic steroid use, weight loss, bleeding disorders, and open wound. ASA class, functional status, dyspnea, BMI, previous operation within 30 days, neoadjuvant chemo or radiation therapy, admission status, type of bariatric surgery. Multiple preoperative lab variables.	Mortality risk calculator. Major morbidity included 17 postoperative complications: deep wound infection, organ space infection, pneumonia, reintubation, ventilator > 48 hours, pulmonary embolus, DVT, renal insufficiency, acute renal failure, stroke, coma, cardiac arrest, MI, Transfusion >4 units packed RBCs within 72 hours, sepsis, septic shock, and return to the operating room. Minor morbidities; Urinary tract infection and superficial infection.	Training dataset: c-statistics 0.80 Validation dataset: c-statistic 0.82.

there should be a consideration of each option including the probability of possible outcomes and the relative desirability or undesirability of these outcomes.[29]

In February 2016, The Joint Commission (TJC) confirmed that informed consent is central to patient safety and is a vital aspect of patient-centered care.[30] TJC recommends the use of decision aids, graphical tools, and other prompts to efficiently determine and communicate risks during shared decision making. Surgical risk calculators are one type of decision tool that provides surgeons with a risk prediction resource to use with patients being evaluated for surgery to enhance the informed consent process. The most commonly known surgical risk calculator today is the SRC for adults, and in July of 2016, the ACS NSQIP Pediatric SRC became publicly available.[31] The ACS NSQIP SRC was not the first surgical risk calculator created. Prior risk calculators focused on specific patient populations or risk factors (**Table 2, page 22**).[32-35] The creation of a single tool readily available online that is useful for many procedures and applicable to multiple patient populations will almost certainly facilitate the use of risk calculators by surgeons.

Technical Aspects of the ACS NSQIP SRC

In 2013, when the ACS NSQIP Universal Surgical Risk Calculator (USRC) was developed for application to a wide range of surgical procedures, the ACS NSQIP clinical outcomes data were from 1,414,006 patient cases encompassing 1,557 CPT codes from 393 hospitals.[26] It was based on 21 preoperative factors used to predict eight outcomes (**Figure 10, this page**). Based on the models evaluated, performance of the ACS NSQIP USRC was similar to the previous procedure-specific calculators used.[26]

Liu Y, et al. (2016) evaluated and enhanced the calibration of the ACS NSQIP SRC to further improve the performance of the risk models. Estimates from the ACS NSQIP SRC are calculated using ACS NSQIP hospitals that are more often larger U.S. teaching and research hospitals. Therefore, the sample tends to over-represent larger hospitals. An improvement over time in both ACS NSQIP and non-ACS NSQIP hospitals has a tendency to result in a slight overestimation of adverse events. However, in the context of the ACS NSQIP SRC, the effect should be small in that the predictive equations are usually updated annually.[36]

The ACS NSQIP SRC provides patient-specific reports to prompt discussion of surgical risks (**Figure 11, this page**). This allows patients and surgeons to have informed discussions in circumstances where poor prognoses and comorbidities complicate the decision to have or delay surgical procedures, such as patients with oncologic diagnoses.[37] Providing accurate patient-specific risk information can guide decision-making and provide realistic expectations for patients and family.

Figure 10. ACS NSQIP Surgical Risk Calculator patient information page

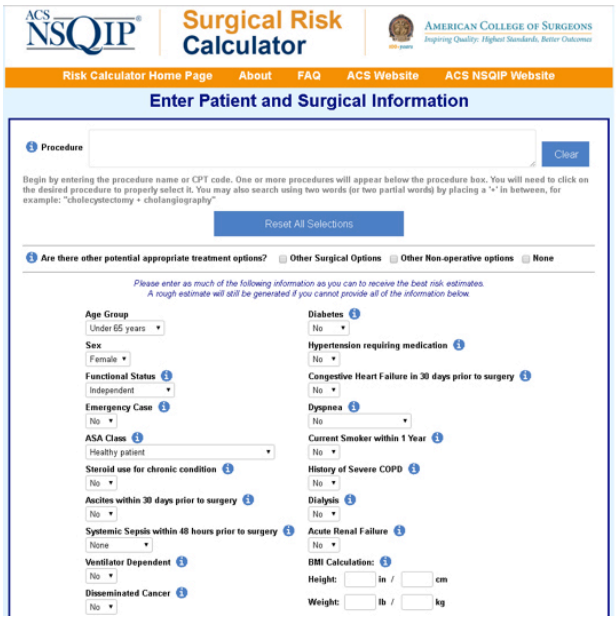
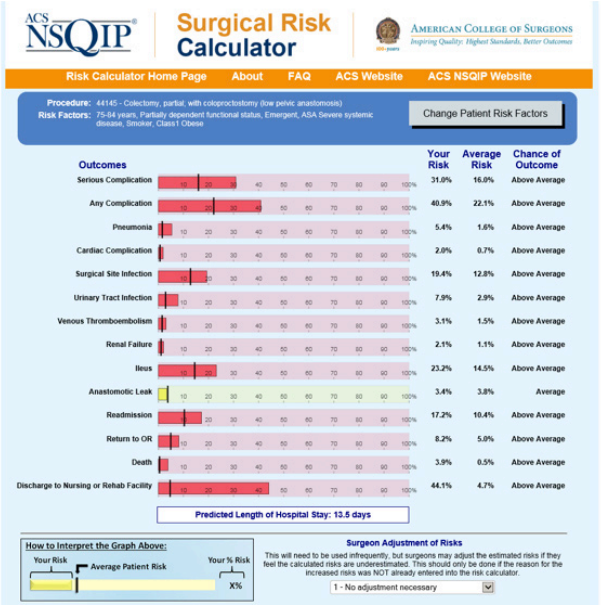


Figure 11. AACS NSQIP Surgical Risk Calculator risk page



Fundamentals of Surgical Quality Improvement

The ACS NSQIP SRC should be leveraged to facilitate shared decision-making during the informed consent process and care coordination to mitigate risks before surgery. Examples of clinical conditions that would likely benefit from the use of the ACS NSQIP SRC include patients at risk for increased postoperative pneumonia who demonstrate higher compliance with physician orders for preoperative exercise or postoperative incentive spirometer use. Postoperative discharge planning can be customized to emphasize the signs and symptoms of pneumonia to prompt earlier intervention and prevent progression to respiratory failure. Patients with small slow-growing tumors and severe comorbidities may decide to forego surgery when considering overwhelming surgical complication risks.

Mobile Apps

Mobile apps have been available for years for simple medical calculations such as body mass index, model for end-stage liver disease (MELD), and so on. A relatively new frontier in health information technology in the world of surgery is mobile apps that provide predictive calculations. Two examples are the Carolinas Equation for Determining Associated Risks (CeDAR) and the Carolinas Equation for Quality of Life (CeQOL) produced by surgeons at Carolinas Health care System. CeDAR used mathematical modeling of more than 500 ventral hernia repair patients to identify patient characteristics that predicted postoperative complications and analyze postoperative financial impacts of complications (**Figure 12, this page**). CeQOL similarly predicts the incidence of chronic discomfort following inguinal hernia repair (*carolinashealth care.org/ceqol,* **Figure 13, this page**). Both apps are designed to allow an immediate prediction of risks of postoperative complications (and in CeDAR financial outcomes are included as well) providing patients with an objective and quantitative assessment of their risks. Future studies are needed to determine the impact of utilization of these technologies on patient understanding and satisfaction.

CONCLUSION

Health information technology has grown substantially since the implementation of the HITECH act in 2009, and we can only imagine the ways in which it will continue grow in the future. Without a doubt, it will have a growing role in quality improvement projects. As residents are often the frontline providers for CPOE and EHRs, their involvement and leadership will be critical to understanding how this data can be used to improve patient care.

Figure 12. CeDAR app pages

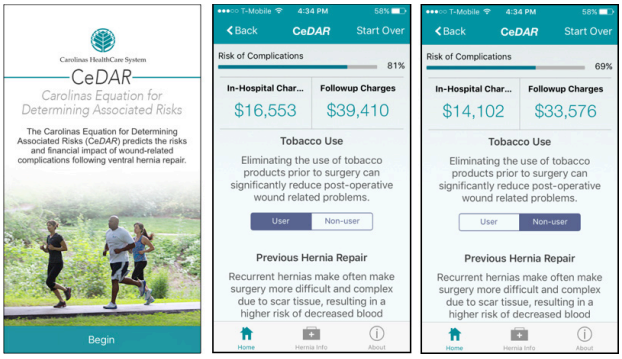
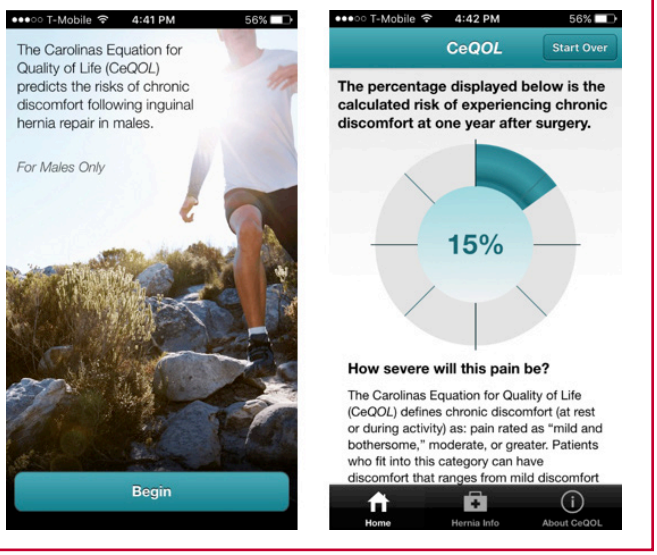


Figure 13. CeQOL app pages



OBJECTIVES

At the end of this section, the learner should be able to:

- Provide two examples of positive and negative safety culture that can influence the quality of care provided
- Identify three examples of clinical communications that can influence the quality of care provided to surgical patients
- Describe two components of a morbidity and mortality conference that can help create a positive safety culture

When we try to define surgical culture, often the traditional "old school" surgeon comes to mind; a cowboy, a lone ranger, with total responsibility for his or her patient.

> "'Get this thing out of my operating room!' The colon stapling device exploded into pieces when I hurled it against the operating room wall … Surgeons are control freaks. We have to be. And when things don't go our way in the operating room, we can have outbursts. Some of us curse, some throw instruments, others have tantrums. These explosions are a go-to reaction when we're confronted with the ghosts of prior complications." —Paul A. Ruggieri, *Confessions of a Surgeon*[1]

Does this kind of surgeon still exist in your hospital? If so, what is it like to work with him or her? If not, are there still stories about surgeons like this?

Culture might be the most important and most challenging component to the delivery of high-quality care. The energy required to overcome a bad culture results in waste and frustration and detracts from the positive aspects of being a surgeon. This fact is extremely important for residents to understand, although often difficult to change. Balancing the persona needed to achieve technical success in the operating room as well as ultimately shoulder the majority of the responsibility of risk associated with surgery against the persona necessary to lead and orchestrate a highly functional team that is aligned in its goals and adheres to the principles of high reliability is often a challenge for surgeons. We associate confidence with competence, but we must also find a way to deliver direct and focused care without arrogance or apathy.

Surgeons are in a unique position with regards to perioperative culture. In most organizations, providers feel that the persona of the surgeon sets the tone for the surgical culture. At the same time, the surgeon is in the most powerful position to change the culture. As such, the balance that we strike between each component of our persona will influence the environment in which we practice. It is hard to be approachable amidst the enormous pressures that we face to perform on a regular basis. But, as they say, if it was easy, everyone would want to be a surgeon.

Try to think about the places in your life that you felt had the best culture. What was it that made it so special? Were the people friendly and competent? Did it "feel like you were at home"? Break down the structure and personal attributes that defined the group. Use them to motivate you to bring those values and characteristics to the care that you provide and inspire those around you. One person at a time, we can develop a safety culture where optimal care is the standard, efficiency is maximized, and people are happy to participate in all aspects of surgical care.

In this section, we will review the fundamentals of safety culture and talk about important "nontechnical skills" that are crucial to patient care: teamwork, communication, and leadership. We will also review how one of the mainstays of surgical culture, the morbidity and mortality conference, can be used to create a stronger safety culture.

A. DEVELOPING A CULTURE OF SAFETY

The study of an organization's safety culture evolved from high-reliability industries that perform complicated high-risk operations with little margin for error and a focus on safety (for example, aviation or nuclear power). Organizations in these fields commit to safe practices on an institutional level and create an environment where any team member can report errors.[2] As health care has looked to these high-reliability industries for insights on how to foster a culture of safety, the theory has been distilled into five key principles. These include (1) preoccupation with failure, (2) reluctance to simplify, (3) sensitivity to operations, (4) commitment to resilience, and (5) deference to expertise. With respect to health care and patient safety, a culture focused on safety is best demonstrated by the behavior of those within a health care system whose actions, values, and peer expectations are directed toward a common goal of safe patient care and preventing harm.[3,4] This type of culture is

Building a Culture of Safety

an environment in which the behavior of many individuals with common goals influences others to act in a manner that fosters the universal objectives of patient safety. The expectations and normative behavior are established in a way that guides health care personnel in the practice of safe patient care while promoting awareness of patient safety along a continuum.[2,5]

In *To Err is Human*, the landmark report published in 1999 by the Institute of Medicine, preventable medical error was identified as a significant source of patient harm and death, as well as a significant burden with respect to cost, length of stay, and resource utilization within the U.S. health care system. Suddenly, the medical community recognized that we were unintentionally harming patients while providing care, and that many of these errors were in fact preventable. This state of practice is contrary to the essential goals of medicine. As physicians and hospitals have worked to understand and correct the sources of errors leading to patient harm, many have turned to the literature of human error that has been developed in other disciplines, which emphasizes the importance of the underlying safety culture.[6] As work in this field has progressed, we are beginning to amass a body of literature within health care demonstrating that elements of a positive patient safety culture are associated with reduced patient harm and preventable error.[5]

In short, culture impacts outcomes. In a study by Abstoss and colleagues, an in-depth set of interventions was instituted with the goal of improving safety culture within an intensive care unit (ICU). At the end of the study period, the rate of medication errors was reduced by 71 percent. The authors concluded that improved safety culture was associated with improved patient safety, and importantly, they also concluded that numerous safety checks in place prior to beginning the study are likely to be more effective in the setting of positive safety culture.[7] An institution-level commitment to patient safety has also been shown to significantly reduce patient harm secondary to medical error. In a study that utilized a multi-faceted approach to staff training in recognition of patient safety issues and opportunities for preventable harm, the number of preventable incidents of patient harm was reduced by half. Furthermore, in the same study period, the in-hospital mortality rate was also significantly reduced.[8] Related studies have shown that one of the most common cited causes from root-cause analyses is poor communication among surgical team members.[9] Similar work shows that perceptions of poor communication and teamwork, along with other facets of a health care organization's safety culture, correlate with increased morbidity and malpractice claims.[10,11]

This handbook contains numerous strategies and tools for targeting specific issues related to quality and patient safety. The remainder of this section includes similar tools and approaches for improving specific nontechnical skills such as communication and teamwork. We do not have a clear understanding of how to directly influence the underlying safety culture of an organization. But, we do know that ensuring patient safety requires more instituting protocols and checklists. These tools are useful and even necessary, but without a robust underlying positive safety culture, implementation of such tools can be meaningless, or even backfire.

A few things have been established in the safety culture literature. Organizations with positive safety cultures have demonstrated commitments from all levels of institution. In teaching hospitals, this is extra challenging as residency programs are distinct from yet strongly tied to the larger organization. This means that safety culture is influenced by the hospital as well as the training program, and leaders from both organizations, including administration, faculty, and residents, are key players.

For each of these players, being committed to safety means striving toward an optimal set of patient care standards. A high level of quality and patient safety should be considered the norm, and should be considered as essential to both education and operations as technical training or clinical efficiency. From the perspective of a training program, initiatives aimed at improving quality and safety should be approached with the same vigor and dedication as any more traditional research project. Patient safety and quality improvement have the same ultimate goal as traditional research: improving patient outcomes. If we strive to practice evidence-based medicine for our patients, why should providing evidence- based, safe, patient-centered care be any different? Therefore, a strong surgical culture is one that is just as focused on providing safe, quality care as it is on the traditional metrics of technical merit, research, and education. Equal respect for the contributions of each of these components is paramount, and mutual respect obligatory.

Promoting a culture of safety means establishing goals, allowing individuals to voice their safety concerns, asking for clarification, providing feedback, and encouraging all members of the team to strive for the common

goal. Promoting a culture of safety means fostering an environment where providers are comfortable speaking up and speaking out when they have concerns about patient safety and quality as well as establishing goals, "closing the loop" or providing feedback when safety concerns are raised, and encouraging all members of the team to strive for these common goals. It also means being open to new ideas and new cultural norms. Promoting a culture of safety sometimes means being willing to try something new or change your processes of care. Undoubtedly, you have experienced the tension between the apparent utopia of this patient-safety culture and the **hidden curriculum** (the unofficial but powerful norms of behavior that any group develops). As with all change, there are growing pains. This tension, in a sense, signifies progress because a lack of tension means that we have failed to continue to seek ways to improve how we take care of patients. It is okay to recognize and feel the tension. But, if you remind yourself that everything we do is for the good of our patients, there should be no choice but to work toward improving the culture of safety in your institution.

In order to do this, it is important that you learn to recognize cues for your institutional safety culture. How do people handle errors? Do your co-residents and attendings think about safety and incorporate it into their practice? Or, is there still a resistance to a patient safety culture? Is it seen as a less rigorous form of practice by some, or not important? Are safety measures seen as an annoyance or impediment to getting real work done? Taking a mental inventory of where your institution or program lies on the spectrum of patient safety culture is a crucial first step for any resident.

Some tools that can be used to impact an organization's safety culture include classes or trainings, visible reminders of unit goals (like a poster keeping track of the number of catheter-associated urinary tract infections or bloodstream infections), frequent reviews with staff of safety events and countermeasures, checklists (like the OR timeout), and standardized protocols (such as nurse-driven foley catheter removal). However, remember that safety culture is defined just as much by individual and group reactions to these tools as by any official endorsement of them. Culture is created simultaneously in both a top-down and bottom-up fashion. There may be a culture developing around you that you weren't even aware of. As you learn to recognize tools like these as quality improvement and patient safety efforts, you may realize that a hospital safety culture exists that is distinct from your program or departmental culture. Or, you may realize that patient safety efforts at your institution are not visible to residents. This may represent an opportunity for you to contribute to creating the culture in a more focused way. Regardless, your role within this culture will mature along with your technical skill and clinical acumen. As a resident, remember that you are an integral part of both creating and perpetuating a safety culture and should be cognizant of how your attitudes or actions can either support it or break it down

B. TEAMWORK

Teamwork is inherent to the practice of medicine. This is even truer now than a few decades ago due to increasing specialization of providers necessitating a multidisciplinary approach to patient care. A team can be defined as two or more individuals who work together to achieve specified and shared goals, have task-specific competencies and specialized work roles, use shared resources, and communicate to coordinate and to adapt to change.[1] Regardless of specialty or level of training, physicians, nurses, midlevel providers, and countless other hospital staff members work together in coordinated fashion in order to provide optimal care for each patient. The importance of successful teamwork as it relates to outcomes and safety has been well documented in other industries, particularly the aviation industry.[2] Research within these industries highlights skills such as situational awareness, group decision-making, task management, communication, and leadership as leading to positive outcomes.[3] Failures in these nontechnical skills within the medical field have been associated with adverse events.[3] Surgical residency has traditionally focused on the development of technical skill, clinical decision-making, and medical knowledge. In 2007, the ACGME developed six competencies, including patient care, medical knowledge, practice-based learning, interpersonal and communication skills, and systems-based practice as a means to integrate both technical and nontechnical skills into residency training programs.

The impact that failures in teamwork have on adverse events and medical errors has been highlighted by many observational and retrospective studies. Teamwork and communication failures are highlighted most frequently (22 to 32 percent) as contributing to adverse events.[4-6] The operating room environment is understandably dependent on the performance of a team, and this team can be dynamic and unpredictable at times. While there is no question that this particular setting demands

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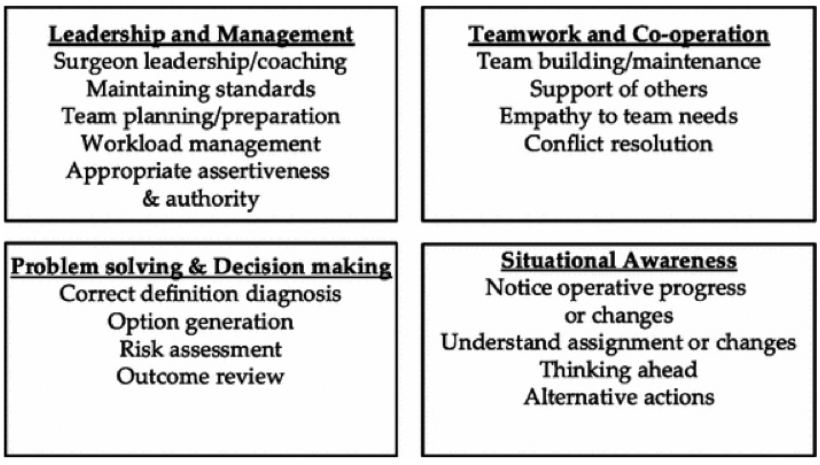
strong teamwork dynamic and communication skills, the importance of heightened awareness and potential for error in such an environment cannot be emphasized enough. Clearly in our efforts to do no harm, we are placing patients at risk for adverse events. Lingard and colleagues observed communication events in the operative setting and documented failure 30 percent of the time. Of these failures, approximately 36 percent resulted in visible consequences such as delay, tension among team members, or procedural error.[7] These visible consequences only reflect the immediate impact of communication error given the observational nature of this study.

Communication error is addressed in part through the development of the surgical safety checklist. Wiegmann and colleagues performed another observational study evaluating the effects of disruption on the surgical process. Surgical errors were found to have increased significantly with increased disruptions and that teamwork and communication problems were the strongest predictors of surgical errors.[8] Catchpole and colleagues found during observational studies of both simple and complex surgeries that surgeons and surgical teams that had high levels of leadership and management skills and situational awareness were able to complete the operations quicker and with fewer errors than those that had lower teamwork skills.[9] In their evaluation, they described four major domains that contributed to the overall successful outcome of the operative team (**Figure 1, this page**). This model was initially developed for use in the aviation industry but adapted for use in the medical field as an assessment for the classification of teamwork.

A 2008 RAND report prepared for the Agency for Healthcare Research and Quality (AHRQ) evaluated the evidence base for the ability of teamwork in health care to reduce errors, improve care quality, increase efficiency, and reduce costs. The report cited empirical evidence to support the relationship between teamwork and clinical outcomes, including risk-adjusted mortality, cardiac arrests, adverse events, and complications.[10] In response, the U.S. Department of Defense working with AHRQ, developed the Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) program. This program has been implemented throughout the active military and federal health care systems and now in an increasing number of private and not-for-profit health care systems around the country.[11,12] The curriculum focuses on leadership, situation monitoring, mutual support, and communication, with emphasis on defining team skills, demonstrating the tools and strategies team members can use to gain proficiency in the competencies/skills, and identification of tools and strategies that can be used to overcome common barriers to achieve desired outcomes.[13]

Teams can make fewer mistakes than individuals, especially when each team member knows his or her responsibilities as well as the responsibilities of other team members. However, simply conducting training or installing a team structure does not ensure the team will operate effectively. Teamwork is not solely a consequence of co-locating individuals together. Rather, it depends on a willingness to cooperate, coordinate, and communicate while remaining focused on a shared goal of achieving optimal outcomes for all patients. Teamwork does not

Figure 1. The four domains of behavior associated with the level of OR team function



require that team members work together on a permanent basis, yet it is sustained by a commitment to a shared set of team knowledge, skills, and attitudes, rather than permanent assignments that carry over from day to day.[14]

Of course, the primary purpose of operating room teamwork is to improve patient safety. However, it has also been shown to improve operating room efficiency. Wolf and colleagues reported on operating room performance after all operating room personnel participated in a one-day intense team training program. Baseline performance metrics were compared 12 and 24 months after the training. There were significant reductions in case delays, reductions in equipment issue delays, and improved compliance with the SCIP measures after the team training.[15]

Clearly, there is evidence to support that teamwork and specific tools to improve communication within operating room teams lead to fewer intra-operative and postoperative adverse events, decreased operative times, and perhaps decreased postoperative mortality. In Flin and Yule's study of attitudes about teamwork in the operating room, while surgeons viewed their teamwork interaction and respect for colleagues, both surgeons and nurses, as quite high, nurses felt that the level of respect shown to them by surgeons was significantly lower than what the surgeon perceived as they were providing.[16] When asked about their leadership style, the majority of surgeons felt that they had a collaborative style. However, the majority of anesthesia providers, surgical trainees, and nurses viewed the surgeon's leadership style as autocratic.[17] In another study specifically evaluating teamwork in the operating room, only 5 percent of surgeons felt that they did an inadequate job of explaining the planned procedure to the rest of the team.[18] Remarkably, the rest of the team felt otherwise with 50 percent of anesthesiologists and circulating nurses rating surgeons as providing inadequate information. Of all the aspects of teamwork evaluated, the greatest measured discrepancy between the surgeon and the rest of the operating room team was in establishing a shared mental model of the planned procedure and expected outcome.

Teamwork is clearly critical to error reduction, efficiency, cost reduction, and improved quality regarding patient care. Surgery demands that individuals come together and function as a team. Traditionally, the surgeon has taken the leadership role. However, without strong nontechnical skills, we cannot serve as effective leaders. Similarly, without communication from the surgeon regarding operative plan and without the team having a shared mental model, the team cannot perform optimally.

The concept of teamwork and leadership in patient safety is not new. In fact, the hierarchical structure of the surgical training program is designed to allow a graduated level of responsibility. The success of a resident service team is dependent upon each resident knowing his or her role within the team and knowing his or her strengths in that capacity. It should not be seen as a weakness for a resident to acknowledge a deficiency in their personal knowledge or skill set or in the team's overall functioning. Rather it should be seen an opportunity for the team to become stronger and safer. Ideally, a strong resident leader (chief) should strive to be able to recognize the strengths and weaknesses of not only themselves but of their team members in order to provide the best patient care.

Team training and leadership development opportunities exist in some, but not all, residency programs. When available, residents should capitalize on such opportunities in order to expand the way they think about leadership. But, formal leadership training is by no means necessary in order to develop these skills. Role models can provide positive and negative examples of leadership behaviors. By taking advantage of the smorgasbord of leadership styles and traits inherent in the faculty of a program, residents have the chance to test out and refine the skills that will help them to develop into successful leaders and effective team members. If you take advantage of it, the structure of the surgical training program can provide an excellent informal education in teamwork and leadership that will undoubtedly positively influence your lives and the lives of your patients.

C. COMMUNICATION

Communication is a critical skill in patient care. Here, we review a number of discrete opportunities to focus on communication skills while providing patient care.

1. Handoffs

Handoff communication has become a subject of discussion since the implementation of the ACGME duty hour restrictions in 2003 and the subsequent modifications established in 2010.[1,2] The duty hour restrictions, created in response to a 2008 report from the Institute of Medicine, were designed to protect patients against fatigue-related errors and to enhance the resident learning environment.[2] While intended to simultaneously improve the resident educational experience and patient care, the duty hour restrictions—specifically the limitation in duty hours—resulted in an increase in the number of physician handoffs performed.[3]

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Existing studies suggest that poor handoffs lead to worse patient outcomes, including adverse events, increased surgical intensive care unit readmissions, delayed diagnoses, redundant tests, and longer length of stays, which lead to higher costs.[4] The Joint Commission identified communication as a root cause in nearly 60 percent of sentinel events in 2012.[6] Gawande et al. found that breakdowns in communication during these handoffs in patient care were the second most common factor reported as contributing to adverse events.[7] Greenberg and colleagues found that 43 percent of communication breakdowns occurred with handoffs and suggested that utilizing strategies from other high-risk fields, such as nuclear reactor control rooms, should be adapted for the medical field to address this inadequacy. Specifically, the standardization of content and format, read-backs to ensure the information was correctly received, and the unambiguous transfer of responsibility were suggested interventions to prevent communication breakdown.[8]

The ACGME recognized the risk for error during handoffs and declared structured handoff to be a main priority in 2010 requiring "sponsoring institutions and programs [to] ensure and monitor effective, structured hand-over processes to facilitate both continuity of care and patient safety. Programs must ensure that residents are competent in communicating with team members in the hand-over process."[8] What was not included in these requirements was how the requirements are to be met.

Multiple studies have been conducted assessing resident perception of handoffs and proposing means to standardize the handoff process. These methods include team training, handoff mnemonics, written templates, and verbal scripts. One of the most powerful recommendations is the simplest: making sure to minimize interruptions during the sign-out process.[5] Health care providers estimate that 15 to 70 percent of medical errors are attributable to communication breakdown or inadequate handoffs.[4] Handoffs are recognized as important and as a learned task; however, the different needs of different clinical disciplines make it unlikely that a single tool will adequately meet the needs of every health care team. It is generally agreed upon, however, that training of some kind is necessary and that the tool best suited to a given specialty or training program or health care team should be under continuous evaluation. Training, in fact, has been shown to have direct impact on patient-focused outcomes.[4] Regardless of the specialty or format used, what defines an effective handoff will inevitably vary between specialties preventing the creation of a single handoff tool.[10] It is imperative that physicians be aware of the impact that this process can have on patient care as improvements in communication can impact patient care by decreasing adverse events during transitions in care.

In this era of duty-hour restrictions and the resulting need for increased handoffs between "shifts" of residents, it is imperative that residents view handoffs not simply as the last hurdle to jump at the end of a day (which is tempting), but as a critical safety element in patient care. The handoff is really a team effort, and it is not limited to the two (or few) people directly involved at the time of transfer. The plan for each patient should be discussed as a primary team using the most up-to-date information and should be clear to all involved. The team should consider the "what ifs" and anticipate questions in order to prepare the receiving team and consider concrete triggers for an intervention, if necessary. The receiving person (or team) should be engaged in the handoff conversation and should also be prepared to ask questions and anticipate problems.

One structured handoff mnemonic that has been published in the literature is I-PASS (**i**llness severity, **p**atient summary, **a**ction list, **s**ituation awareness and contingency plans, and **s**ynthesis by receiver). A pre- and post-intervention trial of this tool for pediatric residents at nine academic hospitals demonstrated a significant decrease in medical error, preventable adverse events, as well as near-misses. Use of this tool did not change the length of the process.[12] Another mnemonic used in some hospitals is SHOUT (**s**ick or not sick, **h**istory and hospital course, **o**bjective data, **u**pcoming plan/disposition, and to do, **t**ime for questions). It is likely that the most important intervention is having a standardized approach that is used every time and that both parties are familiar with.

2. Medication Reconciliation

Adverse drug events have been described at times of transition in patient care. The Joint Commission therefore focused one of its 2005 National Patient Safety Goals on the process of medication reconciliation.[1] Medication reconciliation is a three step process of verifying medication use, identifying variances, and rectifying medication errors at interfaces of care.[2] Performing this task can involve checking and rechecking medication lists with sources such as patient records, other physicians, pharmacists, and the patients themselves.

Adverse drug events and medication errors contribute to 20 to 72 percent of adverse events around the time of hospitalization and 7 to 12 percent of all permanent

disabilities and deaths due to adverse events.[3-8] Medication errors at the interfaces of care (admission, transfer, and discharge) are particularly common, and many of these errors put patients at risk of clinically important harm. One study found that medication errors were reduced by more than 76 percent when medication reconciliation was implemented at admission, transfer, and discharge, with the largest impact at admission.[9,10] Another study in critical care found that errors at the time of discharge from a critical care unit were virtually eliminated by a reconciliation process.[11,12]

There has been no standard regarding what constitutes a comprehensive medication history. Additionally, a complete medication list may be difficult to achieve. Patients take a combination of prescription, over-the-counter medicine, vitamins, supplements, and other medications on a scheduled or PRN (as needed) basis. As current health care information is not integrated throughout all health care operations, it is not easy to validate or fill in the gaps from patient-reported information. Patients and family members may not be good historians of a medication record, and due to limited access to pharmacy records, only an incomplete recording of current medications may be obtained. Lau and colleagues compared community pharmacy drug lists with hospitalized patients and found 25 percent of prescription drugs in use at home were not recorded on the hospital admission record. [13]

Unlike handoff communication, which is focused on the exchange of physician-to-physician information, the communication required to perform medication reconciliation returns our focus to the multidisciplinary nature of medicine. Communication must be facilitated between physicians, nurses, ancillary staff members, and most importantly, patients themselves. It also serves as a tool that can be utilized during transitions in care and provides an opportunity for prevention of adverse drug events.

An accurate medication reconciliation either in the office at the preoperative visit or on admission to the hospital is particularly important for the safety of surgical patients. Important considerations for drug interactions must be made for the safe administration of anesthesia. Close attention should be paid to other important medications that may affect perioperative outcomes. The postoperative setting, when a patient's sensorium may be impaired indefinitely, is a poor time to ask them to recall the specifics of important medications. Relying on family members is an option, although not ideal. While residents' involvement in such preoperative discussions may be sporadic, resident involvement in the discharge process is inevitable. You assume a substantial responsibility when reconciling and prescribing medications at the time of discharge. Surgical patients leave a highly monitored setting for the less regulated outpatient setting, where your name is attached to any new medications, including narcotics, anticoagulants, and other high risk medications. In this regard, your consideration for patient safety should extend beyond the confines of the inpatient setting. Ensuring the appropriate medication regimen begins at the preoperative visit and depends on a multidisciplinary team for safe transitions throughout the patient experience.

3. Surgical Checklist

The 1999 Institute of Medicine report *To Err Is Human* put a spotlight on death from preventable medical errors. Surgically related errors are second only to medication errors as the most frequent cause of error-related death. Although many hospitals have ongoing programs to improve medication safety, a specific focus on operating room safety offers another opportunity for error prevention.[8]

Used for decades in many other industries, checklists serve as aids that ensure essential steps are carried out in the appropriate sequence and allow team members to focus on completing the task at hand or address unexpected situations.[2] The introduction of the World Health Organization Surgical Safety Checklist in 2009 demonstrated the potential impact that checklists have on improving clinical outcomes.[3] The 19-item checklist was introduced in hospitals ranging from the developing world to tertiary care academic centers. Institution of this checklist resulted in significant reductions in both morbidity and mortality in surgical patients. These findings have been reproduced in subsequent studies. While the mechanism of the improvement is unclear, it mandates that team members contribute and communicate, underlying the importance of teamwork in patient care.

Checklists have previously had profound impact when utilized within the medical field prior to being introduced into the operating room. Surgical Care Improvement Project (SCIP) measures, ventilator-associated pneumonia (VAP) reduction measures, and central line insertion bundles are all checklists instituted to ensure that known best practices are followed.[4] Catheter-related bloodstream infections, once an expected risk developed by critically ill patients, are now a rarity after the introduction of the checklist.[5,6] Checklists in surgical procedures are tools to provide a structure for enhanced patient-centered

communication between team members. It is a process that levels the playing field and allows all team members to participate. It creates a shared vision for how the operation is to proceed and allows team members the opportunity to question, clarify, and ensure that standards of care are being met.

As led by the airline industry, perioperative services demand high organizational reliability and commitment to reduction of safety-compromising events. The airline industry has a long history of checklist implementation for risk reduction. The aviation checklist provides structure for the communication of critical information to ensure that all team members possess accurate data and that cross checking can occur. The key feature of the preoperative team checklist system is that it would ensure the exchange of pertinent information among all operating room team members; it would supplement rather than supplant existing communication practices within each discipline. It also requires classification of the current patterns of weakness or failure in this communication process, as well as the outcome dimensions that could be measured following a checklist intervention.

In health care, preventable injuries from care have been estimated to affect between three to four percent of hospital patients.[9] Complications from unintended harm adversely affect patients and their families and increase institutional health care costs.[1] Without the checklist, systems failures portend poor communication, increased team tension, resource waste, inefficiency, and procedural error. Previous studies have shown that use of a comprehensive surgical checklist enhances communication and reduces postoperative complications and death.[3,7]

The checklist is merely one tool in the quality armamentarium. On its own, it wields no power. Several countries have mandated the use of a checklist in an attempt to improve surgical quality. Unsurprisingly, given what we know about the importance of a robust safety culture, the regulation of the mandatory implementation of a surgical checklist in Ontario did not result in a significant reduction in surgical morbidity and mortality.[11] One hint as to why this intervention may not have had the desired effect is that more than 90 percent of hospitals opted to adopt a standardized checklist without any local modifications. Although it cannot be proven, it is quite possible that the mere implementation of the checklist without modification may represent a lack of local buy-in and explain the poor results. Adverse events cannot be prevented just by mandating the use of isolated tools.

Achieving high levels of surgical quality requires that all members of the care team are committed to not only safety but the fundamental skills of communication and teamwork, allowing everyone to perform their necessary roles and be accountable for not just their task but the ultimate outcomes.

4. Patient Education

Patient education is a critical component of health care. In the U.S, this element of the doctor-patient relationship gained attention following the American Hospital Association's adoption of the Patients' Bill of Rights in 1973. The Patients' Bill of Rights addresses several aspects of patient education, including the right to relevant, current, and understandable information about one's diagnosis, treatment, and prognosis and the right to discuss and request information related to the specific procedures and/or treatments available, the risks involved, the possible length of recovery, and the medically reasonable alternatives to existing treatments along with their accompanying risks and benefits.[1]

The process of obtaining patient consent for surgical procedures is an ideal opportunity for a meaningful discussion between patients and surgeons as part of the decision-making process. It is also a good time to review the aforementioned areas included in the Bill of Rights and ensure the patient has a good understanding of (at a minimum) his or her diagnosis, proposed treatment, risks, and alternatives. Unfortunately, many of us are taught that "getting consent" is simply a formal legal process. Training in informed consent should include the important skills of educating and counseling a patient regarding a surgical treatment in order to have a true shared decision-making process. [2]

The informed consent process arose from the Nuremberg trials in 1947 to ensure that the atrocities that were committed on human beings in the pursuit of medical research were never repeated. The basic idea of informed consent is that each individual has the right to make decisions affecting his or her well-being.[3] Informed consent means a patient must receive sufficient information to balance the benefits against the risks before consenting to a medical procedure.[4]

Before delivering medical care, physicians are obligated to provide the patient with detailed information on the risks, benefits, and alternatives, including the option to not perform the procedure or treatment regimen and the effect that doing nothing would have on that patient's health status. Clinicians are also required to inform

the patient about any potential clinically significant adverse drug reactions or other concerns when a new medication is ordered. It is imperative for physicians to foster open dialogue with their patients, which includes allowing adequate time for discussion, translating key terms into common language, and providing commonly asked questions that may put the patient at ease and stimulate further questions. Physicians also need to verify understanding by asking patients to restate or recall key elements to ensure that the patient has accurately understood the information and does not have unrealistic expectations. Failure to do this can result in unfair complaints about the practitioner's care.[5] In a review of 23 studies evaluating surgical patients' understanding of their treatments, less than one third of studies reported that patients had an adequate understanding of the various aspects that should be included in informed consent.[6]

Clear expectations about recovery are often not adequately addressed prior to initiating care. Prior to treatment, the physician should discuss any expected limitations or long-term impact. Often the focus is on early medical issues (for example, pain, possible infection, drainage), but it is valuable for the patient to also understand what life will be like for a longer period of time. Examples would be patients that will likely require readily accessible restrooms or will be not be able to perform household activities for extended periods. Finally, physicians will strengthen understanding and reduce potential complaints by including family members or friends in the discussions.[5]

Effective communication is an important factor in patient satisfaction and perceived quality of care. Studies have shown that patient satisfaction correlates strongly with the amount of information received. Elderly patients in particular need effective and empathic communication as an essential component of treatment.[7]

"Request for Treatment" is a new approach to consenting a patient that facilitates patient-centered care. The physician and patient discuss the same information pertaining to the surgical procedure as in the past, but the patient then takes the consent document and completes it at home in their own words. The patient is required to engage in their care and be able to describe their understanding of the surgical procedure, risks, and alternatives. The physician and patient meet again to discuss errors of understanding or omissions and the document is amended to reflect the patient's more complete understanding of the procedure, risks and alternatives. Physicians have better insights into what understanding patients have regarding conditions and treatments and the process helps care providers refine and improve their communication skills. Patients, in turn, have a better understanding of the operation. There is a clear opportunity to address misconceptions, as well as a more complete documentation of the decision making process.[8]

In a systematic review of patient education outcomes in surgical procedures from 2004 to 2010, current trends included scheduling education early in the surgical process; increased message exposure through several interventions or reinforcements; addressing postoperative management of care; and measurement of patients' cognitive, experiential and bio-physiological outcomes.[9]

The review evaluated patient education interventions on format, content, and outcome. Formats included verbal, written, and visual education incorporating booklets, leaflets, DVDs, or websites. Content focused on pathology, treatment, exercise, use of devices, surgical procedure, complications, prognosis, pain management, activities of daily living, lifestyle after an operation, and alternatives to standard treatments such as nonpharmacologic strategies to reduce pain and anxiety. Measurements of anxiety, knowledge, pain, and length of stay were among the outcomes most frequently evaluated.[7]

Education scheduled before admission was recommended, with the trend supporting a continuum beginning up to six months before a surgical procedure and continuing as long as three months after the surgical procedure. Several interventions or reinforcements, with sessions lasting 10 to 300 minutes, are reported. Particularly, with the trend toward shorter hospitalizations and family members providing home care, thoroughly addressing postoperative management of patient care is essential. Appropriate follow-up after discharge is important because some information presented preoperatively may be applicable months after an operation and will likely need to be reviewed or reinforced.[7]

A review of literature on surgical patients' informational needs from 1994 through 2004 revealed that surgical information needed to be given on more than one occasion beginning preoperatively in clinic and continuing through hospitalization and discharge. Also, an awareness of the influence of one's culture, and that knowledge is situation-specific, was underscored. Acknowledging that patients differ in their learning needs, and in their needs for content, and quantity of information, emphasis should be on evaluating and assessing needs on an individual basis.[10]

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The American College of Surgeons provides patients with a list of 10 questions that patients should ask before their operation. Keeping these questions in mind will assist the clinician in framing the discussion, including a discussion of the procedure, why it is needed, alternatives, risks, options for anesthesia, preparation for an operation, expected recovery, surgeons experience with the operation, facility accreditation and staffing, and cost of the surgical procedure.[11]

Successful exchange of medical information between physician and patient contributes to improved outcomes, reduced treatment time and hospital stay, and reduced morbidity and mortality. A study exploring this issue found that surgeons thought that patients wanted more information on cause and effect, and prognosis of disease. Both surgeons and patients judged symptomology associated with the disease as important. Anatomical considerations were considered less important by both surgeon and patient.[12] Patients identified information related to activity, wound care, complications and pain management as highly important.[13]

When preparing education materials or discussing surgical procedures with patients, surgeons must consider a patient's health literacy. Health literacy is defined by the American Medical Association as the "ability to obtain, process and understand basic health information and services needed to make appropriate health decisions and follow instructions for treatment."[14] Unfortunately, a systematic review of informed consent reported the majority of patients studied have an inadequate understanding of the risks and benefits of their surgical procedure.[15] Fifty-three percent of adults have an intermediate level of health literacy and 36 percent fall below this level.[16]

The complexity of written educational content for patients must be evaluated. The Flesch Grade Level Readability Formula was developed by Rudolph Flesch and John Kincaid. It evaluates number of words per sentence and average number of syllables per word, and results in a score that indicates grade-school level. Text can be inserted into the calculator to grade the level of difficulty.[17] Clinicians must take into consideration that the average adult in the United States reads at a seventh to eighth grade level 18 and 14 percent of the population is illiterate.[19]

Residents play a critical role in the delivery of a quality experience for the surgical patient. Compared with attendings, residents may have additional time to spend educating patients, both in the preoperative and postoperative inpatient setting. Often, this extra time spent with patients translates into improved hospital ratings, improved compliance with prescribed regimens, and improved patient satisfaction. Residents should also recognize time spent on patient education an opportunity to test their own knowledge of the subject and to learn from their patients rather than seeing them as scut work or burdensome to the flow of the workday. You should be able to provide patients with appropriate, trusted resources where they might go to find further information about their operation or disease process. One such place is the American College of Surgeons website, *facs.org,* which contains consent forms for common general surgery procedures and helpful graphics.

D. PROFESSIONALISM

Professionalism has been variably defined. In fact, it is often defined by its absence, but several definitions have been offered that encompass the breadth of the term fairly well. For instance, the American College of Physicians Foundation, the American Board of Internal Medicine Foundation, and the European Federation of Internal Medicine drafted a Physician Charter that set forth the tenets of medical professionalism as the primacy of patient welfare, patient autonomy, and social justice, as well as the commitment of the profession as a steward of limited and precious resource.[1] Subsequently, the American College of Surgeons drafted a *Code of Professional Conduct* that begins with, "Professionalism serves as the basis of the social contract between medicine and the society that it serves." [2] Importantly, the social contract between surgeons and the society it serves is based on trust, namely the trust of the patient in the surgeon's honesty, integrity, and respect for persons. The *Code of Professional Conduct* lists and clearly articulates the behaviors that define professionalism as a surgeon and the requisite personal qualities therein. A few of these behaviors deserve special mention with respect to patient safety:

- Be sensitive and respectful of patients, understanding their vulnerability during the perioperative period.
- Respect the knowledge, dignity, and perspective of other health care professionals.
- Improve care by evaluating its processes and outcomes.

It has been noted that surgeons have long served as leaders in patient safety.[3] No other relationship is like that of surgeon and patient. The implicit trust in the surgeon is unquantifiable, and the vulnerability of the patient is profound. For these reasons, the surgeon is the principal guardian of the patient's safety, and professionalism for the surgeon must include ensuring safe patient care. This professionalism extends to interdisciplinary interactions, as caring for a patient includes many interactions with other health care professionals, including nurses, specialists from other fields, and other surgeons.

Considering the increasingly complex and sometimes chaotic environment in which we function, the delivery of safe patient care relies on the respectful interaction and effective communication between individuals with a mutual goal. Nowhere in the health care arena is this more important than in the operating room. It has been shown that unprofessional behavior by surgeons negatively affects morale and hampers the effectiveness of those caring for the patient.[4] As high as 60% of preventable medical errors can ultimately be linked to a failure in communication.[5] Abusive, disruptive, or disrespectful behavior undermines the interaction and communication between professionals and ultimately leads to a less than optimal outcome for the patient.[6]

In summary, the definition of professionalism is broad, but many of the key components of professional behavior by surgeons have a direct effect on safe patient care. First among these is the unique relationship between patient and surgeon. The potential for harm is ever present in surgical procedures, and the surgeon is the custodian of patient safety. For this reason, the surgeons should always seek to protect the patient and do everything possible to ensure an optimal outcome, including effective collaboration with other multi-disciplinary professionals. Finally, professionalism demands constant assessment of outcomes with the goal of continual improvement to deliver effective, and most importantly, safe patient care.

E. THE MODERN MORBIDITY AND MORTALITY CONFERENCE

The Morbidity and Mortality (M&M) conference is one of the most visible and important forums to discuss adverse events and errors in the medical field.[6] In the early 20th century physicians began advocating for hospital errors to be reviewed.[5] Conferences in the 1930s and 1940s, such as the Anesthesia Study Commission, began systematically looking at adverse events of surgical complications.[5] These conferences have since evolved into a standard conference for hospitals across the world.

From a sociological perspective, the M&M conference has been described as a forum for surgeons to demonstrate professionalism in accepting responsibility and seeking to improve.[7]

In the surgical profession, M&M conferences are highly utilized and deemed critical to both surgical training and practice. Despite this widespread use, recent papers have brought to light deficits within the data presented.[2-4] Some of the major criticisms are the incomplete reporting of complications, unclear presentations, and the lack of benchmarks.[2-4] It has been shown that traditional morbidity and mortality methods identify fewer complications compared with American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP®) collection methods.[8]

In this section, we summarize recent research into the "state-of-the-art" in M&M conferences and provide recommendations for how best use this protected time to not only improve care, but improve the safety culture of a department.

Research into effective M&M conferences has shown a few trends. In order to have and maintain an excellent morbidity and mortality conference, an institution should hold a conference regularly. Most institutions hold them at least monthly, with many holding them weekly and dubbing them a golden hour.[2] These conferences must have a high level of attendance by both faculty and residents to function optimally.[5] Timing is often critical, and some institutions have found that simply rescheduling the timing for M&M conferences can significantly increase participation.[7] One example would be changing the timing from the afternoon when operations are at risk of interfering with participation to the morning prior to the first start of elective surgeries.[7]

A list of cases or potential cases is often selected prior to the presentation.[8] Case reporting differs across institutions. Some rely only on resident reported cases and others pull from hospital datasets that track clinical outcomes. The completeness of the data and the discussion that follows will be heavily influenced by the method of case reporting. For an ideal conference, the case list should pull form the most complete and reliable source of adverse events across the continuum of the patient experience, not just the in-patient course.

The name of the conference will often set the tone. In some hospitals the classic name of Morbidity and Mortality conference has been changed. In order to attempt to change the culture and facilitate a civilized

conversation regarding best practices instead of a blame- filled contentious discussion about poor quality care, some institutions have renamed the conference the Case Management Conference." Others, in order to deem the discussion "protected" from legal discovery, have renamed the conference the Quality Assurance Conference. This approach has been suggested for institutions that are trying to rebuild or modernize their conference to permit a more meaningful use of the opportunity to reflect upon cases when adverse events occur.

Some hospitals use the conference to simultaneously provide education on quality and satisfy regulations governing quality assurance. In this case there must be a balance between the functions of the conference. The dual mission of the conference can impair its effectiveness as an educational conference. In order to optimize the educational benefits of the case-based learning opportunity, there must be order and clear objectives. Most conferences do not have overt objectives beyond the global desire to discuss complicated cases to learn as a collective. The laxity in the objectives often leaves the content of the discussion short on evidence and replete with multiple conflicting approaches to patient care. As such, residents are often left confused about the best practice to maximize quality care.

The lack of standardized presentations can limit the efficacy of the Morbidity and Mortality conference.[3] Standardization of the presentation format can result in improved efficiency and a decrease in the amount of time needed for each case. Presenters must be able to succinctly and effectively explain the case to the audience. Many programs have demonstrated effective change by creating a standardized template for all presentations.

The Situation, Background, Assessment, and Recommendation (SBAR), borrowed from the industrial quality improvement sector, is an effective tool.[9] The **situation** is the initial piece of information that can help the presenter set the agenda for the conference. This has been shown to clarify the case for the audience and improve the quality of the presentation. The **background** is the second portion of the presentation, which delves into the facts of the case. The presenter should focus on the pertinent points of the case, skimming or omitting portions that may add no benefit to the understanding of the case. Time lines may help add an additional level of clarification. The **assessment** involves the actual analysis of the adverse event. The root cause may be unifactorial or multifactorial.[9] Constructing a fishbone diagram to detail possible opportunities can often be illustrative. References may be used during this process in order to help add objective data in the understanding of an adverse event. The **recommendation** summarizes the action plan to either prevent the adverse event or help manage it better in the care of future similar cases. Formal recommendations on the timing include allotting 15 minutes for the presentation and five minutes for discussion.[9] In some hospitals, this does not allow enough time to cover all of the important cases. (See **Table 1, page 37**.)

The case discussion should involve both residents and faculty.[9] A moderator should facilitate the process by encouraging productive conversation and limiting repetitive comments or comments with no constructive basis. One additional idea is a policy of no questions during the presentation of the patient.

Departmental leaders often determine the specific complications to present. Superficial surgical site infection, CAUTI, and a venous thromboembolic event may be considered boring and therefore not selected for presentation at the M&M conference Thomas 2012. From the perspective of quality improvement, minimizing the importance of these events in the patient experience presents a barrier to achieving optimal care. Many of these complications are potentially preventable. Additionally, these often herald worse outcomes, such as pulmonary embolus or sepsis. Moreover, these events are often tied to institutional penalties either directly through reimbursements, or indirectly by patients seeking out hospitals with reduced rates of adverse events. The sharing of the institutional data regarding the aggregated performance on quality measures can be a useful addition to the morbidity and mortality conference. This addition to the conference does not have to be weekly but can be effective on a quarterly basis to highlight local performance with comparison to peer institutions. Alternatively, the institution specific complication rates with benchmark to peer institutions can be shared during the assessment portion of each presentation. Benchmarking the outcomes will encourage residents and faculty to work toward improvement in areas of deficiency.

One example would be a patient with pancreatic cancer who presented to the hospital for an elective Whipple operation and subsequently developed a pulmonary embolus. On review of the patient's history, it might have been noted she had a lapse in her subcutaneous heparin dosing and frequently did not wear her compression

Table 1. Sample template for M&M conference (SBAR)

Overview/Situation (< 1 min)	Patient
	Staff/Resident
	Diagnosis
	Operation/Procedure
	Complication
	Outcome
Background (< 3 min)	HPI: brief, relevant points
	PMH: relevant
	PSH: prior abdominal operations
	PSH: prior abdominal operations
	PSH: prior abdominal operations
	Meds: list relevant (Anticoagulation, cardiac)
	FH/SH: only if relevant
	Pre-op work up: include pertinent labs/imaging
	Operative course: discuss operative conduct, especially deviations from standard of care
	Post-op course: relevant findings/imaging
	FH/SH: only if relevant
	Pre-op work up: include pertinent labs/imaging
	Operative course: discuss operative conduct, especially deviations from standard of care
	Post-op course: relevant findings/imaging
Supporting information (< 3 min)	Brief discussion on diagnosis and indication for operation
	Include relevant literature on disease or complication
Discussion (Assessment and Recommendation) (< 5 min)	Discuss possible causes for complication
	Error in technique
	Error in judgment
	Discuss how to prevent or manage in future
	Staff questions/comments at this point

stockings. While reviewing the contributing factor, ACS NSQIP data could be used to examine the rates of DVTs in the hospital for the last several years with comparison to national data on DVT rates for patients who had pancreas surgery. By using both sets of data, the investigator can help determine whether if DVTs are a particular deficiency within that hospital system. Real patient examples help to make clinical problems real to providers and may inspire increased compliance with DVT prophylaxis. The M&M conference is a great platform to discuss quality improvement strategies.

The conference should be used to share any changes to practice that are developed as a result of cases discussed. Frequently, residents complain that they never get follow-up of actions taken when bad things happen. This is discouraging because it gives the impression that nothing is done and that this is acceptable. Therefore, when a follow-up root cause analysis or other quality improvement investigation ensues following a bad outcome, the improvement strategy should be shared at a subsequent conference to highlight the hospital's commitment to providing high-quality care.

Building a Culture of Safety

Some institutions choose to highlight a small number of interesting cases to permit a more meaningful discussion about a specific topic each week. An individual case can be used to highlight quality improvement initiatives within each organization or provide closure for issues discussed at previous conferences. For example, in the case of a wrong site surgery, discussions at an initial presentation can be heated and many ideas may be generated for the prevention of wrong site surgery in subsequent cases. However, frequently, the follow-up is not publicly shared with the surgical services. In this example, an interesting case might highlight the epidemiology of the problem of wrong site surgery and then discuss subsequent QI tools that were employed to address the local issue. Then, the system wide changes that have been implemented to minimize the risks to subsequent patients treated at their hospital (new consent process, new time out for patient safety, and so on) can be shared.

In summary, the M&M conference or its equivalent should achieve the following objectives:

- To align the organizational quality goals with the departmental goals through an annual report of previous successful quality programs and upcoming areas of concentration
- To list all adverse events for quality assurance purposes on a weekly basis
- To explore the quality of care delivered at the hospital/department compared with institutions through an assessment of aggregated data on a quarterly basis
- To discuss all case details in the event of a potentially preventable adverse outcome
- To review best practices in the case of a potentially preventable adverse outcome

RECOMMENDED READING

Example of patient education and consent (hiatal hernia repair surgery (5:29). Available at: https://www.google.com/search?q=You+tube+Hernia- hiatal+hernia+Repair+surgery+pre-op+patient+education&sourceid=ie7 &rls=com.microsoft:en-us:IE-SearchBox&ie=&oe=&rlz=1I7GZHY_en. Accessed June 16, 2017.

Evidenced-based patient education handouts. Available at: http://www.ebscohost.com/nursing/products/patient-education- reference-center. Accessed June 16, 2017.

Research instruments developed, adapted, or used by the Stanford Patient Education Research Center. Available at: http://patienteducation.stanford.edu/research/. Accessed June 16, 2017.

Informed consent. Available at: http://www.templehealth.org/ICTOOLKIT/html/ictoolkitpage6.html. Accessed June 16, 2017.

This section is designed to help residents and training programs develop curricula in quality and safety. We start with an institutional case study of how an independent academic medical center structured its developing quality curriculum to involve residents in a multitude of ways throughout their training. The next section gives a brief overview of the current state of assessment tools for quality improvement knowledge. Finally, we present three quality-related scenarios and walk through how to use a PDSA framework to approach each.

A. DEVELOPING A QUALITY CURRICULUM AT AN INDEPENDENT ACADEMIC MEDICAL CENTER

The independent general surgery residency at Abington Hospital Jefferson Health has developed a unique quality curriculum that promotes universal resident involvement and engagement through three longitudinal components. Each resident participates in a self-guided and individually paced didactic experience in a nationally recognized, standardized, online interactive environment. Residents are then provided their individual performance data for the previous 12 months generated using the **Quality In-Training Initiative (QITI) custom fields** of the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP®). Residents are sorted into committees based on frequency of occurrences (wound occurrences, pulmonary occurrences, and so on) and committees are diversified by PGY level. The committees review the collated data, the medical literature, and the individual cases to generate two reports on the assigned occurrence. These reports culminate in the presentation of at least two well-thought-out, viable quality projects for advanced analysis. These projects are further vetted through a standing, resident-driven committee, and select projects are advanced to fruition with a dedicated resident champion. This curriculum is repeated annually, and the implemented projects may be compounded or further developed in each cycle.

To build a foundation in the basic knowledge and principles of quality improvement and patient safety, how to utilize basic tools such as PDSA cycles, and standardization of practice/behaviors to improve patient care, the program utilized the **Institute for Healthcare Improvement (IHI) Basic Courses on Quality Improvement and Patient Safety**. Each resident is required to complete four of the 12 courses necessary to earn the basic certificate during each academic year, and this information is tracked at resident semiannual reviews. This schedule ensures that all residents complete the certificate within three years. The modules are online and residents complete them at their convenience and own pace. The modules were prioritized in a sequence to equip residents for early participation in quality improvement. Many residents found the modules inspiring and most have completed more modules than required. Our hospital sponsors an institutional subscription to the IHI Basic School and tracks participation across disciplines. Ten of our 29 surgery residents have completed the certificate.

The QITI custom fields available in ACS NSQIP allow a resident to be assigned to each case entered into the ACS NSQIP database. Resident autonomy and degree of participation in postoperative care may vary by case, but the reports allow residents to have awareness and consideration of complications on specific patients for whom they have cared. QITI reports are generated for the previous 12 months. As we have five categorical residents per PGY level, residents are sorted into five committees by frequency of occurrences on their reports (in other words, the PGY5 with the highest number of wound occurrences is on the wound committee). Occurrences with lower frequency are grouped together so that each committee has approximately the same number of cases to review (for example, one committee combines cardiac, CNS, and renal). Residents of all levels are placed on each committee, and the PGY3 is designated as the chair of the committee with a charge to keep the group moving forward. Junior residents without occurrences are distributed across all committees.

Each committee member has a designated role in the development of the projects. The PGY1s review risk factors for the occurrence, consequences/sequelae of the occurrence, the medical literature and any existing internal protocols regarding that occurrence. The PGY2/3s review all of the cases in that occurrence for the 12-month span (not just those assigned to committee members) searching for trends, protocol failures, and incidents where preventative measures were missed or applied. The PGY4/5s are responsible for interpreting the collated data from the viewpoint of the most experienced team members to identify areas of improvement both on a case and systems basis. Each component is synthesized into an Initial Committee Report that is given during two hours of protected lecture time at a multidisciplinary conference with surgery education and department leadership, quality and process improvement staff, graduate Medical Education Staff, and leaders

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from other departments in the audience. This **Initial Committee Report** reviews illustrative cases, protocol failures, and occurrence causes and includes a structured group discussion about initial recommendations for improvement.

After Initial Committee Reports, the residents are tasked to develop a minimum of two quality improvement (QI) project proposals. They must structure these projects in a PSDA model and specifically address obstacles to success, resources requirements and potential sources, methods of measurement, and determination of outcomes. Each resident committee then returns to present a Committee Action Report, given during a similar two-hour multidisciplinary conference with robust group discussion. Project proposals and presentations are evaluated by the director for surgical quality and safety using a modified QIPAT-7 evaluation form and recorded in resident files.[1] The flow of the curriculum is shown in **Figure 1, this page**. Committees are scrambled each year, allowing residents to critically assess their practice across different occurrences each year and work with different committee members. Proposals are frequently additive, allowing the cross pollination of residents on different committees to collaborate on projects, or augmenting a project from a previous year with new ideas.

While all residents participate in the IHI Basic Certificate modules and the Committee Reports, the program maintains an additional executive level of resident leadership in quality and safety. A **"Quality and Safety" chief resident** is appointed by surgery education leadership for a minimum of a two-year term. This resident and the director of surgical quality and safety serve as co-chairs of the **Surgery Resident Quality, Outcomes, and Performance Improvement Committee (QOPI)**. Membership on this committee is on a volunteer basis, but regular attendance is required to maintain membership. Committee meetings are held monthly and considered protected time unless on an off-site rotation. The current committee consists of 10 members (one-third of the residency) from all PGY levels. The chairman of surgery and program director regularly attend. Faculty and residents with interest in quality from Jefferson University Hospital frequently participate via teleconference, and a QOPI member attends the Jefferson University House Staff Quality and Safety Leadership Council. The QOPI committee reports quarterly to the Surgical Quality and Safety Council at a hospital level.

At the commencement of the academic year, the QOPI committee reviews all projects proposed during Committee Action Reports. Projects are vetted for to ensure they are achievable and have adequate measures of outcome goals. Projects that are considered robust and for whom there is a resident champion are subsequently implemented. All committee members serve as resident champions for at least one project and are often involved in several projects. Activities of the committee are reported to the entire residency and project participation by non-members is welcome.

QOPI resident members are also encouraged to bring new ideas to each meeting for ways to improve both patient outcomes and resident education and experience. Attention to resident workflows and efficiency has expedited and improved clinical care, as well as enhanced resident satisfaction. A list of recent QOPI projects is provided in **Table 1, page 41**. Each project was proposed

Figure 1. Flow of the quality curriculum

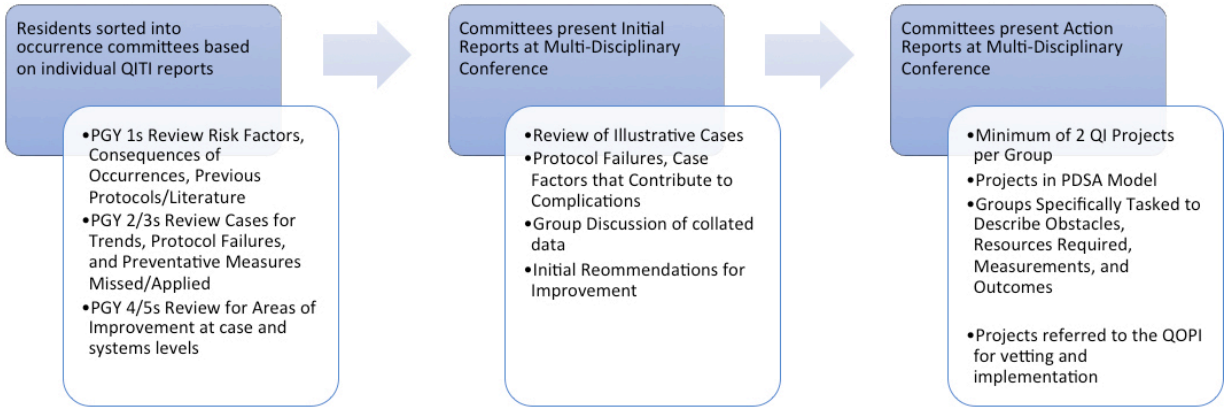

Table 1. List of resident initiatives in QOPI Committee

Patient Care Initiatives	Resident Workflow Initiatives	Hybrid Initiatives
• Midnight Rounds and Prevention of Overnight Events	• Streamlining Consults for Central Line Placement	• Standardizing Use of Temporary Dialysis Catheters
• Improving Peri-Operative Glucose Control	• Electronic Critical Care Note	• Improving Time in Changing EMS Cervical Collars to Miami J
• Improving Pre-Operative Anemia	• Electronic Trauma H&P	• Standardizing Consents
• Improving Pre-Operative Smoking Cessation	• Electronic Procedure Notes	• Improving Foley Protocol for Urinary Retention
• Ambulation Protocol	• Surgical Supply Cart	• Improving Surgical Sign-outs/ Physician Hand-Offs

and carried out by residents with guidance and approval from surgical leadership. Regular committee participation by surgical leadership expedites projects and quickly connects residents with the relevant stakeholders.

The graduate medical education office, CLER focus areas, ACGME core competencies, and the transition toward value-driven care have all highlighted the need for physician training in quality improvement and safety. Our longitudinal approach allows for all residents to acquire the necessary didactic material, review and reflect on their personal practice data, drive an in-depth analysis of collated data, and design comprehensive quality improvement projects. The leadership and supervision by a committed group of energized individuals in QOPI greatly increases the success rate for the projects selected for implementation. Resident feedback has been excellent, and the quality of the presentations and proposed projects has demonstrated unequivocally that the residents approach this curriculum thoughtfully and enthusiastically.

RECOMMENDED READING

Institute for Healthcare Improvement. IHI Open School Online Courses. Available at: http://www.ihi.org/education/IHIOpenSchool. Accessed June 19, 2017.

B. ASSESSING QUALITY IMPROVEMENT KNOWLEDGE

At the end of this section, the learner should be able to:

- Explain the importance of assessment to the learning process
- Outline a framework for achieving high-value care

Assessment is a crucial component of learning any new knowledge or skill, and quality improvement is no exception. As GME has moved toward an outcomes-driven climate, assessment is becoming a crucial part of any educational intervention. Additionally, assessment can be a useful **formative** process, meaning that through the assessment tool, participants can either learn new knowledge or consolidate and formalize existing knowledge. The role of assessment in QI education is often discussed, but clear mechanisms for measuring trainees' competency have not yet been developed. Unfortunately, most of the published literature has focused on designing curricula or experiential learning modules and has not included detailed descriptions of assessment tools. There are a small number of written tools designed to test knowledge that we describe here. While a surgery-specific version has not been published, a number of individual programs have adapted these tools to a surgical setting.

The **Quality Improvement Knowledge Application Tool (QIKAT)** was first developed and described in 2003 for internal medicine trainees.[38] It consists of three pretest and three posttest questions in which examinees are asked to respond to written scenarios describing quality or safety issues. The test consists of three questions for each scenario: (1) what would be the aim of an improvement program targeting the described scenario, (2) what would you measure, and (3) identify one change that would be worth testing. Scores are graded subjectively. It has not been formally validated (a process by which assessment tools are studied to make sure they consistently and accurately measure what they are designed to test). However, a revised version was published in 2014 [QIKAT-R] with a more standardized grading rubric. This version has been used in numerous

published studies describing educational interventions, and has been shown to be able to distinguish degree of QI knowledge between groups of individuals with QI training and those without.

A slightly more advanced tool called the **Assessment of Quality Improvement Knowledge and Skills (AQIKS)** was developed within pediatrics training programs, and has had an initial validation study published. This tool was adapted from the QIKAT, but it is longer (nine questions per scenario instead of three) and tests more specific QI knowledge, such as the ability to draw and interpret a run chart.

Both tools are available for programs to use and adapt. As of yet, there is no widely used or validated tool for measuring the ability of trainees to actually *apply* QI skills in practice, highlighting the need for further development of multi-modal methods of both teaching and evaluation.

RECOMMENDED READING

Doupnik SK, Ziniel SI, Glissmeyer EW, Moses JM. Validity and Reliability of a Tool to Assess Quality Improvement Knowledge and Skills in Pediatrics Residents. *J Grad Med Educ.* 2017 Feb;9(1):79-84.

Singh MK, Ogrinc G, Cox KR, Dolansky M, Brandt J, Morrison LJ, Harwood B, Petroski G, West A, Headrick LA. The Quality Improvement Knowledge Application Tool Revised (QIKAT-R). *Acad Med.* 2014 Oct;89(10):1386-91.

C. CASE STUDIES

In order to improve the quality of surgical care provided to patients across multiple institutions, the Centers for Medicare & Medicaid Services, in partnership with multiple other organizations, has identified certain costly complications as potential targets for universal quality improvement. The events are considered preventable due to wide variation in occurrence rates across institutions. On the whole, these measures include both uncommon events that are devastating to individuals (for example, wrong site surgery) and common occurrences that are harmful to individuals and when added up are incredibly costly to society (for example, surgical site infections).

Some of the targeted measures are generic (apply to all patients), some are specialty specific (apply only to surgical patients), and some are procedure specific. Generic clinical measures include items like deep vein thrombosis, pulmonary embolism, ventilator-associated pneumonia, and sepsis. Surgery-specific measures include surgical site infections, postoperative bleeding, and death following a complication of a surgical procedure. Procedure-specific complications include measures like anastomotic leak following a colon resection or a laryngeal nerve injury following a thyroidectomy.

Each hospital has its own safety profile. As a result, residents in different hospitals often learn to practice surgical procedures (or provide perioperative care) differently. Some of these differences are subtle, some are substantial. An increasingly important part of training is learning to evaluate what you are being taught—how does it vary from the way care is provided in other institutions, and why. This will allow you to develop the skills to adapt to new institutions throughout your career, as well as evaluate new techniques or management strategies as they are developed and allow you to provide optimal care for your future patients. You should make sure that you review your departments profile to understand its strengths and weaknesses in comparison to other institutions. Make sure to consider multiple sources of data so that you can get an accurate picture of the quality of care provided to your patients while understanding the differences in the sources of data that you examine.

In this section, we will review the details and evidence behind three clinical measures: venous thrombotic events, catheter-associated urinary tract infection, and hospital readmissions. We then provide a clinical scenario with prompts for you to consider how you could approach each of these issues if you were targeting a local problem.

These cases can be used to guide a group discussion, or to structure self-study. To guide discussion, we provide a list of possible steps to a PDSA cycle (Plan-Do-Study/Check-Act/Adjust) and suggestions for good clinical practice.

For each case, address the following:

- How would you define the problem? What needs to be fixed? (Write a formal problem statement.)
- What would be the aim of a quality improvement effort focused on this area? (Use the SMART objective format.)
- What would you measure to assess the situation? (Include process, outcome, and balancing measures.)
- What is an initial change or initiative that you could test?

If you are performing this as a group exercise, here are some guidelines:

- Divide participants into groups of three to five members.
- After presenting the background information and the case, give groups 15 minutes to develop a comprehensive plan to address the questions above. Then spend another 15 minutes having each group "report back" using the PDSA cycle. Finish by reviewing the clinical practice suggestions as a group
- Have participants identify the different stakeholders and who they would want in the project team.
- Have participants specify a timeframe for the PDSA cycle

1. Venous Thromboembolism

OBJECTIVES

At the end of this section, the learner should be able to:

- Describe the epidemiology of venous thromboembolic events (VTE)
- Delineate the proper approach to the assessment of patient risk for VTE
- Develop a plan for a quality improvement project using this module as a template to address other problems

Venous thromboembolism (VTE) is a common cause of preventable death in hospitalized patients.[1] Each year in the U.S., deep venous thrombosis (DVT) occurs in 2.5 million people, with pulmonary embolism (PE) occurring in approximately 700,000 people.[2-4] Across all specialties, surgical procedures are associated with an increased risk of thrombosis, and those undergoing an operation for oncologic indications are at even higher risk.[5,6] In the U.S., it is estimated that one-third of VTE-related deaths (150,000 to 200,000) occur following a surgical procedure.[1] Prior to the widespread use of prophylaxis, PE accounted for as many as 5 percent of postoperative deaths.[3,7,8]

To appreciate the significance of the impact of VTE, take into account that postoperative VTE has been cited as the most common cause of preventable hospital death, the second most common medical complication, the second most common cause of excess length of stay (LOS), and the third most common cause of excess mortality and excess charges.[9,10] DVTs may increase hospital LOS by two to five days resulting in additional costs of approximately $7,500, while PE can increase hospital LOS more than five days, resulting in an ICU admission, and incur additional costs upwards of $10,000. These events have significant implications to the patient in terms of additional morbidity, mortality, additional medications and their costs, protracted hospital stays, and delayed return to work, just to name a few. They additionally have significant impact for the physicians and institution, as the incidence of VTE is increasingly being used as a quality measure with negative implications for reimbursement (**Table 2, this page**). Without prophylaxis,

Table 2. ACS NSQIP standardized definition of venous thromboembolic event (or vein thrombosis requiring therapy)

Definition	New diagnosis of blood clot or thrombus within the venous system (superficial or deep) which may be coupled with inflammation and requires treatment.
Criteria	Must be noted within 30 days after the principal operative procedure AND one of the following A or B below: A. New Diagnosis of a [new] venous thrombosis (superficial or deep), confirmed by a duplex, venogram, CT scan, or any other definitive imaging modality (including direct pathology examination such as autopsy) AND the patient must be treated with anticoagulation therapy and/or placement of a vena cava filter or clipping of the vena cava, or the record indicates that treatment was warranted but there was no additional appropriate treatment option available. OR B. As per (A) above, but the patient or decision maker has refused treatment.

Putting Quality into Practice

the risk of VTE following a major surgical procedure is 20 percent, with a 1 to 2 percent risk of PE and a rate of fatal PE in the 0.1 percent to 0.4 percent range. As such, the optimal treatment of thromboembolism is prevention. Understanding appropriate and effective thromboprophylaxis is essential to curbing the incidence of postoperative VTE.

Background

One of the essential components of appropriate and effective thromboprophylaxis is the ability to understand the risk factors in various groups and to be able to stratify patients, as this will affect the evidence-based recommendations regarding agents and methods for thromboprophylaxis. Two commonly used VTE risk classification schemes are included below **(Figure 2, this page, Figure 3, page 45)**.[11,12]

Quality Improvement Pearl—If you are using this information to help providers risk stratify their patients (so that they provide appropriate care), make it easy for them. Most surgeons do not want to be schooled about the risk stratification system. Make a handout with the information in case they are interested but make it separate from the risk stratification tool. Take five minutes at a departmental or divisional meeting to introduce the problem and the project so that you can get feedback and raise awareness of the problem. Make sure to share local data to make it relevant to the audience. Make the tool easy, check boxes and then an obvious therapy once a score has been assigned. Make sure to trial it in paper form before you have your IT team build the software as it will be easier to adapt quickly if you have complete control until you have it done correctly. Make sure to include basic considerations regarding contraindications to recommended therapy.

These models can be used to calculate a risk score for each individual patient. That information can then be utilized to classify a given patient's VTE risk category as demonstrated below. These models take into account the intrinsic difference in risk of VTE between different surgical procedures **(Figure 4, page 45)**.

There are numerous tools at the disposal of the clinician to prevent VTE. There are mechanical prophylaxis options such as elastic stockings (ES) and intermittent pneumatic compression (IPC) devices. From a pharmacologic standpoint, the options include low-molecular weight heparin (LMWH) or low-dose unfractionated heparin (LDUH), fondaparinux, and low-dose aspirin. From an interventional perspective, inferior vena cava (IVC) filters are another instrument available to clinicians in the

Figure 2. Rogers model of risk assessment

Safety in Surgery Study

Risk Factor	Risk Score Points
Operation type other than endocrine	
Respiratory and hernic	9
Thoracoabdominal aneurysm, embolectomy/thrombectomy, venous reconstruction, and endovascular repair	7
Aneurysm	4
Mouth, palate	4
Stomach, intestines	4
Integument	3
Hernia	2
ASA physical status classification	
3, 4, or 5	2
2	1
Female sex	1
Work RVU	
>17	3
10-17	2
Two points for each of these conditions	2
Disseminated cancer	
Chemotherapy for malignancy within 30 d of operation	
Preoperative serum sodium >145 mmol/L	
Transfusion >4 units packed RBCs in 72 h before operation	
Ventilator dependant	
One point for each of the conditions	1
Wound class (clean/contaminated)	
Preoperative hematocrit level ≤38%	
Preoperative bilirubin level >1.0 mg/dL	
Dyspnea	
Albumin level ≤3.5 mg/dL	
Emergency	
Zero points for each of these conditions	0
ASA physical status class 1	
Work RVU <10	
Male sex	

ASA = American Society of Anesthesiologists; RVU = relative value unit. Republished with permission from Rogers et al.[82]

appropriate clinical circumstance. Guidelines have evolved as evidence-based studies, reviews and consensus statements have guided best-practices. The latest iteration of the American College of Chest Physicians (ACCP) guidelines regarding prevention and treatment of VTE were released in 2012.[10] For comprehensive details regarding the latest recommendations, one can refer to the executive summary included in the selected readings or access the guidelines from the ACCP website, which were all released in a February 2012 supplemental edition of the journal CHEST.[10] An abbreviated reference for thromboprophylaxis recommendations is included in **Figure 5, page 46**.

Figure 3. Caprini model of risk assessment

Table 7—*Caprini Risk Assessment Model*

1 Point	2 Points	3 Points	5 Points
Age 41-60 y	Age 61-74 y	Age ≥ 75 y	Stroke (< 1 mo)
Minor surgery	Arthroscopic surgery	History of VTE	Elective arthroplasty
BMI > 25 kg/m²	Major open surgery (> 45 min)	Family history of VTE	Hip, pelvis, or leg fracture
Swollen legs	Laparoscopic surgery (> 45 min)	Factor V Leiden	Acute spinal cord injury (< 1 mo)
Varicose veins	Malignancy	Prothrombin 20210A	
Pregnancy or postpartum	Confined to bed (> 72 h)	Lupus anticoagulant	
History of unexplained or recurrent spontaneous abortion	Immobilizing plaster cast	Anticardiolipin antibodies	
Oral contraceptives or hormone replacement	Central venous access	Elevated serum homocysteine	
Sepsis (< 1 mo)		Heparin-induced thrombocytopenia	
Serious lung disease, including pneumonia (< 1 mo)		Other congenital or acquired thrombophilia	
Abnormal pulmonary function			
Acute myocardial infarction			
Congestive heart failure (< 1 mo)			
History of inflammatory bowel disease			
Medical patient at bed rest			

Figure 4. ACCP 9th edition classification of VTE risk categories

Table 5—*Risk Stratification for VTE in General, Abdominal-Pelvic, Bariatric, Vascular, and Plastic and Reconstructive Surgery*

	Patient Population							
	Patients Undergoing Major General, Thoracic, or Vascular Surgery		Patients Undergoing General Surgery, Including GI, Urological, Vascular, Breast, and Thyroid Procedures		Patients Undergoing Plastic and Reconstructive Surgery			
AT9 VTE Risk Category	Rogers Score	Observed Risk of Symptomatic VTE, %	Caprini Score	Observed Risk of Symptomatic VTE, %	Caprini Score	Observed Risk of VTE, %	Other Surgical Populations in Risk Category	Estimated Baseline Risk in the Absence of Pharmacologic or Mechanical Prophylaxis, %
Very low	<7	0.1	0	0	0-2	NA	Most outpatient or same-day surgery	<0.5
Low	7-10	0.4	1-2	0.7	3-4	0.6	Spinal surgery for nonmalignant disease	1.5
Moderate	>10	1.5	3-4	1.0	5-6	1.3	Gynecologic noncancer surgery Cardiac surgery Most thoracic surgery Spinal surgery for malignant disease	3.0
High	NA	NA	≥5	1.9	7-8	2.7	Bariatric surgery Gynecologic cancer surgery Pneumonectomy Craniotomy Traumatic brain injury Spinal cord injury Other major trauma	6.0

AT9 = Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines.

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Figure 5. ACCP 9th edition VTE prophylaxis recommendations

Table 23—*Recommendations for Thromboprophylaxis in Various Risk Groups*

	Risk and Consequences of Major Bleeding Complications	
Risk of Symptomatic VTE	Average Risk (~1%)	High Risk (~2%) or Severe Consequences
Very low (< 0.5%)	No specific prophylaxis	
Low (~1.5%)	Mechanical prophylaxis, preferably with IPC	
Moderate (~3.0%)	LDUH, LMWH, *or* mechanical prophylaxis, preferably with IPC	Mechanical prophylaxis, preferably with IPC
High (~6.0%)	LDUH *or* LMWH *plus* mechanical prophylaxis with ES *or* IPC	Mechanical prophylaxis, preferably with IPC, until risk of bleeding diminishes and pharmacologic prophylaxis can be added
High-risk cancer surgery	LDUH *or* LMWH *plus* mechanical prophylaxis with ES *or* IPC *and* extended-duration prophylaxis with LMWH postdischarge	Mechanical prophylaxis, preferably with IPC, until risk of bleeding diminishes and pharmacologic prophylaxis can be added
High risk, LDUH and LMWH contraindicated or not available	Fondaparinux *or* low-dose aspirin (160 mg); mechanical prophylaxis, preferably with IPC; or both	Mechanical prophylaxis, preferably with IPC, until risk of bleeding diminishes and pharmacologic prophylaxis can be added

See Table 1 for expansion of abbreviations. See Table 5 for details about risk stratification for VTE; see Table 8 for information about risk factors for major bleeding.

Figure 6. ACCP 9th edition VTE guidelines: risk factors for bleeding complications

Table 8—*Risk Factors for Major Bleeding Complications*

General risk factors
Active bleeding
Previous major bleeding
Known, untreated bleeding disorder
Severe renal or hepatic failure
Thrombocytopenia
Acute stroke
Uncontrolled systemic hypertension
Lumbar puncture, epidural, or spinal anesthesia within previous 4 h or next 12 h
Concomitant use of anticoagulants, antiplatelet therapy, or thrombolytic drugs
Procedure-specific risk factors
Abdominal surgery
Male sex, preoperative hemoglobin level < 13 g/dL, malignancy, and complex surgery defined as two or more procedures, difficult dissection, or more than one anastamosis[89]
Pancreaticoduodenectomy
Sepsis, pancreatic leak, sentinel bleed[87]
Hepatic resection
Number of segments, concomitant extrahepatic organ resection, primary liver malignancy, lower preoperative hemoglobin level, and platelet counts[88]
Cardiac surgery
Use of aspirin[90]
Use of clopidogrel within 3 d before surgery[91]
BMI > 25 kg/m^2, nonelective surgery, placement of five or more grafts, older age[92]
Older age, renal insufficiency, operation other than CABG, longer bypass time[93]
Thoracic surgery
Pneumonectomy or extended resection[94]
Procedures in which bleeding complications may have especially severe consequences
Craniotomy
Spinal surgery
Spinal trauma
Reconstructive procedures involving free flap

CABG = coronary artery bypass graft.

When implementing thromboprophylaxis prevention measures, particularly pharmacologic interventions, particular attention must be paid to the patient's risk factors for bleeding and therapy should be individualized and tailored accordingly. A summary of risk factors for major bleeding complications from the ACCP 9th edition prophylaxis guidelines is included below **(Figure 6, this page)**.

Clinical Case-Based Application

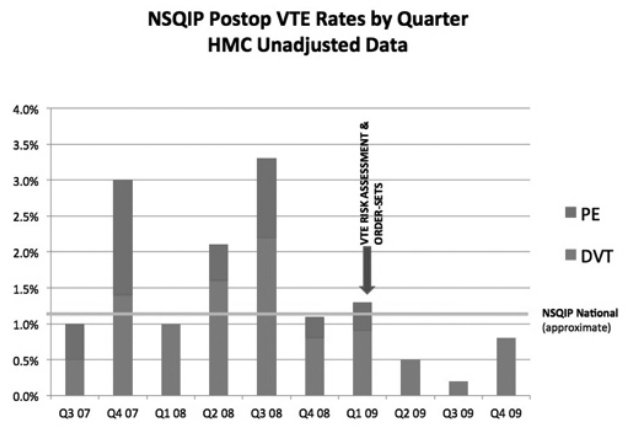
You are a general surgery resident on a large surgical service and have just finished a long day in the OR. The team is scattered finishing up various tasks from the day and you are working on discharging a patient. You know the patient well because he has had a very complicated hospital course and you're glad he will finally get to go home. While filling out the discharge paperwork, the nurse notifies you that the patient has suddenly started complaining of shortness of breath and chest pain. You go to examine the patient and are immediately concerned the patient has a PE. You ask the patient if he has been wearing his TPCs and he tells you they are too uncomfortable. You order the appropriate workup and the results demonstrate a left-sided PE and DVT in the right lower extremity. You cancel the discharge and start treatment for this patient.

This is the second patient this month to develop a PE on this surgical service and you wonder if this was preventable. You begin reviewing the patient's chart for a likely cause. You discover that the patient's subcutaneous heparin was held when the patient went to the interventional radiology suite to have a percutaneous

drain placed two days ago. You thought the team had restarted the patient's VTE prophylaxis after the procedure but nobody did. The patient had been 48 hours without blood thinners prior to developing the PE.

Figure 7, this page, is a graph of your institution's ACS NSQIP postop VTE rates by quarter (unadjusted data).

Figure 7. Institutional postoperative VTE rates



Discussion

Plan

- Establish the objectives and processes necessary to deliver results in accordance with target goals.
- How many of our cases were receiving ACCP guideline-direct DVT/PE prophylaxis? Or what was our range of compliance?
- Filter results by groups. Examine data to see if there are groups who have better or worse success than others, are they doing anything differently?
- Assess available resources for potential effort to improve.
- Decide on approach (such as revised paper documentation or computer entry order).
- Many groups will recommend the implementation of an order set or risk stratification system to streamline and organize care. It is important that the order sets be mandatory, simple to use and not labor intensive for this strategy to be successful and useful.
- Identify DVT/PE reduction as an organizational priority and set performance goals for your hospital.
- For any project to be successful, the key stakeholder groups need to be identified and involved in the conception, design, implementation and follow up of any project.
- Assemble a multidisciplinary team to include physicians, nursing, pharmacy, administrators, IT, executives.

Do

- Disseminate information about appropriate DVT/PE prophylaxis rates.
- Implement mandatory risk stratification, implement electronic or paper order sets.
- Provide resources necessary to implement change (in other words, IT tech support for EMR order set changes).
- Mandate compliance to your VTE prophylaxis protocol and empower staff for accountability.
- Evaluate patients on admission and daily for appropriate DVT/PE prophylaxis.
- Promote highest level of patient activity tolerated, evaluating daily for potential to advance activity level.
- Make sure team members communicate with each other when DVT prophylaxis is suspended for whatever reason, and make sure to readdress at AM rounds whether restarting or continuing to hold more appropriate based on clinical scenario.
- Provide education and feedback to all stakeholders including patients and families.

Study

- Conduct data analysis and performance reports.
- Assess results and determine if goals were met.
- Identify barriers to compliance and/or implementation.
- Communicate performance to leadership, staff and team. Highlight successes, identify problems early.

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Act

- Routinely review and analyze your hospital's DVT/PE rates and outcomes and compare with internal and external benchmarks.
- Reassess to determine if reaching target goals.
- Remember: this is a cycle! Any issues identified here would lead back into the Plan part of the next cycle as the process repeats.

Best Practice Recommendations

The following are general considerations for good clinical practice and apply to thromboprophylaxis in all surgical groups. They are derived from the VTE guidelines in nonorthopaedic surgical patients from the ACCP 9th Edition VTE guidelines.

- It may be advisable for every institution to have a formal, written policy for preventing VTE in surgical patients.
- Adherence with IPC often is less than optimal, therefore should be monitored actively. Portable, battery-powered devices capable of recording and reporting proper wear time may facilitate monitoring. Efforts should be made to achieve at least 18h of use daily.
- Proper fit and adherence with elastic stockings is necessary to ensure efficacy. The correct pressure at the ankle level for primary prophylaxis is an18–23 mm Hg, which is lower than for therapeutic stockings used to treat post-thrombotic syndrome (30–40 mm Hg). Based on indirect evidence from patients with stroke, we favor thigh- high elastic stockings over calf-high stockings.
- Relative contraindications to IPC and elastic stockings include dermatitis, skin breakdown, or ulceration; peripheral vascular disease; lower-extremity bypass procedure; and lower-extremity trauma with plaster cast. Unilateral compression in an unaffected limb should not be used as the sole means of prophylaxis.
- In the overwhelming majority of trials that demonstrated efficacy, LDUH and LMWH were given 2 h preoperatively, although LMWH appears to be effective and is possibly associated with a lower risk of bleeding when the first dose is given 12 hours preoperatively.
- When using pharmacologic prophylaxis, we suggest following the manufacturer's recommendations for dosing. It may be prudent to consult with a pharmacist regarding dosing in bariatric surgery patients and other patients who are obese who may require higher doses of LDUH and LMWH.

Conclusion

VTE is an important postoperative potentially preventable complication which causes significant morbidity and increased risk of mortality to the patient. It is additionally associated with increased LOS and costs of hospitalization and is being increasingly used as a quality measure for hospitals with negative financial reimbursement implications.

Even with perfect compliance with thromboprophylaxis, some patients will still develop VTE. Therefore, the goal is to reduce the risk for potentially preventable VTE and we should strive for 100 percent compliance with tailoring appropriate thromboprophylactic measures for differently risk-stratified groups of patients.

In the sample institution, once a higher than expected incidence of VTE was identified, a multi-disciplinary and collaborative initiative was established to address the issue. The collaborative worked to identify the scope of the problem, identify best-practices used at other institutions or other successful models, and extrapolate key initiatives that could be implemented within our hospital system. In this scenario this involved education and collaboration for the patient, nurses, physicians and other health care providers regarding the risks, costs, and best practices in thromboprophylaxis. Additionally, it involved the addition of a mandatory risk assessment tied to the electronic medical record for every patient. To ensure compliance, reasons specifying contraindications to VTE prophylaxis must be entered if pharmacologic VTE prophylaxis is not entered or sought. Additionally, there are safe guards from the pharmacist to ensure appropriate dosing based on patient's body weight and manufacturer guidelines. There also had to be coordination with social work/care coordination for those patients who required ongoing thromboprophylaxis on an outpatient basis, such as surgical oncology patients. Results are continually tracked and addressed through Morbidity and Mortality conferences, grand rounds, and ACS NSQIP-generated reports so there is continued feedback for the process. This allows for promotion of sustainability and provides ample opportunities for reassessment and redirection where necessary. Our post implementation results are as follows:

Quality data from your institution can be reviewed for any number of complications. ACS NSQIP provides a standardized reporting scheme, which can allow for comparisons between institutional and national data and benchmarks. Ultimately, for any project to be successful, input and collaboration and the consensus that said complication is an institutional priority from all stakeholders is essential. Specific goals and timeframes should be established. Strategies should be individualized to a hospital's budget and available resources. A mechanism for surveillance of outcomes and reassessment of strategies should be incorporated into all quality improvement initiatives.

RECOMMENDED READING

Bates SM, Jaeschke R, Stevens SM, Goodacre S, Wells PS, Stevenson MD, et al. Diagnosis of DVT: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest.* 2012;141(2 Suppl):e351S-418S. Epub 2012/02/15.

Douketis JD, Spyropoulos AC, Spencer FA, Mayr M, Jaffer AK, Eckman MH, et al. Perioperative management of antithrombotic therapy: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest.* 2012;141(2 Suppl):e326S-50S. Epub 2012/02/15.

Gould MK, Garcia DA, Wren SM, Karanicolas PJ, Arcelus JI, Heit JA, et al. Prevention of VTE in nonorthopedic surgical patients: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest.* 2012;141(2 Suppl):e227S-77S. Epub 2012/02/15.

Guyatt GH, Akl EA, Crowther M, Gutterman DD, Schuunemann HJ. Executive summary: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest.* 2012;141(2 Suppl):7S-47S. Epub 2012/03/15.

Kearon C, Akl EA, Comerota AJ, Prandoni P, Bounameaux H, Goldhaber SZ, et al. Antithrombotic therapy for VTE disease: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest.* 2012;141(2 Suppl):e419S-94S. Epub 2012/02/15.

2. Urinary Tract Infection

OBJECTIVES

At the end of this section, the learner should be able to:

- Identify the appropriate uses and indications for indwelling urinary catheters based on CDC guidelines
- Appreciate that data within the literature supports early removal of indwelling urinary catheters in multiple conditions previously thought to necessitate prolonged urinary drainage (for example, patients with epidurals or following low pelvic surgery)
- Understand that the length of time an indwelling catheter is in place directly correlates with the risk of CAUTI

Background

Indwelling urinary catheters (IUCs) account for 80 percent of nosocomial urinary tract infections (UTIs) and are a leading cause of morbidity in acute care settings.[1-4] Catheter-associated bacteria is further estimated to directly cause 13 percent of deaths related to nosocomial infections in the United States.[5] A single UTI can cost upward of $12,000 and can prolong hospitalization by an average of 2.5 days.[6-8] These astounding numbers are especially true in surgical patients, in whom IUCs are frequently placed during the perioperative period. The standardized ACS/ACS NSQIP UTI definition is listed in **Table 3, page 50**.

In 2005, the Surgical Care Improvement Project (SCIP) was launched with the goal of a 25 percent reduction in surgical complications by the year 2010.[9-11] SCIP utilizes evidence- based medicine along with a multi-disciplinary approach to establish surgical practice guidelines for reducing postoperative complications. In 2009, SCIP Inf-9 was added to these guidelines, recommending that all IUCs placed at the time of a surgical procedure be removed by postoperative day two (POD 2).[12] To meet compliance with SCIP Inf-9 guidelines, a patient must have their IUC removed on or before POD2 or meet exemption criteria. Patients can be deemed exempt from SCIP Inf-9 if there is appropriate documentation from a physician stating both the necessity and justification of leaving the catheter in place **(Table 4, page 50)**.

A single-institution case-control study investigated the correlation between SCIP Inf-9 compliance and rate of postoperative UTI as well as the association between UTI rate and SCIP Inf-9 exemption status.[13] The study showed increased SCIP Inf-9 compliance over time. As time moved forward, nurses and surgical staff became aware of the new guideline and were trained on the importance of timely and well-documented postoperative removal of IUCs. During this same time frame, however, the postoperative UTI rate showed little improvement. The majority of postoperative patients who developed UTI were deemed SCIP Inf-9 exempt by their surgeon, and thus, their IUCs were not removed within 48 hours following an operation. Although SCIP Inf-9 compliance rates between

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Table 3. ACS NSQIP Standardized Definition of Urinary Tract Infection (UTI)

Definition:	An infection in the urinary tract (kidneys, ureters, bladder, and urethra).
Criteria:	Must be noted within 30 days after the principal operative procedure AND patient must meet ONE of the following A OR B below: **A: ONE** of the following six criteria: • fever (>38oC or 100.4o F) • urgency • frequency • dysuria • suprapubic tenderness • costovertebral angle pain or tenderness **AND** • A urine culture of > 100,000 colonies/ml urine with no more than two species of organisms **OR** **B: TWO** of the following six criteria: • fever (>38o C or 100.4o F) • urgency • frequency • dysuria • suprapubic tenderness • costovertebral angle pain or tenderness **AND** At least one of the following: • Dipstick test positive for leukocyte esterase and/or nitrate • Pyuria (>10 WBCs/mm3 or > 3 WBC/hpf of unspun urine) • Organisms seen on Gram stain of unspun urine • Two urine cultures with repeated isolation of the same uropathogen with >100,000 colonies/ml urine in non-voided specimen • Urine culture with < 100,000 colonies/ml urine of single uropathogen in patient being treated with appropriate antimicrobial therapy • Physician's diagnosis • Physician institutes appropriate antimicrobial therapy

Table 4. SCIP Inf-9 Guidelines

SCIP Inf-9: Urinary catheter removed on Postoperative Day 1 (POD 1) or Postoperative Day 2 (POD 2) with the day of Anesthesia End Date being day zero (POD 0)

Expectation	**Includes:** All selected surgical patients with a catheter which was in place peri-operatively and remains in place immediately post-operatively. **Excludes:** • Laparoscopic, gynecological, perineal procedures • Procedures requiring general or spinal anesthesia that occurred within 3 days (4 days for CABG or other cardiac surgery) prior to or after the procedure of interest • Length of stay less than 2 days • Patient who have and indwelling catheter (uretheral or suprapubic) or intermittent catheterization prior to admission or prior to surgery • Documentation by an MD or PA of a reason for not removing the catheter postoperatively • Patients with documented preoperative infection
Documentation Requirements	Documentation that the urinary catheter was removed on POD 1 or POD 2. **-OR-** Reason for not removing the catheter postoperatively is documented clearly in the medical record.

IF the catheter is removed by POD 2, the measure will PASS

IF the catheter is not removed by POD 2, and a medical reason for leaving it in is not documented, the measure will FAIL.

the two groups were not statistically different, when compared with the control group, the UTI case group had an exemption rate, which was more than three times higher. In fact, more than 70 percent of the patients who developed postoperative UTIs were theoretically exempt from SCIP Inf-9.

When a patient's IUC remains greater than 48 hours postoperatively (in other words, noncompliant), but is then deemed SCIP Inf-9 exempt by their surgeon, the chart is marked as compliant by a reviewer. This creates a false sense of improved patient care without true improvement in our practice. Consequently, there has been little change in patient outcomes. The odds of postoperative UTI were nearly eight times higher among the group of patients who were exempt when compared with the nonexempt group alone. It can be argued that surgeons are missing out on a critical opportunity to potentially prevent UTIs in a majority of postoperative patients.

The most common exemption criterion cited was the presence of an epidural catheter. More than one-quarter of catheter-associated UTIs were in patients whose catheters were maintained secondary to epidural analgesia. Less than 8 percent of control patients were deemed exempt for this reason. The appropriate duration for maintaining IUCs in patients with epidural analgesia remains controversial. Urinary retention among postoperative patients with epidural analgesia has been reported to be as high as 23 percent to 29 percent.[14-16] Conversely, one series which focused specifically on colorectal surgery patients reported a 10 percent urinary retention rate among patients with thoracic epidural analgesia, compared with 1 percent for patients receiving parenteral opioids.[17] Because the rate of urinary retention among patients with epidural analgesia is debatable, many physicians elect to leave in IUCs as long as the patient has an epidural. It has been documented that lumbar epidurals are more likely to lead to urinary retention, however one randomized controlled trial reports that early removal (POD#1) of IUCs in patients with thoracic epidurals is associated with a significantly lower UTI rate, and, in fact, it does not lead to a higher rate of re-catheterization.[16,18]

Other reasons for SCIP Inf-9 exemption within the review included low pelvic dissection, critical illness, preoperative indwelling IUC, and other reasons related to monitoring urine output. Maintaining postoperative IUCs for the purposes of monitoring renal function and fluid balances in critically-ill patients, as well as following urologic procedures, is justified. However, prolonged IUC following nonurologic cases of low pelvic surgery remains debatable. A trial investigating removal of IUCs on POD#1 versus POD#5 following rectal resection concluded that prolonged IUC should only be reserved for resection of low rectal carcinoma; otherwise urinary catheterization should be discontinued on the first day after an operation.[19,20]

In addition to being deemed exempt from SCIP Inf-9, patients within the study who developed postoperative UTIs were more likely to be older females. There is evidence within the literature which states 83 percent of patients with bacteremia secondary to nosocomial UTIs and 95 percent of patients who died secondary to UTIs were older than 50 years.[6] Additionally, patients who underwent pancreatic surgery were also more likely to develop UTIs. This is likely attributed to the fact that a majority of pancreatic surgery patients received epidurals for postoperative analgesia. These data further supports the notion that surgeons must be aware of patient-specific demographics and risk factors when deciding whether or not to delay removal of IUCs following a surgical procedure.

The risk for UTI increases 5 to 10 percent per day of bladder catheterization, and the acquisition of UTI associated with an IUC has been linked to a threefold greater risk of mortality in hospitalized patients.[6,20] Thus, some surgeons propose that all IUCs be removed on POD#1, and exceptions should be reserved for situations like urologic surgery or sedated and critically-ill patients. Furthermore, many suggest that epidural analgesia no longer be allowed as a SCIP Inf-9 exemption criterion, and thus maintaining IUCs beyond 48 hours for this reason alone would result in the case being deemed noncompliant. The decreased flexibility of SCIP Inf-9 exemption criteria would encourage surgeons to think about patient-specific risk factors and the true necessity and accompanying risk of prolonged IUCs following an operation.

Quality Improvement Pearl—Quality improvement requires multidisciplinary team work. In order to address the specific issue of UTI in patients who require epidural analgesia, a multidisciplinary team should be convened including pharmacy, nursing, anesthesiology, pain service, and surgery.

Clinical-Based Application

Consider the following clinical scenario:

You are the intern on the surgical oncology service and are taking care of a 65-year-old female who is postoperative day five from a Whipple procedure for pancreatic adenocarcinoma. The patient has had a relatively unremarkable postoperative course, but this morning the nurse calls you and states your patient has a fever of 38.7°C. You go to examine the patient. She has an epidural in place, which was capped by the pain service earlier today. There is no erythema surrounding the entrance site. The patient's incision is clean and dry, also without any signs of cellulitis or surgical site infection. The patient still has a foley catheter in place. Your chief resident told the team to keep the foley as long as the patient had her epidural. You decide to do a fever workup with blood and urine cultures and chest X ray. Later that evening you get a call from the lab that the patient's urine culture is growing gam negative rods. Your team starts the patient on antibiotics for a catheter-associated UTI.

Putting Quality into Practice

Discussion

Based upon the results of the aforementioned study, one institution developed an indwelling urinary catheter protocol and a urinary retention protocol **(Figures 8, this page and Figure 9, page 53)**. A daily nursing checklist was also created based on CDC guidelines for appropriate usage of IUCs **(Figure 10, page 53)**. These protocols and checklists are being implemented within electronic postoperative order sets as an effort to truly change our institutional practices and limit the ability for individual physicians to exempt their patients from important quality measures such as SCIP Inf-9. Postoperative order sets within electronic medical records automatically instruct the nurse to remove the IUC on POD#1. If the surgeon wishes to continue the IUC, they must opt-out of this option and document an appropriate reason for exemption. Integrating technology of the electronic medical record with process improvement measures such as SCIP should be a tool which is utilized to implement quality measures within the health care system.

Development of new protocols, even when used for quality improvement, is not easy and does not happen overnight. Below we outline the success of the nurse-driven protocol using the PDSA cycle:

Plan

- Review institutional ACS NSQIP CAUTI data.
- Review institutional SCIP compliance rates.
- Review patient charts of those who developed CAUTI in the postoperative period.
- Identify common underlying themes across patients who developed CAUTI.

Do

- Present your data to important stakeholders: residents, attending surgeons, nursing staff, anesthesia staff.

Figure 8. Indwelling urinary catheter (IUC) protocol

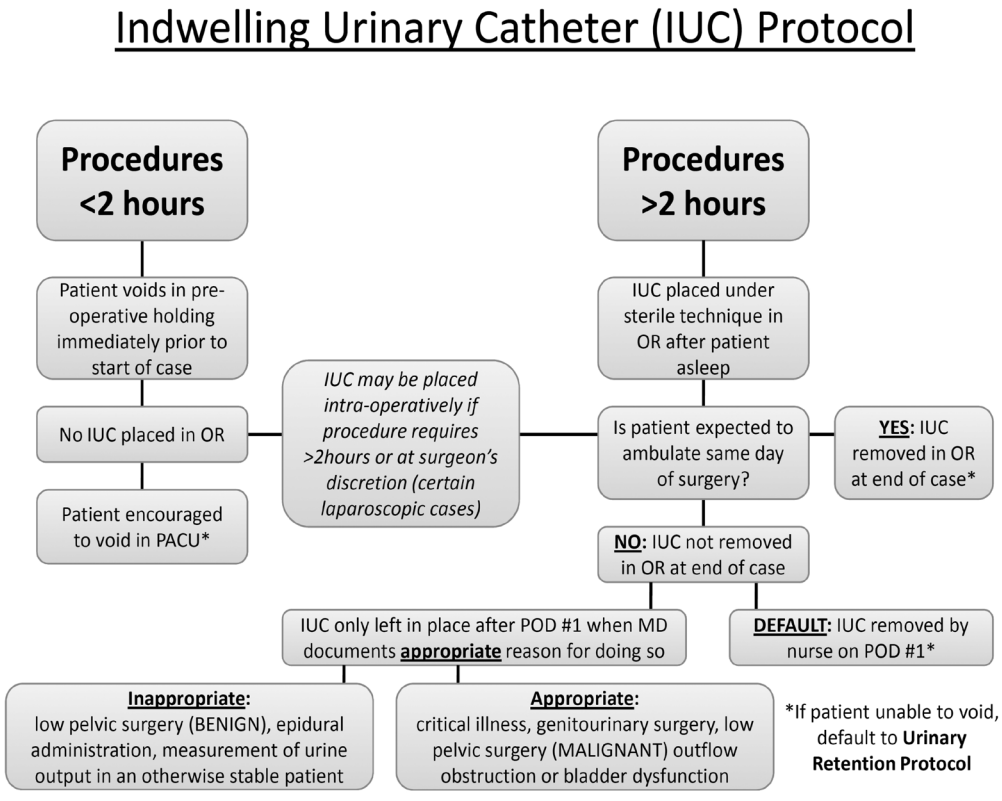

Figure 9. Urinary retention protocol

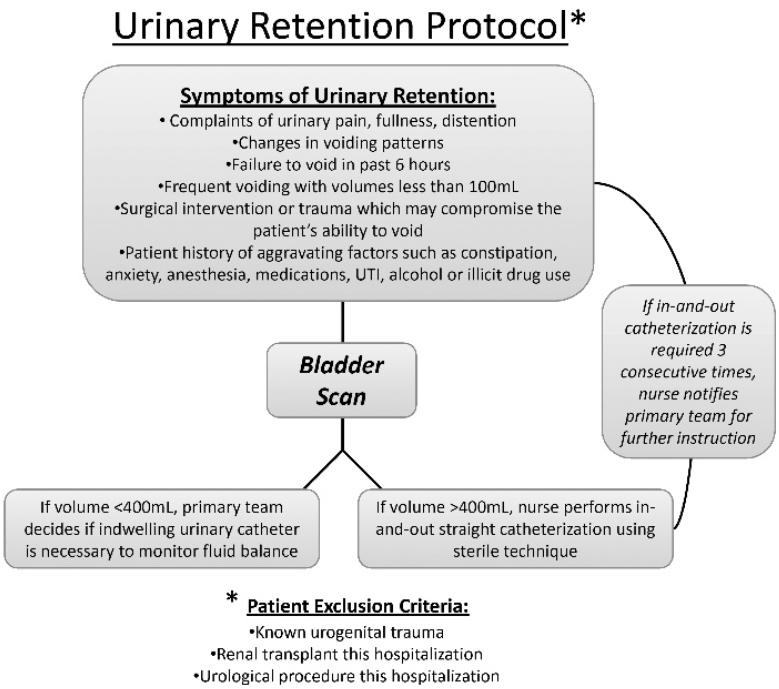

Figure 10. Daily nursing checklist for appropriate usage of IUCs

Nursing Checklist

To be completed DAILY on all General Surgery Patients* with an Indwelling Urinary Catheter

(1) If the patient is ***POD#1 and has an epidural catheter*** *for pain control, wait until* ***noon on POD#1*** *to do the following checklist.*

(2) For ***all other patients*** *(POD#1 without epidural, or ALL patients POD#2 or later) do the following at* ***daily at 6am***

CDC-approved Appropriate Uses of Indwelling Urinary Catheters

Check all that apply:

- ☐ Precise measurement of urinary output in specific patient populations (Chemically sedated/ paralyzed, orders for strict I &O in patients unable to provide measureable urinary output)
- ☐ Perioperative uses, anticipated prolonged duration of surgery, receiving large volumes in surgery, need for intraoperative monitoring in surgery
- ☐ Genitourinary, urological, bladder, colorectal or gynecological surgery requires an MD order for removal (Check with physician daily)
- ☐ Continuous bladder irrigation
- ☐ Patient requires prolonged immobilization (e.g., potentially unstable thoracic or lumbar spine, multiple traumatic injuries such as pelvic/hip fractures)
- ☐ End of life care/Palliative care (comfort measures only)
- ☐ Urinary incontinence in patients with stage III or IV pressure ulcer on the sacral/ gluteus/trochanteric areas

➔ IF ANY OF ABOVE APPLY/CHECKED DO NOT REMOVE CATHETER

➔ IF NONE APPLY/CHECKED, REMOVE THE CATHETER AND DOCUMENT IN CHART

IUC Removed? ☐**YES (Time:**_____**)** ☐**NO**

Comments:_____

_____

_____

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- Engage those with particular interest and get their buy-in for a quality improvement initiative surrounding postoperative CAUTI.
- Develop a test of change (in this case, a nurse-driven protocol for foley catheter removal in postoperative patients) and discuss potential logistical challenges with key players.

Study

- Implement your test of change.
- Collect data (compliance with protocol, specific barriers noted during implementation, and most importantly outcomes including CAUTI, urinary retention, need for catheter re-insertion).
- Modify your protocol as necessary based on results of specific tests of change. Start small, and realize that your protocol will not be perfect on the first try. It will change multiple times during your testing phases.
- Share successes with team members and other stakeholders with invested interest.

Act

- Routinely review and analyze your hospital's CAUTI rates and outcomes and compare with internal and external benchmarks.
- Reassess to determine if reaching target goals.
- This is a cycle and any issues identified here would lead back into the Plan part of the cycle and the process repeats.
- In the case of the nurse-driven protocol, once initial glitches were address and an initial four-month pilot period was performed on a single surgical floor, the protocol was introduced and implemented on other surgical floors in the hospital.
- Successes of the protocol were shared with hospital administration, and the protocol was then implemented on medical (nonsurgical) units.
- Over the past 24 months, the protocol has now become a system-wide process improvement tool for decreasing CAUTI rates, not just in surgical patients, but in all patients within a single health care system.
- Success with such protocols does not happen overnight. It takes time and flexibility to modify your methods and processes as you go along and realize what works and what doesn't, all the time keeping in mind that you are doing this with the single goal of improving the care of your patients.

Best Practice Recommendations

Below are the CDC guidelines for appropriate use of indwelling urinary catheters:

- Precise measurement of urinary output in specific patient populations (chemically sedated/ paralyzed, orders for strict I &O in patients unable to provide measureable urinary output).
- Perioperative uses, anticipated prolonged duration of a surgical procedure, receiving large volumes in a surgical procedure, need for intraoperative monitoring in a surgical procedure.
- Genitourinary, urological, bladder, colorectal or gynecological surgery requires an MD order for removal (check with physician daily).
- Continuous bladder irrigation.
- Patient requires prolonged immobilization (for example, potentially unstable thoracic or lumbar spine, multiple traumatic injuries such as pelvic/hip fractures).
- End of life care/Palliative care (comfort measures only).
- Urinary incontinence in patients with stage III or IV pressure ulcer on the sacral/ gluteus/trochanteric areas.

Conclusion

Patients who are deemed exempt from SCIP Inf-9 are at significantly higher risk of UTI than those who remain compliant with SCIP guidelines. Data within the literature support the clinical importance of SCIP Inf-9 in preventing catheter-associated UTIs and offer justifiable reasons for why SCIP Inf-9 exemption should be constrained, beginning with elimination of exemptions such as epidural analgesia. Finally, inclusion of exempt cases within the overall compliance ratings will continue to result in an ongoing lack of correlation between this important quality initiative and the outcome measure of postoperative UTI.

RECOMMENDED READING

Basse L, Werner M, Kehlet H. Is urinary drainage necessary during continuous epidural analgesia after colonic resection? *Reg Anesth Pain Med.* 2000;25:498-501.

Benoist S, Panis Y, Denet C, Mauvais F, Mariani P, Valleur P. Optimal duration of urinary drainage after rectal resection: a randomized controlled trial. *Surgery.* 1999;125:135-141.

Marret E, Remy C, Bonnet F. Meta-analysis of epidural analgesia versus parenteral opioid analgesia after colorectal surgery. *Br J Surg.* 2007;94:665-673.

Owen RM, Perez SD, Bornstein W, Sweeney JF. Impact of SCIP Inf-9 on Postoperative Urinary Tract Infections: Do Exemptions Interfere with Quality Patient Care? *Archives of Surgery.* 2012;147(10):946-953.

Saint S, Kowalski CP, Kaufman SR, et al. Preventing hospital-acquired urinary tract infection in the United States: a national study. *Clin Infect Dis.* 2008;46:243-250.

Saint S. Clinical and economic consequences of nosocominal catheter-related bacteriuria. *American Journal Infection Control.* 2000;28:68-75.

Stephan F, Sax H, Wachsmuth M, Hoffmeyer P, Clergue F, Pittet D. Reduction of urinary tract infection and antibiotic use after surgery: a controlled, prospective, before-after intervention study. *Clin Infect Dis.* 2006;42:1544-1551.

Zaouter C, Kaneva P, Carli F. Less urinary tract infection by earlier removal of bladder catheter in surgical patients receiving thoracic epidural analgesia. *Reg Anesth Pain Med.* 2009;34:542-548.

3. Readmissions

OBJECTIVES

At the end of this section, the learner should be able to:

- Identify procedural-based risk factors for unplanned hospital readmission following surgical procedures
- Recognize that postoperative complications drive the risk for unplanned readmissions
- Understand current policy within health care reform based on hospital readmissions

Background/Health Care Policy

From 2003 to 2004, 19.5 percent of all Medicare beneficiaries who were discharged from a hospital were readmitted within 30 days leading to a cost of $17.4 billion.[1,2] In June of 2009, the Centers for Medicare and Medicaid Services (CMS) began publishing 30-day readmission data for selected medical diseases and hospital readmissions quickly became an important metric for measuring quality of care. Furthermore, in March of 2010, the Patient Protection and Affordable Care Act was signed into law and within it, Section 3025 brought substance to holding hospitals accountable for 30-day hospital readmissions by reducing reimbursements according to an adjustment factor determined by an institution's expected versus observed 30-day readmission rate.

On October 1, 2012, based on Section 3025 of the Affordable Care Act, CMS officially enacted penalties against more than 1,400 hospitals for "excessive" readmission rates.[4] This places an intense focus on decreasing unnecessary surgical readmissions. These penalties are just the beginning of what is likely to be a developing trend of "pay for performance" in health care reform.[5,6]

A retrospective study using institutional ACS NSQIP data analyzed outcomes of 1,442 general surgery patients.[7] The overall readmission rate was 11.3 percent. Those who underwent a procedure that required an inpatient stay in the hospital were much more likely to be readmitted within 30 days when compared with patients who underwent an outpatient procedure. Patients with a history of insulin dependent diabetes, disseminated cancer, dyspnea, preoperative ventilator, a 10 percent weight loss in the prior 30 days, preoperative steroid use, and/or patients undergoing a pancreatic resection, colectomy, or liver resection were also at increased risk for readmission.

Most importantly, however, was the finding that patients who suffered one or more complications in the postoperative period were more than four times more likely to be readmitted than patients who did not experience a postoperative complication. The impact of complications on readmission was dose dependent, meaning that as the number of complications a patient experienced increased the likelihood of readmission increased. **Table 5,** page 56, demonstrates that patients who suffered a surgical site infection complication (SSI), postoperative pulmonary complication (PPC), urinary tract infection (UTI), postoperative transfusion within 72 hours of an operation, or sepsis/shock had a two to six times higher chance of readmission when compared with a patient who did not suffer the same complication.

Additional studies have investigated the risk factors for hospital readmission following surgical procedures.[8] A recent study identified 230,864 patients discharged after general, upper gastrointestinal (GI), small and large intestine, hepatopancreatobiliary (HPB), vascular, and thoracic surgery using ACS NSQIP data.

Putting Quality into Practice

Table 5. ACS NSQIP standardized definition of readmissions

Definition:	Patients who were discharged from their acute hospital stay for their principal operative procedure, and subsequently readmitted as an inpatient to an acute care hospital setting.
Criteria:	**1.** Was there a readmission for any reason within 30 days of the principal operative procedure? Report any readmission (to the same or another hospital), for any reason, within 30 days after the principal operative procedure. The readmission has to be classified as an "inpatient" stay by the readmitting hospital, or reported by the patient/family as such. **Answer "Yes" or "No"** • If "Yes", enter date of readmission, if known (mm/dd/yyyy) or select 'Unknown' • If "Yes", enter information Source: Medical Record, Patient/Family Report, Other **2.** Was this readmission unplanned at the time of the principal operative procedure? **Answer "Yes" or "No"** **3.** Was this readmission likely related to the principal operative procedure? **Answer: "Yes" or "No"** • Select "Yes" if the readmission (to the same or another hospital) was for a postoperative occurrence likely related to the principal operative procedure within 30 days after the principal operative procedure. "Yes" is the default answer unless it is definitively indicated that the readmission is not related to the principal operative procedure. • If likely related, choose the primary suspected reason (postoperative occurrence) or enter ICD code, or if code unknown please describe the reason for the readmission. Choosing one of these occurrences does not indicate that the NSQIP criteria for the occurrence were met; it merely indicates that this diagnosis was given as a reason for readmission. - Superficial Incisional SSI - Deep Incisional SSI - Organ/Space SSI - Wound Disruption - Pneumonia - Intraoperative OR Postoperative Unplanned Intubation - Pulmonary Embolism - On Ventilator > 48 Hours - Progressive Renal Insufficiency - Acute Renal Failure - Urinary Tract Infection (UTI) - Stroke/CVA - Intraoperative OR Postoperative Cardiac Arrest Requiring CPR - Intraoperative OR Postoperative Myocardial Infarction - Transfusion Intra/Postop (RBC within the First 72 Hrs of Surgery Start Time) - Vein Thrombosis Requiring Therapy - Sepsis - Septic Shock - Other: ICD Code_____ • Beginning January 1, 2014 sites will have the option of using ICD-9 or ICD-10 Codes for this field. • If the readmission is unrelated, choose the primary suspected reason (postoperative occurrence) or enter ICD code, or if code unknown please describe the reason for the readmission. Choosing one of these occurrences does not indicate that the NSQIP criteria for the occurrence were met; it merely indicates that this diagnosis was given as a reason for readmission. - Superficial Incisional SSI - Deep Incisional SSI - Organ/Space SSI - Wound Disruption - Pneumonia - Intraoperative OR Postoperative Unplanned Intubation - Pulmonary Embolism - On Ventilator > 48 Hours - Progressive Renal Insufficiency - Acute Renal Failure - Urinary Tract Infection (UTI) - Stroke/CVA - Intraoperative OR Postoperative Cardiac Arrest Requiring CPR - Intraoperative OR Postoperative Myocardial Infarction - Transfusion Intra/Postop (RBC within the First 72 Hrs of Surgery Start Time) - Vein Thrombosis Requiring Therapy - Sepsis - Septic Shock - Other: ICD Code_____ • Beginning January 1, 2014 sites will have the option of using ICD-9 or ICD-10 Codes for this field.

Table 6. Odds ratio for readmission following specific postoperative complication

Complication Type	OR	95% CI
Vascular	6.36	2.84-14.25
UTI	5.08	2.62-9.86
Sepsis/Shock	4.73	3.03-7.37
Wound	3.52	2.40-5.17
PPC	3.45	2.08-5.71
Renal	3.19	1.38-7.35
Transfusion	1.98	1.35-2.90

UTI, Urinary Tract Infection; **PPC**, postoperative pulmonary complication

Factors strongly associated with readmission included ASA class, albumin less than 3.5, diabetes, inpatient complications (**Table 6, this page**), nonelective surgery, discharge to a facility, and the LOS (all $P < 0.001$). On multivariate analysis, ASA class and the LOS remained most strongly associated with readmission. The authors go on to point out that factors associated with readmission might include the following: (1) preadmission factors, (2) health care factors, and (3) postdischarge factors **(Table 7, this page)**.

Clinical-Based Application

Consider the following clinical scenario:

You are a PGY3 resident on a general surgery service that focuses mostly on GI surgery. Many of your patients get bowel resections and new ostomies. You have noticed that while on service, many of these patients seem to be coming back to the hospital within a week of discharge and are presenting with high ostomy output, dehydration, and acute kidney injury.

Table 7. Proposed conceptual model for the causes of readmission

Biologic Factors	Health Care Factors	Social Factors
Disease process	"Quality"	*Discharge setting*
Demographics	Appropriate indication	Socioeconomic status
Comorbidities	Preoperative planning	Informal caregivers
	Surgeon performance	Social support
	Anesthesia	Health beliefs
	Critical care	Health care self-efficacy
	Postoperative care	Health care social norms
	Nursing	
	Infection control	
	Allied health	
	Social work	
	Discharge planning	
	Home health services	
	Outpatient follow-up	
	Care coordination	
	Complications	

*The ACS-NSQIP only addresses italicized factors.

Discussion

Plan

- Review institutional readmission data (administrative/claims data).
- Review charts of postoperative patients readmitted within 30 days of operation.
- Identify common underlying themes across readmitted patients.

Do

- Present your data to important stakeholders: residents, attending surgeons, ostomy nurses, floor nurses, emergency department clinicians, etc.
- Select a single topic revealed in the data and create institutional buy in
- Develop a test of change based on identified issues. Some possible initiatives:
  - For patients presenting for elective surgery with a planned or possible ostomy, use the preoperative visit to begin a structured educational process on ostomy care, including a visit with an ostomy nurse.
  - Develop an improved discharge document that includes detailed information about relevant topics (e.g. ostomy care and monitoring ostomy output)
  - Start your discharge planning early! Do not wait for the patient to be one day prior to discharge to think about their needs once they get home. If you anticipate the need for home health, initiate the process on postoperative day zero (or even preop)
  - Institute a protocol for calling patients 1-2 days after discharge to answer questions and attempt to detect any problems early enough to be addressed in the outpatient setting (e.g. dehydration)
  - Create a protocol by which patients can receive IV fluids without requiring an official ED visit or inpatient admission (note: this is likely a poor choice for an initial QI project as it may require significant resources; however, once you have a proven track record, an initiative like this can have a substantial impact).

Putting Quality into Practice

Study

- Implement your test of change.
- Collect data (compliance with protocol, specific barriers noted during implementation, and most importantly outcomes including readmissions or other complications).
- Modify your protocol as necessary based on results of specific tests of change. Start small, and realize that your protocol will not be perfect on the first try. It will change multiple times during your testing phases.
- Share successes with team members and other stakeholders with invested interest.

Act

- Routinely review and analyze the service's readmission rates and compare with internal and external benchmarks.
- Reassess to determine if reaching target goals.
- This is a cycle and any issues identified here would lead back into the Plan part of the cycle and the process repeats.

Conclusion

Readmissions are a hard target for quality improvement in surgical procedures as the nature of the problem is poorly understood. However, certain steps in the process of patient care that might influence readmission rates do make for an attractive target for resident initiated quality improvement project. For example, quality improvement projects that target the prevention of postoperative complications will likely reduce the rate of hospital readmissions. Furthermore, improving the patient experience across the surgical continuum through enhanced communication may reduce the need for readmission. Targeting the preoperative visit as an opportunity for enhanced education regarding the recovery process may be a good target for a resident initiated quality improvement project to reduce the likelihood of readmission.

The significance of readmission data cannot be overstated. In addition to increasing the risk for 30-day readmission, postoperative complications increase overall hospital costs and hospital length of stay. Understanding the data not only enables physicians to have the ability to identify patients who are at risk for hospital readmission, but also creates the opportunity for quality improvement initiatives that actively target at-risk populations to decrease the risk of readmission. In doing so, not only will the requirements within new health care reform be fulfilled, but patient care will also improve.

Understanding the current health care policy surrounding readmissions is important, but so is the dialogue surrounding the issue. Simply being aware and discussing readmissions among co-residents and other members of the surgical team is a good place to start. Increased awareness will lead to the ability to recognize areas for improvement of processes within your own institution that may help to decrease readmission rates. Ultimately, focusing on one small task such as medication reconciliation or postoperative patient education will be key for a resident to feel as though they can apply QI to such a large issue as hospital readmissions. As with everything else in QI, start small, don't expect success overnight, and be willing to embrace flexibility during your tests of change.

RECOMMENDED READING

Adeyemo D, Radley S. Unplanned general surgical re-admissions—How many, which patients and why? Ann R Coll Surg Engl. 2007;89:363-367.

Aust JB, Henderson W, Khuri S, Page CP. The impact of operative complexity on patient risk factors. Ann Surg. 2005;241:1024-1027.

Friedman B, Basu J. The rate and cost of hospital readmissions for preventable conditions. Med Care Res Rev. 2004;61:225-240.

Kassin M, Owen RM, Perez S, Leeds I, Cox J, Schnier K, Sadiraj V, Sweeney JF. Identification of Risk Factors for 30-Day Hospital Readmission among General Surgery Patients. Journal of the American College of Surgeons. 2012;215:322-330.

Lucas DJ, Haider A, et al. Assessing readmission after general, vascular, and thoracic surgery using ACS-ACS NSQIP. Ann Surg. 2013;258(3):430-439.

Tsai TC, Joynt KE, Oray J, Gwande AA, and Jha AK. Variation in Surgical-Readmission Rates and Quality of Hospital Care. N Engl J Med. 2013;369:1134-1142

ADDITIONAL RESOURCES

ACS NSQIP has published best practices in a few areas of perioperative care (pneumonia, renal failure, and geriatric care) that you can use as a resource in designing QI projects in these areas. In addition, we have listed a few published accounts of QI being performed "in the wild" that can help you envision how you could approach a quality-related topic in our own institution.

Creating an Efficient System for Patient Care

OBJECTIVES

At the end of this section, the learner should be able to:

- Identify the characteristics of high-reliability systems
- Provide concrete examples of preoperative, intraoperative, and postoperative systems issues that influence surgical outcomes
- Develop a plan to improve a systems issue in the delivery of surgical care

The Oxford World Dictionary defines a "system" as a "set of things working together as parts of a mechanism or an interconnecting network; a complex whole."[1] From day one as an intern, surgical residents are introduced to the concept of a system. Residents are assigned to a specific team or service. Multiple specialty services exist within a surgical department and multiple departments within a health organization. In order to provide high quality and safe care to surgical patients, we rely on the contributions of numerous additional services (anesthesia, nursing, social work, laboratory medicine, diagnostic radiology, etc.). Perhaps the most important responsibility of hospital administrative leadership, and ultimately the board of directors, is ensuring that individual departments and services work together to allow patients to move or flow through the entire health care system.

In the strictest sense, the hospital is a series of microsystems. These individual departments or services cannot function independently and must be led by individuals who are sensitive to how they interact with each other. Failing to do this inevitably compromises patient outcomes and contributes to potentially preventable complications or death.

One of the foundational concepts of the patient safety movement is that unfavorable outcomes are most often due to breakdowns within or between various delivery systems, not the actions of individual actors. Unfortunately, it can be easy to blame an individual (including oneself) for an unfavorable outcome. Certainly, after any adverse event, all individuals involved should reflect on their own actions or non-actions to see how they contributed. However, most adverse events such as organ system dysfunction, sepsis, returns to the OR, prolonged length of stay, readmissions, and death are caused by *system failures*, not individual failings.[2-4]

As residents progress in their training, they should be taught to recognize specific system failures, report observations using their institution's official reporting system, and offer suggestions for change. Ideally, residents should act as members of performance improvement teams and contribute to the development of standardized policies and procedures that improve the quality and safety of patient care.

By studying a number of high-risk industries, including automotive manufacturing, aviation, and nuclear power, researchers have developed a set of "high-reliability" principles.[5,6] As healthcare develops into a "high-reliability" system, it is important that physicians learn and adopt these traits:

- Preoccupation with failure – constantly looking for and identifying system flaws and areas of weakness
- Reluctance to simplify – avoiding the tendency to come to a conclusion quickly without being aware of underlying contributory causes
- Sensitivity to operations – recognizing the dynamic nature of complex systems and appreciating that a process that appears to be working well now may be need to adapt to changes in other processes in the near future
- Commitment to resilience – preparing in advance for "unforeseen" events so that the overall system can continue to function and is able to learn and grow
- Deference to expertise – recognizing that different individuals may have high-level knowledge in different areas, and even more junior members should be able to assume leadership if they have expertise in a given area

The rate and degree to which residents-in-training gain these traits is unique to everyone, but it is obvious that success in practice is not only a function of clinical judgment and technical skills but the ability to be willing to accept that adverse events are inevitable and multifactorial. It is critical that one can study and learn from such events, to seek constructive criticism from colleagues, and to develop the ability to avoid shying away from challenging cases going forward.

To illustrate the importance of a systems-based approach, we have selected three challenging and interrelated areas that surgical residents deal with on a regular basis: emergency department crowding, operating room availability, and discharge planning. Inefficiencies in these areas often frustrate residents and faculty as their efforts to provide optimal care are compromised, resulting in physical harm to patients, prolonged length of stay, and dissatisfaction among patients and their care givers. The various factors contributing to these issues and the

Creating an Efficient System for Patient Care

barriers (strategic, cultural, structural, and technical) that compromise their effective resolution will be discussed.

A. EMERGENCY DEPARTMENT CROWDING

At the end of this section, the learner should be able to:

- Identify the various factors that contribute to overcrowding in the emergency department (ED)
- Describe the potential negative outcomes that may result
- Identify the stakeholders

Identify metrics that could be used to assess the impact of any initiative developed to address these issues

In 2005, the Academy of Emergency Medicine (AAEM) released a position statement on emergency department crowding.[7] It described this as a "serious nationwide problem with multiple causes," emphasizing the overall decrease in total hospital and health systems' capacity to meet increasing demands of patients that present to our emergency rooms. In a subsequent statement the following year, the phrase "hospital capacity failure" was utilized to express the same concept.[8]

The prevalence and negative impact of emergency department crowding was highlighted by Pines et al.[9] in a relatively recent survey that was conducted to assess perceptions regarding the extent of this problem among medical directors/chairs of emergency departments in Pennsylvania. A total of 83 percent (86/104) agreed that that *crowding* was a problem; 98 percent (102/104) agreed that *patient satisfaction* was compromised and 79 percent (84/106) that *quality of care* suffered. Although the numbers vary somewhat in other surveys, it is clear that ED crowding is a major problem.

Several studies have noted that ED crowding tends to be worse during the week, as inpatient beds are reserved for patients undergoing scheduled surgeries. In fact, one of the possible solutions proposed in the AAEM position statement was "changing elective surgery scheduling to accommodate the resource demands for emergency department patients".[8] The interdependence of these two departments highlights the fact that correcting serious issues that involve patient flow cannot be done by focusing on independent services, but requires the careful assessment of the overall process of flow; corrective actions in one area can have significant beneficial effects in another. Here, we review common causes of ED overcrowding, the potential negative impact on patients and providers, and some potential solutions.

Common Causes of ED Overcrowding

The number of patients entering emergency rooms continues to increase and is expected to increase further.[10] While one commonly cited factor is the use of the emergency room as safety net by patients who lack insurance, many emergency departments have noted that recent increases in volume are not limited to those without health insurance. Indeed, many patients who enter emergency rooms do have a primary care physician (PCP). Some of these patients have true emergent conditions, but visiting the ER for non-urgent care is common even among insured patients. One comprehensive review[11] of ED overuse identified multiple ways in which shortcomings in the primary care system drive patients to the ED: difficulty seeing a PCP for an urgent matter, lack of convenient hours for PCP appointments (e.g. evenings and weekends), and PCP offices directing patients to the ED rather than developing robust triage systems. The authors also identified additional factors, including the desire by patients for immediate reassurance regarding personal medical concerns, and the financial and legal obligations that hospitals have to evaluate and treat any patient who comes to the ER for evaluation, regardless to their acuity level.

However, ED overcrowding is not simply a matter of an increased number of patients. A literature review of common causes[12] included a rising number of non-urgent visits and "frequent flyer" patients, but also identified seasonal trends (e.g. influenza season), inadequate staffing levels, and the use of the ED as a site for "boarding" of patients who have been admitted to the hospital but are awaiting an inpatient bed. For a detailed review of this complex problem, see Chapter 4 of The National Academies Press 2007 publication "Improving the Efficiency of Hospital-Based Emergency Care".[13] Although it is easy to blame the physical capacity of the emergency room as a limiting factor, multiple studies have shown that a lack of available inpatient beds and inefficient patient flow through the hospital is often a main culprit in ED overcrowding.[14]

Other hospital-specific factors can contribute to delays in patient flow. Many of the patients who enter the emergency room require consultations from members of other services, including surgery. The timely availability of such consultants is necessary, and the lack of it can often contribute to delays in initiating treatment or in assuring discharge with appropriate follow-up. Increasing emergency room volume can easily challenge the capacity of the laboratory or diagnostic radiology to meet demands. Delays in obtaining diagnostic information

that will impact on the disposition of the patient are not uncommon.

Impact of Overcrowding

Overcrowding is a symptom of an overburdened system. The negative effects are felt by patients, family members, and care providers. These include:

- Potential deterioration of a patient's status while awaiting assessment and treatment – A delay in diagnosis, especially in patients with an acute MI or stroke, can preclude rapid therapeutic interventions that prevent permanent compromise of these organs. The same pertains to any critically ill or injured patient who can't be assessed quickly due to delays in obtaining laboratory and diagnostic imaging results. Sun et al. studied the impact that the level of crowding has on the outcomes of patients who are admitted to the hospital.[15] They used "ambulance diversion hours" as an indirect measure of crowding. They noted that patients admitted on days with high ED crowding experienced 5 percent greater odds of inpatient death, 0.8 percent longer hospital length of stay, 1 percent increased costs per admission
- Patient and family frustration
- Increased numbers of patients who "walk out" – Some patients get tired of waiting and leave without being seen. For patients who are truly at need of emergency services, this places both the patient and the organization at significant risk.
- Dissatisfaction and burnout among staff and care providers caused by excessive workload and inability to deliver the quality of care that they recognize patients deserve

Surgical residents and attendings often become most acutely aware of the impact of ED overcrowding when called to see a patient with an acute surgical crisis. Few emergency rooms are adequately equipped to resuscitate hypotensive patients and provide intravenous monitoring in preparation for emergency surgery when overcrowding exists. Transferring the patient to the SICU or continuing resuscitation in the operating room prior to initiating the procedure is often necessary in such cases. Unfortunately, unless the operating room is adequately prepared to address these kinds of patients in a timely fashion, patient outcomes are often compromised. A common sequence of questions often asked in a surgical M&M conference for many of these critically ill patients who are admitted through the emergency room includes: What time did the patient arrive in the emergency room and what was the hemodynamic status? When was the surgical consult called? What resuscitation was provided in the ED and what was the response? What time did the patient get into the operating room?

Potential Solutions

ED crowding is common, and has received significant attention. In spite of an enormous efforts that organizations have made to combat ED overcrowding, it continues to frustrate patients, care givers and institutional leadership. The most straightforward solutions, such as increasing the physical size of the emergency department, often take substantial resources and time to implement. In addition, there are usually less costly interventions that should be explored first.

Many solutions have been proposed and implemented by different organizations. Some of these are collected in a task force report published by the American College of Physicians in 2009.[16] While some solutions focus within the emergency department, others address the interactions between the ED and the rest of the institution. A partial list includes:

- Flexible and enhanced staffing of physicians, physician extenders, nurses, and support personnel
- Realigning staffing with peak patient volume intervals using queuing methodologies
- Streamlining the admission process
- "Fast-tracking" patients with less urgent or nonurgent conditions to a defined area within the ER where they can be more efficiently evaluated and discharged
- Health system redesign to decompress physical emergency departments. This can include the incorporation of telemedicine services, in-home services, and urgent care centers.
- Restructuring related services to dedicate resources to ED patients:
    - Creating a general surgery "consult resident" position to rapidly evaluate ED patients; of note, to be effective, this person must remain available and cannot be asked to cover a case on another service or facilitate the patient flow in a busy clinic
    - Dedicating radiologic or laboratory services to ED patients (e.g. designating a specific CT scanner)

Creating an Efficient System for Patient Care

Addressing ED overcrowding requires first acknowledging that the issue is a systems-wide problem and will require a concerted effort on the part of many individuals to effectively increase patient flow. Baker and Esbenshade[17] pointed out that the root cause of overcrowding in the majority of EDs in the United States is due to boarding of patients. The resulting impact is a reduced capacity to treat patients in the ED, deceased bed utilization, and compromised quality and safety and the patient experience. It is important to try to fix what can be fixed in the ED, but it is imperative to create a "hospital-wide throughput committee" that focuses on expediting inpatient admissions. At the same time, it is critical that the patients that are "admitted" but are boarding in the ED are not neglected either by the ER staff or the admitting service. The ability to effect and sustain meaningful improvements is dependent on respected and trusted leadership (administrative, departmental, medical and nursing staff) to create an environment that fosters patient safety and quality; appropriate and timely communication; and individuals with the knowledge and experience to guide the organization by utilizing robust process improvement techniques as described elsewhere in this curriculum.

B. OPERATING ROOM AVAILABILITY

At the end of this section, the learner should be able to:

- Identify the characteristics of a well-functioning operating room (OR)
- Describe potential negative organizational and patient care outcomes of a poorly-functioning OR
- Describe how an effective multidisciplinary team interacts in assessing performance and responds to concerns raised by each of the constituents who work in the OR including the surgeons (faculty, residents, and students), the anesthesiology staff, the nursing staff and other support personnel.
- Evaluate how the OR in your organization functions. Are you familiar with the roles and responsibilities of other team members? What responsibilities as a surgical resident do you have that can influence the conduct of the case? Identify one or more factors that you would like to see improved and how you would go about trying to effect a change.

The operating room is the "workshop" where a surgeon uses his/her technical skills and surgical judgment in order to perform the indicated procedure for a given patient. However, it is clear that a successful outcome for a patient relies on more than just the skill of the surgeon. It also depends on contributions from multiple other individuals. When these individuals do not successfully work together as a large multidisciplinary team, it can lead to adverse events for the patients, enormous dissatisfaction of the individual team members, and negative consequences for the financial stability of the organization.

One of the most obvious symptoms of a poorly functioning perioperative system is when the flow of patients into and out of the operating rooms is interrupted, leading to delays in scheduled cases, and wasted valuable time. This in turn leads to a perception of scarcity that is labeled as lack of operating room availability. The goal of the section is to review the host of preoperative, intraoperative and postoperative factors that contribute to the disruption of flow in a given operating room/rooms and compromise operating room availability.

Factors Contributing to OR Availability

While many different factors contribute to operating room availability, it is ultimately a function of supply (total number of operating rooms available at any given time) and demand (the number of patients who require surgical intervention). In most institutions, the operating room leadership is under enormous pressure from administrators to balance volume, revenue and cost is such a way that the operating room can buffer losses in other areas. Unfortunately, this pressure can contribute to inefficiency if the entire system is not properly analyzed.

Some of the important pieces to consider in your institution:

1. **Nature and size of the organization.** Does your medical center have an active emergency room? Is it a trauma center? How many transfers does your hospital typically accept? Are there nursing homes that admit patients directly? All of these factors can increase the burden of integrating emergency and urgent cases into the operating room schedule. While level 1 trauma centers are required to have a dedicated OR available for emergencies 24 hours a day, most other hospitals do not.
2. **Number of operating rooms.** The number of total operating rooms in an institution varies over time. Similarly, the distribution of operating rooms to different procedural specialties can vary. An organization with a good balance between supply and demand may be tempted to aggressively recruit

busy surgeons to optimize utilization of the ORs and enhance revenue. Although this may have a positive impact initially, without an increase in other resources it can place a heavy burden on staff and potentially lead to dissatisfaction.

3. **Turnover time and delays.** Turnover time is defined as the time interval between when a given patient is "wheeled out" to when the next patient is "wheeled in". The recommended national standard is 30 minutes. For many organizations, meeting this target is a challenge. Common factors include a lack of staff to assist with turnover, poor communication between different team members involved in turnover, or delays related to preparation for the next case. These can include patient delays, surgeon delays, or equipment delays.

4. **Overlapping versus concurrent surgeries.** In response to newspaper reports about overlapping or concurrent surgery, the American College of Surgeons published revised guidelines in 2016. The new guidelines re-emphasize that the primary attending surgeon is personally responsible for the patient's welfare throughout the entire procedure, and advised against concurrent or **simultaneous** surgeries in which "the critical or key components of the procedures for which the primary attending surgeon is responsible are occurring all or in part at the same time." The policy differentiated this from **overlapping** surgeries, in which "key or critical elements" of the first operation are finished, allowing the primary attending to then start a second operation in another room. The ACS policy stated that this type of overlap may be appropriate. In response, many institutions have revised their own policies to more clearly differentiate between simultaneous and overlapping surgeries, and requiring more clear notification to patients when concurrent surgeries may be occurring, as well as official designation of a backup surgeon.

5. **Surgeon-specific issues.** There are many surgeon-specific issues that can compromise operating room availability. The judgment and skill of the surgeon and his/her ability to realistically estimate the length of the procedure and the potential for unforeseen complications that may contribute to its duration is critical. Many surgeons have competing responsibilities (teaching, office hours, ER call) that may compromise their ability to be available at the time that the operating room is open. Surgeons who perform both elective and acute care/trauma cases are often placed in a position that may compromise their patients and themselves, especially if they are "on call" on the same days that they have elective cases scheduled. Pressure by patients to be scheduled for elective surgery ASAP may lead to a surgeon with limited block time to underestimate the duration of each case in order for the scheduling office to accommodate the request to add the case onto the elective schedule.

6. **Delay in discharging the patient from the OR** to the PACU or directly to the SICU. At certain times of day, many institutions experience a "bottleneck" as the PACU runs out of available beds, forcing patients to remain in the operating room until a slot is available. A similar situation can occur if a patient requires ICU-level care following a procedure (e.g. a patient who was not able to be extubated) but does not have an ICU bed reserved.

7. **Misuse of in-patient operating rooms.** Many hospitals now have dedicated ambulatory surgery centers which often have more efficient processes. In these institutions, hospital-based operating rooms use should be limited to in-patients or select ambulatory cases who do not meet criteria to be done in an ambulatory setting. Coexisting patient-specific factors such as age, BMI, co-morbid organ system dysfunction, or special monitoring needs may dictate that the surgical procedure be performed in the main OR to provide a level of safety that may not exist in the ambulatory setting if a problem arises. As institutions make this transition, it can be challenging for busy surgeons with a balance of in-patient and out-patient cases to adapt their schedule when they are accustomed to performing both types of cases on the same day in the same location.

8. **Leadership.** There are many human factors at play in the operating room setting. At times a mal-alignment of incentives can lead to inefficiencies in patient flow resulting in delay of care. Effective leadership can ensure the proper staffing and influence the culture through incentives to improve harmony and efficiency in patient flow. Absent the appropriate leadership, competing interests between team members will distort the efficiency. Unfortunately, residents frequently do not have input on the operating room operations committee or leadership team, yet are keen observers of what works and what doesn't both in and out of the OR and must not be overlooked

when it comes to addressing common problems that impact the efficiency and productivity of the operating room.

9. **Malalignment of incentives across stakeholders.** Anesthesiologists are incentivized to provide services in Nursing shifts. Surgeons who are reimbursed according to RVUs are incentivized to fit "one more case" into a day. For other stakeholders, including anesthesiologists, patients, families, and other consultants can have their own incentive structures.

Solutions

Given how many institutions have issues with patient flow through the OR, there is a wide range of proposed and implemented solutions. The most successful are all-encompassing approaches that tackle the entire system – from patient scheduling to the use of preop checklists all the way to redesigning recovery room processes.

A few organizations have published their experiences using different strategies. Cima and colleagues used a combined Lean and Six Sigma methodology to study and improve operating room efficiency at the Mayo Clinic in Rochester, Minnesota.[18] Five work streams were created, each of which dealt with different aspects of patient flow from the initial consult to the postoperative recovery. The objectives for each of the work streams included: unplanned surgical volume variation, streamlining the preoperative process, reducing OR nonoperative time, reducing the collection and documentation of redundant patient information, and improving employee engagement and satisfaction. The effectiveness of their efforts was reflected in measurable and sustainable improvements in OR efficiency in their organization. Smith et al. published the methodology used in a similar project at the Mayo Clinic Florida practice, which applied the principles of variability methodology to address "natural" and "artificial" variation that influenced the operational and financial performance of their organization.[19] They described the concept of "nonrandom" and "random" variables and how they can impact on OR efficiency. Although the scheduling of elective cases is a "nonrandom variable," unplanned intraoperative events contribute to "random variability" and can significantly disrupt the operating room schedule.

Here are some potential solutions to consider:

1. **Staggering start times** of different rooms to prevent the "bottleneck" of all ORs attempting to start at the same time.
2. **Real-time monitoring**. There will always be some degree of variation present in both the timing of cases and intraoperative needs. Creating "smart" systems can help with the necessary work of tracking the progress of each case, alerting subsequent surgeons that a case may be finishing ahead or behind of schedule, and readjusting the assignments of other staff so that a full team is available when the room is open.
3. **Creation of dedicated "emergency" surgery ORs.** There must be a defined policy for prioritization of emergent and urgent cases when a surgeon sees a patient in the ER or an inpatient who has developed a process for which surgery is needed or anticipated. Realistic expectation of when the preoperative assessment will be completed is required in order that a room is not kept open waiting for additional testing to be completed**.** A mutually agreeable arbitrator who will facilitate the discussion and make the final decision is required. This may be the senior anesthesiologist on call, the admitting surgeon, an OR nurse manager or the medical director of perioperative services
4. **Patient preparation. Misunderstanding of** preoperative instructions by the office nurse or provision of contradictory information by the OR staff can lead to delays or last minute cancellations. Incomplete medical records including absence of medical clearance, missed abnormal laboratory result, failure to stop a particular anticoagulant, failure to document a latex allergy, and changing the nature of the planned surgery at the last minute are but a few of the potential reasons why an elective case may be delayed or cancelled. Ensuring that medical record documentation is complete and all appropriate preoperative testing including laboratory studies, imaging studies and medical clearance, etc. has been reviewed and included in the preadmission package is critical to avoid a last-minute cancellation. Equally important is confirming with the patient and family the date, time, and location of the procedure and any special preoperative instructions that may be unique to a given procedure. It should be clear who is responsible for this type of communication with patients prior to surgeries.
5. **Better estimates of operative time.** While it is not possible to eliminate all random events in during a procedure, one should make every attempt to do so. It is the responsibility of the surgeon to carefully review the patient's disease process and operative strategy at the time of scheduling and again prior to

the surgery to assess the potential for unexpected findings that may significantly prolong the procedure. Failure to consider potential random variables at the time of scheduling often leads to underestimating the length of the surgical procedure and the time allotted. The thoughtful surgeon will anticipate the need for specialized instrumentation, intraoperative imaging studies, frozen sections, and in certain situations the availability of a colleague in another specialty who may be called upon to assist in a challenging dissection. In addition, surgeons often are not trained to estimate the length of the entire time spent in the OR rather than just the "skin-to-skin" time. In fact, the OR time depends not just on the procedure but also the time spent positioning the patient, prepping and draping, and bandaging. In addition, the "anesthesia controlled time" (induction and emergence) can vary significantly depending on the nature of the anesthetic to be administered (local, regional, general). Studies have shown that neither surgeons nor anesthesiologists are particularly accurate in making such predictions, often leading to a case going far beyond the scheduled time and compromising the flow of the OR.[20] van Veen-Berkx and colleagues[21] showed that anesthesia-controlled time can easily account for 25 to 30 percent of the total procedure time,17 and developed predetermined time estimates for various anesthesia techniques that were then incorporated into the procedure time estimates given by the surgeon. In doing so, they noted fewer case cancellations, lower prediction errors and a smoother OR work flow in their organization.

6. **Improved team communication.** The introduction of the Comprehensive Surgery Check List in 2009[22] followed the World Health Organization's (WHO) efforts to ensure the safety of surgical patients worldwide by the adoption of guidelines that identified certain recommended practices.[23] When practiced diligently, it serves to control for as many of the non-random and random variables that may be associated with a given procedure, allowing the operating schedule to run smoothly. Careful and detailed communication with the anesthesiologist and nursing staff regarding unique patient characteristics and particular needs prior to the initiation of the operation, and again at the "time out" is "mandatory," but unfortunately, often performed in a perfunctory and inadequate way. The quality of the sign-in, the time-out and the sign-out or debriefing needs to be periodically surveyed by the OR leadership to be sure that the process is taken seriously and is not conducted in a perfunctory manner. Equally important to the pre-procedure interaction with all members of the team and the time-out prior to the surgical incision is the debriefing at the end of the procedure. It provides an opportunity to reinforce what went well and perhaps what did not, and to thank the operating room staff for their contribution to the success of the procedure. The amount of good will that is achieved by this expression of appreciation is enormous.

7. **Scheduling patterns.** In most institutions, scheduling patterns have historically been based upon surgeon preference and seniority – certain surgeons are assigned "block time", while others must compete for "open time" booking, and each surgeon typically works in the same OR throughout the day. A number of institutions are experimenting with data-driven approaches to revising or even breaking away from historical block assignments. Typically, blocks are reassigned based on recent trends in actual usage, with the expectation that allocations would be adjusted on an ongoing basis.[24] The concept of shared "flip" rooms (e.g. two surgeons rotating through three rooms, allowing for dramatically decreased turnover time) has been described to work well in certain situations.[25] In general, the availability of high-quality detailed data on utilization is making more sophisticated analytics and predictive models possible, creating flexibility while still matching the complexity and type of the case with appropriate room, equipment, staffing and availability of ancillary services such as blood bank and pathology.

8. **Expanding capacity.** While **a**dding additional operating rooms is generally not feasible within a short time frame, it may be possible to rethink the use of existing OR space. Perhaps a room can be dedicated to minor procedures that do not require general anesthesia. Perhaps space currently used by non-surgical proceduralists (e.g. endoscopy) can be incorporated into a dynamic scheduling process. Inpatient surgery should not compete with ambulatory cases and whenever possible, the main operating rooms should be limited to in-patients or ambulatory patients with specific risk factors that may place them at risk if performed in the ambulatory setting.

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9. **Detailed monitoring** is crucial to not only determine what specific issues are present in your institution, but also the ongoing impact of any changes. In order to be sure that there is a balance between supply and demand, it is imperative that meaningful **monitoring** be performed on a regular basis and the results reviewed in the appropriate setting. The composition of the monitoring committee and its leadership may vary depending on the nature of the organization (large academic medical center, a specialty organization, a large community hospital or a small rural facility). Regardless of the title an effective "perioperative service committee" must include representative leadership from surgery, anesthesia, and nursing, administration and, ideally, a surgical resident. Standard monitoring metrics include both surgeon specific and service specific data. First case delays, turnover time ("wheels out"/"wheels in"), delays due to availability of space in the PACU or SICU, cancellations, actual versus estimated duration of the case, delays due to lack of OR availability (particularly in cases that are urgent or emergent), delays due to surgeon unavailability and reasons for same, delays due to lack of required specialty equipment or specialty nurses, percent utilization of block time by surgeon and specialty, represent the majority of metrics that are available to evaluate the efficient and safe use of the operating room. The ability to gather and evaluate the above metrics will vary but clearly, this is an area where administrative support in mandatory to assure that appropriate IT systems are in place to collect the necessary data for analysis. Continued monitoring of these various metrics can lead to recommendations to administration regarding additional staffing (nursing, environmental, transport) and instrumentation. Physician specific issues (surgeon or anesthesiologist) must be addressed by the leadership of their respective departments.

C. DISCHARGE PLANNING

At the end of this section, the learner should be able to:

- Determine and document preoperative assessment of patient risk factors and how this might impact postoperative hospital discharge planning
- Understand the value and necessity of appropriate transitions of care from the inpatient hospitalization to the outpatient environment
- Consider the use of new technologies and how they can be utilized for appropriate postoperative follow-up

The length of a patient's hospital stay is a fundamental factor in the increasingly important and complex interplay between the quality of health care delivery, medical costs, and hospital readmissions. One potential unintended consequence of the push to limit readmissions would be if providers kept patients in the hospital for a longer period of time with the intent of lowering the risk of readmission.[26] The inpatient environment bolsters the intensity of care, and indeed longer hospital stays have been associated in some cases with a lower incidence of adverse outcomes leading to readmissions. However, the hospital is also an exceptionally expensive care delivery environment. In 2010, the average daily hospital charge per patient exceeded $7,000 and the total national bill for hospital charges for 39 million patients exceeded $1.28 trillion.[27] In addition, longer lengths of stay have been associated with higher rates of hospital acquired infections and other selected complications. The objective of decreasing medical costs, or at least reducing their outsized rate of increase, would seem to be well-served by reducing hospital length of stay (LOS) as well as unplanned readmissions. In 2010 for example, the average LOS was 4.7 days. It was estimated that reducing this by just 0.1 days, to an LOS of 4.6 days, would create savings in excess of $27 billion. However, a shorter LOS might lead to higher hospital readmission rates unless the quality of hospital discharge decision making is improved.

A recent study explored the criteria that surgeons preferentially value in their discharge decision-making process.[28] All surgical faculty and residents at a single academic institution were surveyed about the relative importance of specific criteria regularly used to make a discharge decision. Respondents reported significantly less reliance on common laboratory tests and patient demographics when making discharge decisions than on vital signs, perioperative factors, and functional criteria.

Surgeon-specific factors that influenced discharge criteria preferences included years of clinical education and gender. The study further identified subtle variations in preferences for specific criteria based on clinical education, gender, and race. The study concluded that surgeons use a wide-range of clinical data when making discharge decisions and further understanding the nature of these preferences may suggest novel ways of presenting discharge-relevant information to the clinical decision-makers in order to optimize discharge outcomes.

One way to address the problem of overspending on health care is to increase the value of health care delivery using health information technology to enhance the quality of information presented to providers and to provide decision support tools that help with complex decision making.[29,30] The Agency for Healthcare Research and Quality (AHRQ) has recently funded a program entitled Project RED (re-engineered discharge) which focuses on patient education as a means to facilitate successful hospital discharge **(Table 1, this page)**.[31] In a randomized trial by Jack et al., a nurse discharge advocate worked with patients during their hospital stay to arrange follow-up appointments, confirm medication reconciliation, and conduct patient education using an individualized instruction booklet that was then sent to their primary care provider.[32] A clinical pharmacist called patients 2 to 4 days after discharge to reinforce the discharge plan and review medications. Participants in the intervention group (n = 370) had a lower rate of hospital utilization than those receiving usual care (n = 368) (0.314 versus 0.451 visit per person per month; incidence rate ratio, 0.695 [95 percent CI, 0.515 to 0.937]; $P = 0.009$). The intervention was most effective among participants with hospital utilization in the six months before index admission ($P = 0.014$).

Table 1. ProjectRED Discharge Checklist

1. Reconcile medications
2. Reconcile discharge plan with national guidelines
3. Make followup appointments
4. Follow up on outstanding tests
5. Arrange postdischarge services
6. Create a written discharge plan
7. Inform patient what to do if problem arises
8. Educate patient
9. Assess patient understanding
10. Send discharge summary to primary care physician
11. Reinforce the discharge plan via telephone

Other studies have assessed the utility of our clinical decision making tools meant to assist physicians in making a discharge decision. In an effort to improve discharge communication and improve patient outcomes, a recent study performed a cluster-randomized trial to assess the value of discharge software embedded within computerized physician order entry (CPOE).[33,34] In summary, the CPOE software facilitated communication at the time of hospital discharge to patients, pharmacists and community physicians. While the software did not statistically reduce the rates of hospital readmission, ER visits, or adverse patient events, both patients and physicians perceived to have a more positive discharge experience than those patients who underwent a discharge without the software.

In summary, the transition from an inpatient hospital stay to outpatient care (whether that means home, a nursing facility, or rehabilitation), is a vulnerable time for all patients. The risks of poor communication between physicians, patients, hospital personnel, primary care physicians, and patient family members are high. The communication is often delayed, ineffective or inaccurate, and the result is often an adverse event for the patient. As surgeons who wish to improve the value of patient care, we must not only focus on hospital costs associated with faulty discharge planning, but also on the direct impact it might have on our patients.

Summary

As the primary providers of care to surgical patients, residents are quite familiar with many of the issues described above. They recognize the difficulty in "getting the patient through the system" or "getting the patient from the ER into the OR". They often develop creative ways in order to overcome the inefficiencies that they encounter. While many of these "workarounds" are seemingly effective in addressing a particular issue at a particular point in time, they are not true solutions to the underlying problems. It is imperative that residents appreciate that they are patient advocates, as well as care givers, and that the faculty and the departmental leadership expect them to come forward with observations without feeling intimidated. By participating in workgroups and performance improvement teams they will be able to embrace the concepts of systems-based practice that are discussed above. In doing so, they will become significant contributors to the process of assuring quality and safety for our patients.

Putting It All Together

Review the typical scenario below that highlights the relationship of the ER to the OR and how the efficiency with which this occurs influences the "throughput" of the patient in the system and the expectation of an uneventful outcome. Pretend that you are part of a multidisciplinary team that is evaluating the patient's experience from the time that he was admitted to the time he was discharged. The outcome turned out to

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be favorable but could have easily been compromised. Identify some of the random and nonrandom variables that were in play. Given what you have read in the above sections identify ways in which the process could be made more efficient and productive.

Scenario: *An elderly couple live independently in an apartment close to the regional hospital in a busy metropolitan city. The wife notices that her 80-year-old husband hasn't seemed to be himself over the last several days. His appetite started to decrease and he didn't want to get out of bed. He started to develop some vague abdominal discomfort and he "started to look ill". She contacted their PMD who advised them to call 911 and bring the patient to the ER in the hospital in which he is on the staff. The patient is known to have a history of hypertension and non-insulin dependent diabetes mellitus. He had a mild stroke several years ago, that left him with no significant residual effects. His medications include: amlodipine, atorvastatin and aspirin. It is a busy Monday morning and the ER is crowded.*

Start to think of the potential factors that will impact on the outcome of the patient as you read through the scenario. It has been broken down into individual time frames in order to facilitate your assessment.

1. The waiting room was crowded but the EMS technician spoke directly to the triage nurse and indicated that he brought in an elderly male who was ill and that the patient's wife was with them.

2. It is a busy Monday morning with at least 5 'boarders" from the weekend who have been admitted and are waiting for beds. Fortunately, there was a slot became available for the patient about 30 minutes after arriving to the ER and the patient was delivered to a quiet treatment room.

3. The nurse evaluating the patient is one with much ER experience and whose assessments are respected by the ER physicians. She wasted no time evaluating the patient and reporting the patient's status to the ER physician who directed the ER resident to see the patient first and report back to him.

4. The ER resident is a non-designated PGY1 on his first month of a 2- month rotation in the ER and is felt to be a solid resident but has acknowledged that he has limited experience working the ER environment. The patient is noted to be febrile to 102 with a blood pressure of 105/60 and pulse of 110. The patient is responsive and oriented and appears pale and dehydrated. During the examination, he elicits tenderness in the lower abdomen. IV resuscitation is initiated and blood work and blood cultures are drawn. Imaging studies are ordered including a chest x-ray and a flat plate. He reports his findings to the attending and indicates that he thinks the patient has "something going on in his abdomen but did not feel he had peritonitis at this point. The attending accepts the accuracy of the initial diagnostic and treatment plan and tells the resident to report back as soon as the labs and imaging studies are completed.

5. These return an hour later and reveal no evidence of pneumonia and no evidence of obvious bowel obstruction or free air. Although the blood pressure and pulse seem to be responding to fluid administration, it appears that the patient is becoming more uncomfortable and he now seems to have more abdominal tenderness.

6. The resident discusses the patient's status with the attending who evaluates the patient and determines that he needs to be seen by surgery and instructs the resident to contact the admitting surgical service to come and see the patient. He advises the resident to order a CT scan as he knows that "surgery will want it".

7. The ER resident pages the admitting surgical resident who indicates that he is stuck on the SICU stabilizing another patient and the rest of the team is in the OR, but indicates that he will come down to the ER as soon as he is available.

8. The radiology department is backed up and there is a delay of one hour before the scan can be completed. When completed it reveals evidence of thickening of the sigmoid colon and mesentery with some extraluminal air and contrast.

9. The surgical resident is recalled and alerted to the CT results. The surgical resident has finished stabilizing the SICU patient and now rushes to the ER to evaluate the patient and determines that surgical intervention will be required. At the same time antibiotics are initiated and the labs reassessed and appropriate adjustments made. He

alert's the patient and his wife and informs then that the patient will need surgical intervention and that he will contact his attending.

10. The surgical attending is in the OR performing a laparoscopic cholecystectomy on a patient of his that was admitted over the weekend and was able to "sneak onto the schedule". He indicates that he will be done soon but the case turned out to be more difficult than was anticipated.

11. The attending surgeon alerts the OR that there is a consult in the ER that will require surgery and will probably require a bowel resection. Fortunately, the surgeon had the one case that day and no scheduled office hours so he will be able to assume responsibility for the ER patient without having to cancel an elective case. In addition, a case in another room was cancelled unexpectedly and it will be possible for the case to be done after the room is set up.

12. The surgical resident introduces the attending to the patient and wife. He is noted to be an experienced member of the faculty with an excellent bed side manner and is able to have and a complete discussion with the patient and his wife in a non-threatening way, immediately winning over their confidence. He thoroughly explains regarding the need for surgical intervention and what the possible findings and surgical procedures may be. He indicates that he has been in contact with the patient's primary physician who still seeing patients in his office but that the PMD did review the patient's history with him and was able to provide some reassurance that the patient was compliant and reliable and that he had done a routine echocardiogram a year ago that revealed that the patient had an ejection fraction of 65 percent. The patient and wife are comforted by the surgeon's professionalism and reassurance and consent for an exploratory laparotomy and possible bowel resection.

13. The surgeon contacts the OR and is told that the room is prepared and the patient can be taken to the holding area. The patient is seen by the processing nurse who assures that all appropriate paper work is completed including consent and DNR status. The anesthesiologist assesses the patient and reviews anesthesia risks with the patient and wife and indicates that the patient will require general anesthesia and he may or may not leave the patient intubated at the end of the case.

14. The patient finally enters the OR 6 hours after arrival and undergoes a sigmoid resection with end colostomy and Hartman pouch for a perforated sigmoid diverticulitis. The surgery was expeditious and the patient stable throughout the procedure. He is left intubated on transfer to the PACU where he is noted to be hemodynamically stable, making adequate urine, and well oxygenated. There is a bed available in the step-down unit and it is felt that the patient does not require a SICU bed.

15. The patient goes on to recover slowly, but uneventfully without any superficial or deep space infection and is discharged to a subacute care facility on POD # 10. In the end, the patient and his wife are extremely pleased with the outcome and never complained about the amount of time that they had spent in the emergency room.

What are the potential factors that will impact on the outcome of the patient? What elements of the patient's care went well? What could be improved? What circumstances chance could have easily changed the outcome? What favorable qualities of the resident and surgery attending contributed to the patient and his wife being appreciative of the overall care that was provided.

After spending some time reflecting on the scenario review the interdependent factors that are linked to the various time frames of his care. Each is followed by some comments in italics that address some of the questions that are raised above. What else did you pick up on?

1. The effectiveness of the registration and triage process to timely identify the seriousness of the patient's condition and the acuity of emergency care that is required. *The patient was brought in by EMS, identifying him as a high-risk patient. The EMS technician alerted the triage nurse that the patient was ill and needed to be processed quickly.*

2. The current level of activity in the ER and availability of a bed*. The patient was fortunate that a bed became available relatively in spite of the fact that there were 5 boarders waiting to be admitted.*

3. Timeliness and accuracy of the initial assessment by the nursing staff and reporting of the patient's presence and status to the ER physician. *The level of experience of the ER staff varies in the ER as it does throughout the organization. She evaluated the patient efficiently and accurately and reported his status to the surgical resident. Suppose the*

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nurse was completing a long shift and had to stay over to help facilitate the throughput of the boarding patients as the nurse who was to relieve her had called in sick.

4. Quality of the medical assessment by ER resident including history and PE and initial differential diagnosis. *Although the ER resident was new to the service he was able to initiate the evaluation and treatment and interacted appropriately with the ER attending. Perhaps a more experienced resident would have picked up subtle abdominal findings that would have led to the surgical team being contacted sooner.*

5. Time to complete ordered labs and imaging studies. *Timely access to imaging studies in influenced by the number of patients requiring studies, the availability of radiology department to handle the volume, and the presence of a policy that allows accurate prioritization.*

6. Assessment by the ER attending. *Although the imaging studies did not identify the presence of a bowel obstruction or free air, he immediately identifies the patient as having an acute abdomen and instructs the ER resident to contact surgery. He also appreciates that surgery will want a CT and puts this into motion.*

7. Timeliness or alerting the surgical admitting team and the availability of the surgical consult resident. *Unfortunately, the reality is that surgical residents are often forced to address several issues at the same time. Perhaps the acuity of the patient's status was not accurately portrayed by the ER resident and the surgical resident felt he could finish what he was doing and then come down to the ER. By that time, the CT would probably be done and he would have more information to relay to his senior resident. The surgical resident could have alerted his senior resident at this time and indicated that there was a patient in the ER that needed to be seen "sooner rather than later" and the senior resident could have come down himself or dispatched another member to the team or another team.*

8. Ability of the radiology department to accommodate the patient. *The demand for advanced imaging of patients in the ER is high and it is unfortunate when the radiology suite has to deal with patients who have "non-urgent" problems but are forced to image patients in order to protect the organization from potential litigation if something is missed.*

9. Availability of the surgical resident. *It took the surgical resident longer to finish what he was doing on the SICU than expected and he is now concerned that the patient in the ER is sicker than it was initially suggested. He fears that his senior resident is going to be annoyed that he was not alerted sooner as his motto is "Never hesitate to call me when you need help. We are a team and must work together at all times."*

10. Availability of the surgical attending. *In spite of the fact that the attending on call had no elective cases or clinic responsibility on that day, consistent with departmental policy, he thought that he could take advantage of an available OR and "slip in" a patient known to him with chronic gallbladder disease who had come to the ER with another acute attack. Unfortunately, the case turned out to take longer than expected as the amount of inflammation was more than he had expected. In spite of the pressure of knowing that there was an elderly patient in the ER who needed surgery he was able to focus on the case at hand and completed the case without any complications.*

11. Availability of the OR to accommodate the case. *The attending surgeon alerted the OR that he had another case to do and felt "lucky" that the OR would be able to accommodate the case.*

12. The nature of the interaction of the attending with the patient and his wife. *The surgical attending is known for his bedside manner and ability to communicate effectively with patient, even those that he is meeting for the first time. He is able to be realistic regarding the risks and benefits of surgical intervention but is able to provide reassurance to the patient and his wife that he and his team will do everything they can to assure a favorable outcome. He takes the opportunity to describe what he means by "his team" and complements the competency of the anesthesiologist, the OR staff and the support staff.*

13. Availability of the OR. *The surgeon alerts the OR that the patient has signed consent and is told that the patient can be brought to the holding area almost 6 hours since he was admitted to the ER.*

14. The nature of the surgical event. *Fortunately, the patient had as sealed perforation and did not have significant intraabdominal spillage. The surgery was expeditious and completed within 2.5 hours. Although the patient is hemodynamically stable the surgeon and the anesthesiologist feel to be safe and delay extubation until the patient is observed in the PACU for a period of time where is subsequently extubated uneventfully and sent to a monitored bed.*

15. Uneventful postoperative recovery. *Although there were several bottlenecks during the time that the patient was in the ER, he went on to recover without the "usual" adverse events that are seen in such patients (pneumonia, sepsis, wound infection, deep space infection, etc. Throughout the course of the hospitalization the surgical team and the nursing staff were caring and supportive. When the patient was being prepared for discharge, the patient's wife commented that she couldn't wait to write a complementary letter to the president of the organization and noted that she was going to leave out the part relating to the ER, as she appreciated that it was an extremely hectic place and it appeared that everyone was working hard to facilitate the care of the patients there.*

RECOMMENDED READING

Graumlich JF, Novotny NL, Nace GS, Aldag JC. Patient and physician perceptions after software-assisted hospital discharge: Cluster randomized trial. *J Hosp Med.* 2009;4:356-363.

Jack BW, Chetty VK, Anthony D, et al. A reengineered hospital discharge program to decrease rehospitalization: a randomized trial. *Ann Intern Med.* 2009;150:178-87.

Leeds IL, Sadiraj V, Cox JC, Schnier KE, and Sweeney JF. Assessing clinical discharge data preferences among practicing surgeons. *The Journal of Surgical Research.* 2013;184(1):42-48.

Naylor MD, Brooten D, Campbell R, Jacobsen BS, Mezey MD, Pauly MV, Schwartz JS. Comprehensive discharge planning and home follow-up of hospitalized elders: A randomized clinical trial. *JAMA.* 1999;281:613-620.

SIDEBAR. TEACHING QUALITY: THE SYSTEMS-BASED PRACTICE COMPETENCY

The Accreditation Council on Graduate Medical Education (ACGME) has defined six core competencies for graduate medical education. This section focuses on **systems-based practice** (SBP).

The description of SBP given in the program requirements for general surgery states that "residents must demonstrate an awareness of and responsiveness to the larger context and system of health care, as well as the ability to call effectively on other resources in the system to provide optimal health care."[1] The expectation is that surgical residents will:

- Work effectively in various health care delivery settings and systems
- Coordinate patient care within the health care system
- Incorporate considerations of cost awareness and risk-benefit analysis in patient and/or population-based care as appropriate
- Advocate for quality patient care and optimal patient care systems
- Work in interprofessional teams to enhance patient safety and improve patient care quality
- Participate in identifying system errors; and implementing potential systems solutions
- Practice high quality, cost effective patient care
- Demonstrate knowledge of risk-benefit analysis
- Demonstrate an understanding of the role of different specialists and other health care professionals to overall patient management

This competency is broad and has many necessary components. Program directors and surgical educators have struggled to distinguish between the competencies of SBP and practice-based learning and improvement (addressed in Section IV of this manual). To address the confusion, a metaphor was developed by Ziegelstein and Fiebach in which practice-based learning and improvement is likened to a mirror, and systems-based practice is likened to a village.[2] The idea comes from the realization that continuous personal improvement requires self-reflection (in other words, looking in a mirror). Similarly,

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high-quality care requires teamwork and individuals working effectively together in an interdependent way. In other words, it takes a village (or team) to provide optimal outcomes.

The ACGME defines two practice domains that encompass systems-based practice: coordination of care and improvement of care.[3] In the **coordination of care** domain, the resident is expected to move from an understanding of the resources available for coordinating patient care (for example, social workers, visiting nurses, and physical and occupational therapists) to effectively coordinating these activities to ensure that the patient is safely discharged with whatever support is required. In the **improvement of care** domain, the resident moves from *understanding* of how health care systems and local processes can impact the delivery of care to *participating* in improvement activities and the development of standardized protocols.

1. The Accreditation Council for Graduate Medical Education (ACGME). Program Requirements for Graduate Medical Education in General Surgery. Available at: ACGME.org. Accessed June 13, 2017.

2. Ziegelstein RC, Fiebach NH. "The Mirror" and "the village": a new method for teaching practice-based learning and improvement and systems-based practice. Acad Med. 2004 Jan;79(1):83-88.

3. The Accreditation Council for Graduate Medical Education and the American Board of Surgery. The General Surgery Milestones Project. Available at: https://www.acgme.org/Portals/0/PDFs/Milestones/SurgeryMilestones.pdf. Accessed June 13, 2017.

A. VALUE: TEACHING HIGH-VALUE, COST-CONSCIOUS CARE

At the end of this section, the learner should be able to:

- Demonstrate basic knowledge about the issues of health care value, including costs, waste, and unnecessary and overused care
- Outline a framework for achieving high-value care
- Identify online resources that promote high-value care, such as the *Choosing Wisely®* campaign and the IDEAL framework

By 2020, it is predicted that nearly one out of every five dollars of U.S. gross domestic product will be spent on health care.[1] Rising health care costs have been blamed for a decade of stagnant income for the middle class and less money to spend on other national priorities.[2] By some estimates, nearly a third of health care spending is wasteful, the largest share coming from unnecessary and overused care, such as inappropriate use of diagnostic testing, avoidable hospitalizations, and avoidable complications of surgical care.[3-6] Physicians can have an impact on these factors by focusing on improving the value of care.[4,7]

At its heart, value is the "bang for your buck," or the good you expect from a product divided by the cost of purchasing it. In health care, value increases when better quality and outcomes are achieved for the same cost, or when the same results are achieved for less.[8] It should be noted that expensive health care services like surgery are considered high value when they provide an incremental increase in benefit. Fundamental to this movement is recognition of the responsibility that physicians have in addressing the cost issue. In fact, a new charter on medical professionalism for the new millennium, endorsed by the American College of Surgeons, includes an explicit obligation to consider societal goals, including the just distribution of finite resources.[9]

Graduate medical education has embraced the issues of cost and value. There is growing recognition that practice patterns are formed early, and that the training period is the time to influence physicians to practice high-value, cost-conscious care.[10] The High Value Care (HVC) curriculum jointly developed by the American College of Physicians (ACP) and the Alliance for Academic Internal Medicine (AAIM) addresses these issues but is not specific to surgical procedures.[11,12]

Whereas prevention and screening are key components of high-value care for trainees in all medical specialties, surgical residents have a unique challenge in making value-based decisions on the *appropriateness* of a surgical or procedural intervention, and in the context of continual surgical *innovation* and an ever-expanding array of technology, including new diagnostic tests, devices, implants, and prosthesis that are very costly and for which adequate evaluation in terms of effectiveness has not yet occurred. In addition, surgeons face a set of *barriers* to high-value care that may be different than other physicians, such as the fact that the cost of surgical interventions and their inevitable complications usually surpasses the cost of provision of care in medical settings.

Frameworks for Value Improvement

The frameworks listed in **Table 1,** this page, provide a basic approach to considering value when recommending a treatment plan for a given patient. As residents, you should apply these principles to the care that you provide (or are asked to provide) and ask questions when decision-making seems irrational.

Table 1. Frameworks for value-based decision-making

	Topic	Example Cases Included
1	Eliminating Healthcare Waste and Over-ordering of Tests	Headache, heart failure, deep venous thrombosis
2	Healthcare Costs and Payment Models	Appendicitis, sports injury, osteomyelitis
3	Utilizing Biostatistics in Diagnosis, Screening and Prevention	Chest pain, periodic health examination, chemoprevention
4	High Value Medication Prescribing	Seasonal allergies, discharge medication reconciliation
5	Overcoming Barriers to High Value Care	Low back pain, URI, septic joint
6	High Value Quality Improvement	

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Diagnostic Testing

The most basic and expensive services that residents often control are the use of laboratory and imaging studies. Residents should be trained to achieve more accurate and efficient diagnoses and improved patient outcomes by avoiding the harms associated with unnecessary testing and diagnostic delay. Content in this area will focus on understanding guidelines related to the *Choosing Wisely* lists of diagnostic tests endorsed by the American College of Surgeons (for example, avoiding routine use of preoperative chest radiography for patients with unremarkable history and physical exam).[14] (See Appendix 2.) Content will also include the use of clinically validated decision support tools such as those for diagnosis of deep vein thrombosis.[15,16]

Technology Assessment

As surgeons, we are driven to incorporate new technologies and procedures into practice to advance our specialty. The evidence base for new surgical innovations is often not very robust because new surgical techniques require continual improvisation and updating, including with new technologies and instrumentation, and are complicated by surgical learning curves and often a lack of agreed-upon outcomes of a surgical procedure.[17] While new techniques like robotic surgery offer promise, they often lack the same rigorous evaluation as drug treatments and therefore open themselves to criticism that the costs may not be worth the benefits.[18]

We must develop an improved approach to the evaluation of surgical techniques and devices. Recently, the IDEAL framework has been proposed as a methodology for evaluating new surgical innovations. The mnemonic IDEAL describes the stages of innovation: idea, development, exploration, assessment, and long-term study.[17-22] The ultimate goal is better evidence for the value of new technologies and techniques, but with the understanding that the process is different than for drugs and other treatments. Fried suggests that, when faced with the dilemma of whether to adopt a new idea or technique, the surgeon should ask four basic questions: (a) Does this innovation fulfill a clinical need? (b) Does it add value to the existing options? (c) Is it financially viable? and (d) Can it be adopted by the average surgeon with relative ease?[23]

Appropriateness of Surgical Procedures

The appropriateness of surgical procedures is another concept that impacts the delivery of high-value, cost-conscious care.[24] Unwarranted variations occur when interventions are either overused or underused. Various methods provide some guidance for providing the right treatment to the right patient at the right time. The decision whether or not to operate is always made between the surgeon and the patient, but better use of guidelines, appropriateness criteria, and decision-aids can improve these personalized decisions.[25-30]

Barriers

Barriers exist to the surgeon's interest in considering the value of the care provided especially when the quality of care they deliver is exceptional. Some obstacles include a lack of knowledge of costs, discomfort with diagnostic uncertainty, time pressures, and patient expectations that more care is better.[11] Additional barriers are that may affect surgeons include: misaligned financial incentives that reward the volume of procedures instead of their value and the implicit assumption that a procedure is indicated when a patient is referred to a surgeon, rather than the more neutral assumption that the surgeon is being called upon to evaluate the appropriateness of an operation for the patient. A lack of guidelines and poor data on the actual benefits and harms of surgical interventions may further cloud the judgment of value. Furthermore, defensive medicine may be even more prominent in surgical fields where the risk of facing a malpractice suit is considerably higher (even though few lawsuits actually lead to payment).[31,32] Finally, surgeons all too commonly face the patient or the family at a time when there is a serious illness or an important health decision to be made, and family or patients demand testing (and occasionally operations) that do not improve the outcome.

Conclusion

As residents, now is the time to start considering the value of the care you are providing and develop your thoughts on the surgeon's role in determining how to provide the best care for each individual patient you treat. Consider the services that you provide across the continuum of the patient experience, recognizing that the treatment that you provide will likely affect your patients' lives long after you complete your training. Ultimately remember that as physicians we want to provide good health, not just good health care.[33]

RECOMMENDED READING

Cooke M. Cost consciousness in patient care: what is medical education's responsibility? *N Engl J Med.* 2010;362: 1253-1255.

Fuchs VR. Eliminating "waste" in health care. *JAMA.* 2009;302:2481-2482.

Institute of Medicine. Best Care at Lower Cost: The Path to Continuously Learning Health Care in America. Washington, DC: National Academy Press, 2012.

Institute of Medicine. The Healthcare Imperative: Lowering costs and improving outcomes. Washington, DC: National Academies Press, 2010.

Porter ME. What is value in health care? *N Engl J Med.* 2010;363:2477-2481.

B. PATIENT-REPORTED OUTCOMES AND THE RECOVERY PERIOD

At the end of this section, the learner should be able to:

- Define patient-reported outcomes and Patient-Reported Outcome Measures
- Describe the three phases of recovery

As data become more widely available and analytic strategies become more sophisticated, it is increasingly important to realize how much our perspectives are shaped by what and how we measure. One clear example is how the development of patient-reported outcomes (PROs) is redefining our conceptions regarding the recovery period.

In 1958, Dr. Francis Moore described the process of surgical recovery as "the inter-locking physical, chemical, metabolic, and psychological factors commencing with the injury, or even slightly before the injury, and terminating only when the individual has returned to normal physical well-being, social and economic usefulness, and psychological habitus."[1] For decades, clinicians and outcomes researchers have struggled to normalize recovery as it is defined by patient's perception rather than objective means. This was evident in the randomized controlled trial comparing recovery in open colectomy and laparoscopic-assisted colectomy patients, where minimal differences in objective and/or quality of life differences were identified.[2] Identifying the point at which a person has returned to normal is not always readily apparent, especially when "normal" is so individualized.

Recovery is a multifaceted process, taking root in physical, physiologic, psychologic, social, and economic domains.[3] Although the definition of recovery remains loosely defined, input from patients during the recovery period can provide important information about the patient's actual recovery and better informs providers about their patients' experience after leaving the inpatient wards. Despite recovery being highly individualized, there are ways to quantify the patient's report that enables comparisons of a patient over time as well as comparison within groups of patients.

PROs are defined as any data about the patient's health condition that come directly from the patient.[4] They are measured through Patient-Reported Outcome Measures (PROMs). Therefore, PROMs can be used to collect meaningful data about a patient's recovery and help explain variation that exists in the recovery process. Information gained from patient input outlining how he or she feels and what he or she is able to do provides a means to approach the patient's complete experience and help define when the patient feels he or she has recovered.

Bridging the Gap between Registry Data and PROs

Traditionally, quality measures are derived from clinical outcomes that can be tracked through audit data and national data repositories like American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP®).[5] The metrics measuring postoperative recovery include hospital length of stay (LOS), readmissions, morbidity, mortality, and other biologic or physiologic parameters. The hallmark of these measurements is they are easily quantifiable and can be categorized to support the broad story of postoperative recovery.

Understanding the patient's experience with postoperative recovery could provide meaningful data and may improve the quality of postoperative care. Data from medical oncology literature suggest that patients experience significantly more symptoms than care providers expect.[6] Important postoperative outcomes, such as pain at discharge, postdischarge sleep, postoperative anxiety, financial and/or caregiver burden, and postoperative function are not measured using audit data.[7] Understanding the impact of these patient- centered outcomes gives important information to providers who can use these data to facilitate postoperative expectations prior to a surgical procedure and enables closer monitoring of patients after discharge.

PRO data describing surgical recovery is often obtained using generic health-related quality-of-life questionnaires. These measures were not developed with a postoperative cohort and may not be designed to detect meaningful changes during the postoperative period. Moreover, the

most important symptoms postoperatively are often not assessed on quality-of-life questionnaires. Thus, the content validity of these instruments in the context of surgical recovery is often unknown.[8] Measures designed to assess postoperative recovery must be easily attainable from patients at home and should be designed to capture how a patient experiences the process of recovery.

Current literature shows there is no perfect PROM that has been validated to evaluate postoperative recovery.[8,9] PROMs can act as meaningful tools to assess provider quality and performance, especially following procedures with low complication rates where the greatest variation in postoperative course may be due to individual patient experiences rather than biophysical markers. There is evidence that implementation of PROs varies across hospitals and between individual providers, but despite this variation PROs provide a sensitive assessment of provider performance.[10,11] This fact illustrates that despite imperfections in current PROs and implementation variation, PROs play a valuable role in providing important information for understanding the entire postoperative recovery trajectory.

Stages of Recovery and How PROs Can Help Define Recovery

Recovery is a generic process that all patients experience after having a surgical procedure. Although it is difficult to precisely define recovery, Lee and colleagues described three predictable stages of recovery that patients progress through, defining an early, intermediate, and late phase of recovery.[3] We have used these stages of recovery to develop a framework to guide use of PROs in understanding recovery.

Early-phase recovery can be thought of as postanesthesia care, where a patient recovers enough for safe transfer to a surgical ward. Evaluation of this stage is heavily informed by biologic and physiologic parameters like blood pressure, respiratory rate, or hematocrits. While limited, some items such as pain or anxiety could be considered PROs. Additionally, once the patient has recovered, it may be possible to evaluate the patient's experience regarding the effectiveness of various postoperative processes during early recovery, such as the provision of information after surgery to the patient and/or caregivers.

Intermediate phase recovery is described as the patient's time on the surgical ward until discharge. The threshold for patients to be discharged is typically defined by the ability to care for oneself at home. During this time, audit metrics such as LOS, complications, activities of daily living, and morbidity play a key role while biologic and physiologic measures may still be obtained. Opportunity for collection of PROs increases during this phase, as the patient is more alert and can describe aspects of physical and psychological state in the context of symptoms they experience following a surgical procedure. For example, mobilization is a vital part of a patient's recovery course that takes place during the intermediate phase of recovery. Patient concerns surrounding mobilization, such as pain, concerns about catheters or lines, anxiety about disturbing their surgical wound, and satisfaction with how care was coordinated can all be captured using PROs.

Late-phase recovery occurs after discharge from the hospital and continues until the patient feels he or she has returned to baseline function. This phase often lasts longer than clinicians anticipate because patients often define recovery as a lack of symptoms and the return of ability to perform previous activities as they could prior to surgery.[12] For example, a study by Mayo and colleagues found that less than 60 percent of patients had returned to their baseline walking capacity at three months after elective colorectal surgery.[13] Qualitative interviews with patients recovering from abdominal surgery and health care professionals reveal a surprising discordance when considering important concepts in surgical recovery, illustrating that what patient's value during recovery differs from what health care workers anticipate they will find important.[8]

The assessment of late recovery provides the most opportunity for collection of PROs. While functional capacity may be measured by the six-minute walk test, questionnaires, and the ability to perform ADLs, the results from these tests alone are not scalable and do not provide information about when the patient feels they have recovered completely. PROs may apply to a broader patient base and can be scaled to each individual patient's physical function. For example, you could still measure a patient's perceived improvement in walking even if they are not able to complete the six-minute walk test. Outcomes measuring recovery during this stage are amiable to measurement with PROs to describe the patients return of baseline physical, emotional, and social health.[3] By collecting PRO data in real time, we have the opportunity to use the data to make clinical care decisions, such as when the patient should return to work. By collecting the right data at the correct time, we gain information about the full scope of patient disability during the recovery period, and can gauge when actual "recovery" occurs. Additionally, we could measure long-term outcomes of patients even after they feel they have achieved recovery.

PRO Instruments Used to Evaluate Recovery

Currently there is no PRO or PROM that has been specifically developed to evaluate the postoperative recovery period. We have collated all the various PRO instruments reported in the last 10 years and identified subscales that may be useful in collecting meaningful data at the various phases of recovery (**Table 2, pages 80-83**). The strengths and weaknesses of each scale are identified. The number of instruments currently being used is a testament to the old adage that if there are multiple methods being used there is no perfect method. The use of specific subscales to test various phases is appealing but lacks psychometric validity.

There is a need for a PROM to assess postoperative recovery. The instrument would need to delineate between the anticipated recovery trajectory in a wide range of patient populations and procedures, including everything from a laparoscopic cholecystectomy to pancreaticoduodenectomy. The measures would need to be able to be captured electronically, be psychometrically sound, require minimal burden to patients, and be actionable. The potential role of PROMs with item response underpinnings is exciting, but to date has not been evaluated as a measure for the postoperative period and currently has not been validated to measure daily changes in the postoperative recovery period.

Future Steps for PROs in Postop Recovery

PROs provide an important bridge for innovative advancements in surgery such as enhanced recovery pathways, new procedures, and/or new technologies. While audit data show relatively few complications during this time, PROs may report the true trajectory of recovery.[8,10] Moreover, the engagement of patients during the postoperative recovery period may increase patient self-efficacy, decrease unnecessary health care utilization, and increase satisfaction with the surgical process. However, this process cannot be done without the proper tools, and further improvement is needed to validate and standardize PROs instruments. Instruments specifically tailored to measure surgical recovery are needed so that clinically relevant changes in the quality of recovery may be accurately measured. Overcoming technological barriers by creating an interface for patients to enter PRO data into their electronic health record and creating a way for clinicians to abstract data is an important step to the future of PROs. Standardized methods for integrating PROs into clinical workflow are needed and may create a potential shift in workflow, with data from patients being entered into the electronic health record, perhaps in real time.[14] While barriers exist, incorporating PROs into the postoperative period would likely improve surgical quality assessment in the postoperative period and provide a way to evaluate the true impact of advancements in the field of surgery.

C. SURGICAL PALLIATIVE CARE

At the end of this section, the learner should be able to:

- Summarize the guiding principles of surgical palliative care
- Describe the difference between palliative care and hospice services

Surgical palliative care is fundamentally the promotion of quality of life and the treatment of suffering (physical, psychological, social, and spiritual) in seriously or terminally ill surgical patients.[1] It is care provided in parallel with other medical treatment, not in replacement of other treatment. In contrast to hospice care (defined below), there are no specific qualifications required for a patient to receive palliative services, and all therapies, including surgical interventions, may be considered part of surgical palliative care depending on the specific case.[1]

In 2005, the American College of Surgeons (ACS) Task Force on Surgical Palliative Care and the Committee on Ethics put together a statement on the principles of surgical palliative care.[2] This statement specified 10 guiding principles to help physicians navigate the often-challenging issues that arise when discussing palliative care topics with patients, their caregivers, and other physicians and members of the medical team. They are as follows:

1. Respect the dignity and autonomy of patients, patients' surrogates, and caregivers.
2. Honor the right of the competent patient or surrogate to choose among treatments, including those that may or may not prolong life.
3. Communicate effectively and empathically with patients, their families, and caregivers.
4. Identify the primary goals of care from the patient's perspective, and address how the surgeon's care can achieve the patient's objectives.
5. Strive to alleviate pain and other burdensome physical and nonphysical symptoms.

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6. Recognize, assess, discuss, and offer access to services for psychological, social, and spiritual issues.
7. Provide access to therapeutic support, encompassing the spectrum from life-prolonging treatments through hospice care, when they can realistically be expected to improve the quality of life as perceived by the patient.
8. Recognize the physician's responsibility to discourage treatments that are unlikely to achieve the patient's goals, and encourage patients and families to consider hospice care when the prognosis for survival is likely to be less than a half-year.
9. Arrange for continuity of care by the patient's primary and/or specialist physician, alleviating the sense of abandonment patients may feel when "curative" therapies are no longer useful.
10. Maintain a collegial and supportive attitude toward others entrusted with care of the patient.

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The formal documentation of these principles marked the culmination of several decades of slow but steady increased acceptance of the concepts of palliative care as being important to incorporate into surgical training and, more importantly, surgical care.[1] While hospice and palliative medicine was only established as an official medical subspecialty as recently as 2006, the term palliative care was coined over 40 years ago by Balfour Mount, MD, a surgeon, when he discussed his belief that in situations of life-limiting illness, surgeons, patients, and families should assess interventions in terms of patient quality of life and decide jointly how to proceed with care.[1,3] Today, the field of palliative medicine has grown to tackle not only issues directly related to the end of life, but can also be employed to address pain and suffering related to a medical or surgical condition that occurs during any phase of life. As of 2014, there are 62 surgeons who have completed accredited fellowships in hospice and palliative medicine, and as of 2009 the ACS has established a handbook, *Surgical Palliative Care: A Resident's Guide*, that includes resident teaching modules focusing on many aspects pertinent to surgical palliative care.[4] Topics include delivering bad news, conducting a family conference, the surgeon-patient relationship, and managing symptoms like pain, dyspnea, delirium, and depression.[1]

Hospice, in contrast to palliative care, is a specific type of care for dying patients that falls under Medicare benefits. Hospice care is focused on symptom management, psychological and spiritual support for the patient and caregivers, and bereavement care.[1] Terminally ill patients with a prognosis of fewer than six months seeking palliation as opposed to curative treatments enter into hospice care with the support of a physician who attests to the terminal nature of the illness. Hospice care can be provided at home or in a hospital facility, and services include medications for symptom management, counseling, home health aides, medical equipment, and a variety of other support services. See page 218 of *Surgical Palliative Care: A Resident's Guide* for more information on hospice services and Medicare reimbursement.

Familiarity with surgical palliative care principles has grown increasingly important, as the percentage of the U.S. population over the age of 65 is projected to reach 83.7 million by 2050, which is double what it is today.[5] Yet while there has been increased focus on patient-centered care and appropriateness of surgical interventions at the end of life in patients with life-limiting illness, there has also been a paradoxical increase in aggressive end-of-life procedures in recent years.[6] Even though a majority of patients with terminal disease prioritize comfort and nonoperative treatment when faced with the choice of a high-burden procedure, studies show that upwards of 25 percent of patients with stage IV disease undergo an invasive intervention in the last month of life.[6,7] Patients who die in the hospital and intensive care unit (ICU) have worse quality of life than those who die at home, and their caretakers are at increased risk of posttraumatic stress disorder (PTSD), prolonged grief disorder, and other psychiatric illnesses.[8]

This dichotomy between the increased focus on surgical palliative care and aggressive, invasive care at the end of life has a potential negative impact on the quality of care delivered to the patient. There are many things residents and surgeons can do to help improve the patient experience and better understand the potential benefits of incorporating surgical palliative care concepts:

1. A recent study in the Veterans Health Administration population showed that surgical patients were less likely to receive palliative care or hospice services in the year preceding death than medical patients.[9] Surgical residents can work to change this pattern by enlisting the expertise of palliative consultation services more frequently and earlier in a patient's clinical course. Involving palliative care services earlier helps improve patient-centered care and symptom management, and helps change the perception that enlisting palliative services is equivalent to "giving up" on the patient.

2. Residents can familiarize themselves with the *ACS National Surgical Quality Improvement Project/ American Geriatric Society Best Practice Guidelines: Optimal Preoperative Assessment of the Geriatric Surgical Patient* guidelines which recommend discussion of patient expectations regarding possible treatment outcomes and goals of treatment as part of the routine preoperative assessment of all older adults.[10] Residents should revisit goals and expectations of treatments with patients frequently throughout the clinical course.

3. Residents and attending surgeons can utilize the preoperative visit (or preoperative inpatient encounter) to educate patients on advanced care planning, and importantly, help patients designate a health care proxy and discuss with the patient (and potentially the proxy) what kinds of scenarios may be encountered.[4] Less than 50 percent of terminally ill patients have advanced directives.[11] While advanced directives have inherent flaws, and can be challenging to implement, they do offer patients and providers an opportunity to think about what health care choices are consistent with patients' overall goals.[4,12]

4. Residents can read *Surgical Palliative Care: A Resident's Guide* (available at *facs.org/~/media/files/education/palliativecare/surgicalpalliativecareresidents.ashx)* and work through the modules individually or in small-group settings to further explore the issues of surgical palliative care. Residency programs can incorporate monthly discussions amongst residents about issues related to death and dying to help increase their comfort tackling the subjects with patients.[4]

In summary, surgical palliative care represents a broad range of services with the common goal of improving patient quality of life and reducing suffering for patients and caregivers. Aspects of palliative care services can be incorporated into many facets of surgical care, beginning in the outpatient setting with advanced care planning. Hospice is a specific Medicare designation for care provided to dying patients seeking palliative treatments only. Patient goals of care and expectations of treatment should be discussed thoroughly and revisited often through the care process.

RECOMMENDED READING

ACS *Surgical Palliative Care: A Resident's Guide.* Available at: https://www.facs.org/~/media/files/education/palliativecare/surgicalpalliativecareresidents.ashx. Accessed June 15, 2017.

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Table 2. Patient-reported outcome instruments and measurements by phase of recovery

PRO Instrument	Items	Design purpose	Validated for Surgical Recovery	X-scales	
Emphasis on Early Phase					
Aldrete Postanesthetic Recovery Score[15]	5	Assess acute postoperative recovery	Yes	Activity, Respiration, Circulation, Consciousness, Color	
Emphasis on Intermediate Phase					
Quality of Recovery-40[16-17]	40	Recovery from anesthesia and surgery	Yes	Patient support, Comfort, Emotions, Physiocal independence, Pain	
Gastrointestinal QoL Index[18]	36	QoL in patients with gastrointestinal disease.	Yes	Physical function, Social function, Emotional function, Symptoms, Subjective treatment assessment	
Abdominal Surgery Impact Scale[19]	18	QoL after abdominal surgery	Yes	Physical limitations, Functional Impairment, Pain, Visceral Function, Sleep, Psychological Function	
Quality of Recovery Score[20-22]	9	Quality of recovery post anesthesia and surgery	Yes	Not specifically categorized; encompasses emotional wellbeing, support from staff, understanding of instructions, able to independently use toilet, pain, nausea/vomiting	
Wolfer Davis Recovery Inventory[23]	8	Assess patients perioperative recovery`	Yes	Emotional, Physical	
Systemic Symptom Scale[24]	11	Systemic symptoms in patients hospitalized for stem cell transplant	No	Overall physical status, Overall emotional status, Energy level	
Emphasis on Late Phase					
PROMIS[25]	Varies	Assessment of symptoms and functions across all patient conditions	No	Global Health, Mental Health, Physcial Health, Social Health domains	
European Organization for Research and Treatment of Cancer QoL Questionnaire-C30[26]	30	QoL in cancer patients	No	Functional scales: physical cognitive, emotional, social Symptom scales: fatigue, pain, nausea/vomiting (n/v) Global health status / QoL scale	

	Early Phase	Intermediate Phase	Late Phase	Strengths	Limitations
	Activity, Respiration, Circulation, Consciousness, Color	Limited role	Limited role	Designed for acute recovery Brief to complete	Not true PROs insturment, requires provider interpertation
	Pain, physical comfort, anxiety	Pain, physical comfort, ADLs, support from staff, social support, emotional well being	Pain, physical comfort, ADLs, support from staff, social support, emotional well being	Well validated and designed for surgical patients	Length of questionnaire
	Limited role	Pain, abdominal discomfort, belching, flatulence, bowel movements, fatigue, nausea	pain, abdominal discomfort, bowel movements, appetite, emotional, sleep, physical endurance, sexual	Validated in patients following lap chole and colorectal surgery. Evaluates sexual symptoms	Lacks social evaluation Not designed specifically for postoperative recovery
	Pain, visceral function	Physical limitation, ADLs, pain, visceral function (appetite, thirst), sleep, psychological function	Physical limitation, ADLs, pain, visceral function (appetite, thirst), sleep, psychological function	Able to use in all three phases Designed specifically for surgical patients	Many questions not easily transferable to late stage
	pain, emotional wellbeing, understanding of instructions, support from staff	emotional, support from staff, understanding of instructions, able to independently use toilet, pain, n/v	pain, n/v, able to independently use toilet	Focuses on acute/early intermediate recovery Designed to assess quality of surgical recovery	Many questions not easily transferable to late stage
	Limited role	Anxiety, fear, physical condition	Limited role	Compares preoperative fear and anxiety with adjustment postoperatively	Not applied to patients in late phase
	pain	pain, physical status, emotional status, energy level, symptoms (n/v, diarrhea)	pain, physical status, emotional status, energy level, symptoms	Not validated in surgery patients	Not applied to patients in late phase
	symptoms, fatigue, pain	emotional distress, psychosocial impact, symptoms, fatigue, pain, mobility, sleep, support	cognative function, emotional distress, psychosocial impact, self-efficacy, symptoms, fatigue, pain, mobility, sexual function, sleep, social roles and activities, support	Highly psychometrically validated. Designed to apply to any procedure or population. Different short forms, computer adaptive tests, and item banks allow tailoring survey to population.	Not designed specifically for/ validated in surgical recovery
	Limited role	Pain, fatigue, n/v, dyspnea, some physical (out of bed, short walk)	Pain, fatigue, n/v, physical endurance, activity level, sleep, cognitive function, emotional, social, financial, overall QoL	Well validated Covers many concepts related to postoperative recovery	Not designed specifically for/ validated in surgical recovery

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Table 2. Patient-reported outcome instruments and measurements by phase of recovery (continued)

Short Form-36[27-28]	36	Medical Outcomes Study (MOS), mulit year multi site study to explain variation in patient outcomes	No	Physical activity, Social, Limitations in usual role activities, Pain, Mental health, Vitality (energy/ fatigue), General health perceptions	
EQ-5D[29]	26	Measurement of health outcomes	No	Mobility, Self-care, Usual acitivity, Pain, Anxiety/ depression, Overall health	
Surgical Recovery Scale[30]	13	Functional recovery following major surgery	Yes	Not stratified into specific categories; encompasses Energy, ADLs, IADLs, Social, Concentration	
Postdischarge Surgical Recovery Scale[31]	15	Postdischarge surgical recovery	Yes	Health status, Acitivity, Fatigue, Work ability, Expectations	
Baseline and Transition Index[32]	8	Transition back to patient's baseline status	Yes	Physical function, Mental function, Emotional function	
Community Health Activites Model Program for Seniors[33]	41	Estimate the time spent on activities the previous week	Yes	physical acitvity, physical endurance, social	
Spitzer Quality of Life Index[34]	5	QoL in cancer patients and patients with chronic disease	No	Activity, Daily living, Health, Social support, Outlook	
Cleveland Global QoL questionnaire[35]	3	QoL and functional outcome after restorative proctocolectomy with ileal pouch-anal anastomosis	Yes	QoL, Quality of health, Current energy level	
Home Recovery Log[36]	11	Recovery after discharge in gynecologic surgery patients	No	Pain, Fatigue, Functional limitations	

	Limited role	ADLs, IADLs	pain, fatigue, activity level, physical endurance, physical limitations, return to work, emotional, social, ADLs, IADLs, overall QoL	Asks patients to compare general health to 1 year prior for baseline Generic questions that can be generally applied to postop recovery Validate in colorectal surgery patients	Limited role in acute and intermediate postop due to questions being based on experience over the past 4 weeks Not designed specifically for surgical recovery
	Limited role	Mobility, self care, pain, anxiety/depression, overall health	Mobility, Self-care, Usual acitivity, Pain, Anxiety/ depression, Overall health	Well validated Covers many concepts related to postoperative recovery	Not designed specifically for/ validated in surgical recovery
	Limited role	Energy level, fatigue, ADLs, IADLs, social	Energy, fatigue, physical function, ADLs, IADLs, social, concentration	Validated in elective colon resection patients. Brief to complete Evaluates patients recollection of 'last two days'	Lacks emotional wellbeing
	Limited role	Limited role	Pain, activity, perception of recovery/return to baseline, mental well being	Designed specifically for surgical recovery	Not applicable to recovery while inpatient
	Limited role	activity, mental health, stress coping ability	activity, physical endurance, mental health, stress coping ability	Uniquely designed to evaluate transition to baseline Addresses stress coping	Lacks specific symptoms
	Limited role	physical activity	social, physical activitity, physical endurance	Validated to measure recovery after laparoscopic cholecystectomy Indepth assesment of activity	Designed for seniors Limited to activity evaluation; lacks emotional, physical function, symptoms, pain
	Limited role	activity, ADLs, social support, mental wellbeing, health	activity, ADLs, social support, mental wellbeing, health	Includes social support and outlook	May not be easily applied to the intermediate phase Not validated specifically for surgical patients
	Limited role	energy level	QoL, quality of health, energy level	Very brief	Does not address all aspects of recovery
	pain, fatigue	pain, fatigue, ADLs	pain, fatigue, ADLs	Designed specifically for surgical recovery Self reported by patients at home	Used only in ambulatory gynecologic laparoscopic patients to date Not validated

References

SECTION I: MAKING SENSE OF QUALITY AND SAFETY FROM THE RESIDENT PERSPECTIVE

1. https://www.google.com/search?client=safari&rls=en&q=definition+of+quality&ie=UTF-8&oe=UTF-8. Accessed May 8, 2014.
2. Donabedian A. Evaluating the quality of medical care. The Milbank Memorial Fund Quarterly. 1966;44(3) Pt. 2:166-203.
3. Institute of Medicine. To Err Is Human: Building a Safer Health System. Kohn LT, Corrigan JM, Donaldson MS, eds. Washington, DC: National Academy Press; 1999.
4. Institute of Medicine. 2001. Crossing the Quality Chasm: A New Health System for the 21st Century.Washington, DC: National Academy Press.
5. McDonald KM, Sundaram V, Bravata DM, et al. Closing the Quality Gap: A Critical Analysis of Quality Improvement Strategies (Vol. 7: Care Coordination). Rockville (MD): Agency for Healthcare Research and Quality (U.S.); 2007 Jun. (Technical Reviews, No. 9.7.)
6. Conceptual Frameworks and Their Application to Evaluating Care Coordination Interventions. Available at: http:// www.ncbi.nlm.nih.gov/books/NBK44008/.
7. Medicare.gov. Hospital-Acquired Conditions. Available at: http://www.medicare.gov/hospitalcompare/Data/Hospital-Acquired-Conditions.htm. Accessed November 14, 2013.
8. Weidmer BA, Brach C, Slaughter ME, Hays RD. Development of items to assess patients' health literacy experiences at hospitals for the Consumer Assessment of Healthcare Providers and Systems (CAHPS) Hospital Survey. *Med Care.* 2012 Sep;50(9 Suppl 2):S12-2.1.
9. Physician Quality Reporting System. Centers for Medicate & Medicaid Services. Available at: http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/PQRS/index.html?redirect=/PQRI/. Accessed December 2013
10. Centers for Medicare & Medicaid Services. Available at: www.cms.gov/Medicare/Medicare-Fee-for-ServicePayment/PhysicianFeedbackProgram/ValueBasedPaymentModifier.html. Accessed April 10, 2014.
11. Khuri SF, Daley J, Henderson WG, et al. The comparative assessment and improvement of quality surgical care in the Department of Veterans Affairs. *Arch Surg.* 2002;137:20-27.
12. Hunt JA. Assessing Physician Competency: An Update on the Joint Commission Requirement for Ongoing and Focused Professional Practice Evaluation. Advances in Anatomic Pathology. November 2012;19(6):388-400.
13. Makary MA, Wick E, Freischlag JA. PPE, OPPE, and FPPE Complying With the New Alphabet Soup of Credentialing. *Arch Surg.* 2011;146(6):642-644.
14. Medical Peer Review. American Medical Association. Available at: http://www.ama-assn.org//ama/pub/physician-resources/legal-topics/medical-peer-review.page#. Accessed December 2013.
15. Garcia N, Fogel S, Baker C, Remine S, Jones J. Should compliance with the surgical care improvement project (SCIP) process measures determine Medicare and Medicaid reimbursement rates? *The American Surgeon.* 2012;78(6):653-656.

SECTION II:FUNDAMENTALS OF SURGICAL QUALITY IMPROVEMENT

1. Hughes B, et al. Using Root-Cause Analysis to Improve Risk Management. *Professional Safety.* 2009 Feb;54-55.
2. Khorsandi M, et al. Quality review of an adverse incident reporting system and root cause analysis of serious adverse surgical incidents in a teaching hospital of Scotland. *Patient Safety in Surgery.* 2012;6:21.
3. Provost, L and Murray, S. The Health Care Data Guide: Learning from Data for Improvement. San Francisco: Jossey-Bass, 2011.
4. Fairbanks CB. Using Six Sigma and Lean methodologies to improve OR throughput. *AORN J.* 2007 Jul;86(1):73-82.
5. Chassin MR. Is Health Care Ready for Six Sigma Quality? Milbank Q. 1998;76(4):565-591, 51.
6. Frankel HL, et al. Use of corporate Six Sigma performance: improvement strategies to reduce incidence of catheter-related bloodstream infections in a surgical ICU. *J Am Coll Surg.* 2005 Sep;201(3):349-358.
7. Chassin MR. The Six Sigma initiative at Mount Sinai Medical Center. *Mt Sinai J Med.* 2008 Jan-Feb;75(1):45-52.
8. George M, et al. What is Lean Six Sigma? McGraw Hill Professional; Oct 27, 2003.
9. Ettinger WH. Six Sigma: Adapting GE's Lessons to Health Care Trustee. 2001 Sep;54(8):10-5, 1.
10. Adams R, et. Al. Decreasing Turnaround Time Between General Surgery Cases. *J Nurs Adm.* 2004 Mar;34(3):140-148.
11. Mazzacato P, et al. Lean Thinking in Healthcare: A Reaslist Review of the Literature. *Qual Saf Health Care.* 2010;19:376-382.
12. Seidl K, et al. The Intersection of Evidence-Based Practice With 5 Quality Improvement Methodologies. *JONA.* 2012;42(6):299-304.
13. Waldhausen JHT, et al. Application of lean methods improves surgical clinic experience. *Journal of Pediatric Surgery.* 2010;45:1420-1425.
14. Kim C, et al. Lean Health Care: What Can Hospitals Learn from a World-Class Automaker? *Journal of Hospital Medicine.* 2006;1:191-199.
15. Courtney W et al. Lean principles optimize on-time vascular surgery operating room starts and decrease resident work Hours. *J Vasc Surg.* 2013;1-5.
16. Settles C. Meaningful Use in 2015: A History of Meaningful Use. 2015; http://technologyadvice.com/blog/healthcare/history-of-meaningful-use-2015/. Accessed January 3, 2017.
17. Blumenthal D, Tavenner M. The "Meaningful Use" Regulation for Electronic Health Records. *The New England Journal of Medicine.* 2010;363(6):501-504.

References

18. McCullough JS, Casey M, Moscovice I, Prasad S. The effect of health information technology on quality in U.S. hospitals. *Health Aff (Millwood).* 2010;29(4):647-654.

19. Black AD, Car J, Pagliari C, et al. The impact of eHealth on the quality and safety of health care: a systematic overview. *PLoS Med.* 2011;8(1):e1000387.

20. Weis JM, Levy PC. Copy, paste, and cloned notes in electronic health records: prevalence, benefits, risks, and best practice recommendations. *Chest.* 2014;145(3):632-638.

SECTION III: BUILDING A CULTURE OF SAFETY

Developing a Culture of Safety

1. Ruggieri, P. Confessions of a Surgeon: The Good, the Bad, and the Complicated... Life Behind the O.R. Doors. Berkley Press: 2012.

2. Zohar D, Livne Y, Tenne-Gazit O, Admi H, Donchin Y. Healthcare climate: a framework for measuring and improving patient safety. *Crit Care Med.* 2007; 35:1312-1317.

3. Schein EH. Organizational Culture and Leadership. 4th ed. Hoboken, NJ: Jossey-Bass; 2010.

4. Pronovost PJ, Berenholtz SM, Goeschel CA, Needham DM, Sexton JB, Thompson DA, et al. Creating high reliability in health care organizations. *Health Serv Res.* 2006; 41:1599-1617.

5. Mardon RE, Khanna K, Sorra J, Dyer N, Famolaro T. Exploring relationships between hospital patient safety culture and adverse events. *J Patient Saf.* 2010 Dec;6(4):226-232.

6. Institute of Medicine. To Err Is Human: Building a Safer Health System. Washington, DC: National Academy Press; 1999.

7. Abstoss KM, Shaw BE, Owens TA, Juno JL, Commiskey EL, Niedner MF. Increasing medication error reporting rates while reducing harm through simultaneous cultural and system-level interventions in an intensive care unit. *BMJ Qual Saf.* 2011 Nov;20(11):914-922.

8. Brilli RJ, McClead RE Jr, Crandall WV, Stoverock L, Berry JC, Wheeler TA, Davis JT. A comprehensive patient safety program can significantly reduce preventable harm, associated costs, and hospital mortality. *J Pediatr.* 2013 Dec;163(6):1638-1645.

9. Hempel S, Maggard-Gibbons M, Nguyen DK, et al. Wrong-site surgery, retained surgical items, and surgical fires. *JAMA Surg.* 2015;150(8):796-805.

10. Mardon RE, Khanna K, Sorra J, et al. Exploring relationships between hospital patient safety culture and adverse events. *J Patient Saf.* 2010;6:226–232.

11. Birkmeyer NJ, Finks JF, Greenberg CK, et al. Safety culture and complications after bariatric surgery. *Ann Surg.* 2013;257:260–265.

Teamwork

1. Institute of Medicine. To Err Is Human: Building a Safer Health System. Washington, DC: National Academy Press; 1999.

2. Sutcliffe KM. High reliability organizations (HROs). *Best Pract Res Clin Anaesthesiol.* 2011;25:133-144.

3. Cima RR, Deschamps C. Role of the surgeon in quality and safety in the operating room environment. *Gen Thorac Cardiovasc Surg.* 2013 Jan;61(1):1-8.

4. Suresh G, Horbar JD, Plsek P, Gray J, Edwards WH, Shiono PH, Ursprung R, Nickerson J, Lucey JF, Goldmann D. Voluntary anonymous reporting of medical errors for neonatal intensive care. *Pediatrics.* 2004;113:1609.

5. El-Dawlatly AA, Takrouri MS, Thalaj A, Khalaf M, Hussein WR, El-Bakry A. Critical incident reports in adults: an analytical study in a teaching hospital. *Middle East J Anesthesiol.* 2004;17:1045-1054.

6. Pronovost PJ, Thompson DA, Holzmueller CG, Lubomski LH, Dorman T, Dickman F, Fahey M, Steinwachs DM, Engineer L, Sexton JB, Wu AW, Morlock LL. Toward. Learning from patient safety reporting systems. *J Crit Care.* 2006;21:305-315.

7. Lingard L, Espin S, Whyte S, Regehr G, Baker GR, Reznick R, Bohnen J, Orser B, Doran D, Grober E. Communication failures in the operating room: an observational classification of recurrent types and effects. *Qual Saf Health Care.* 2004;13:330-334.

8. Wiegmann DA, ElBardissi AW, Dearani JA, Daly RC, Sundt TM. Disruptions in surgical flow and their relationship to surgical errors: an exploratory investigation. *Surgery.* 2007;142:658-665.

9. Catchpole KR, Giddings AE, Wilkinson M, Hirst G, Dale T, de Leval MR. Improving patient safety by identifying latent failures in successful operations. *Surgery.* 2007;142:102-110.

10. Sorbero ME, Farley DO, Mattke S, Lovejoy SL. Outcome measures for effective teamwork in inpatient care: final report. Santa Monica: RAND Corporation; 2008.

11. Agency for Healthcare Research and Quality. TeamSTEPPS instructor guide. Rockville: AHRQ; 2006 (AHRQ publication no. 06-0020-0).

12. Alonso A, Baker DP, Holtzman A, Day R, King HB, Toomey LM, et al. Reducing medical error in the military health system: how can team training help? *Hum Resour Manag Rev.* 2006;16:396-415.

13. King HB, Battles J, Baker DP, et al. TeamSTEPPS™: Team Strategies and Tools to Enhance Performance and Patient Safety. In: Henriksen K, Battles JB, Keyes MA, et al., eds. Advances in Patient Safety: New Directions and Alternative Approaches (Vol. 3: Performance and Tools). Rockville (MD): Agency for Healthcare Research and Quality (US); 2008 Aug. Available from: http://www.ncbi.nlm.nih.gov/books/NBK43686/. Accessed June 19, 2017.

14. 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;37:1553-1581.

15. Wolf FA, Way LW, Stewart L. The efficacy of medical team training: improved team performance and decreased operating room delays; a detailed analysis of 4863 cases. *Ann Surg.* 2010;252:477-485.

16. Flin R, Yule S, McKenzie L, Paterson-Brown S, Maran N. Attitudes to teamwork and safety in the operating theatre. 2006;4:145-151.

17. Wauben LSGL, Doorn CM, Wijngaarden JD, Goossens RH, Huijsman R, Klein J, et al. Discrepant perceptions of communication, teamwork and situation awareness among surgical team members. *Int J Qual Health Care.* 2011;23:159-166.

18. Stogdill RM. Personal factors associated with leadership: a survey of the literature. *J Psychol.* 1948;25:35-71.

Handoffs

1. Philibert I, Friedmann P, Williams WT. New requirements for resident duty hours. *JAMA.* 2002;288:1112.

2. Nasca TJ, Day SH, Amis ES Jr. The new recommendations on duty hours from the ACGME Task Force. *N Engl J Med.* 2010;363:e3.

3. DeRienzo CM, Frush K, Barfield ME, et al. Handoffs in the era of duty hours reform: a focused review and strategy to address changes in the Accreditation Council for Graduate Medical Education Common Program Requirements. *Acad Med.* 2012;87:403.

4. Mueller SK, Call SA, McDonald FS, Halvorsen AJ, Schnipper JL, Hicks LS. Impact of resident workload and handoff training on patient outcomes. *Am J Med.* 2012;125:104-110.

5. The Joint Commission. Sentinel events statistics. Available at: http://www.jointcommission.org/sentinel_event.aspx. Accessed October 14, 2013.

6. Gawande AA, Zinner MJ, Studdert DM, Brennan TA. Analysis of errors reported by surgeons at three teaching hospitals. *Surgery.* 2003;133(6):614-621.

7. Greenberg CC, Regenbogen SE, Studdert DM, et al. Patterns of communication breakdowns resulting in injury to surgical patients. *J Am Coll Surg.* 2007;204:533.

8. Accreditation Council for Graduate Medical Education. Common program requirements. Available at: http://www.acgme.org/acgmeweb/Portals/0/dh_dutyhoursCommonPR07012007.pdf;2010. Accessed October 14, 2013.

9. Date DF, Sanfey H, Mellinger J, Dunnington G. Handoffs in general surgery residency, and observation of intern and senior residents. *Am J Surg.* 2013 Sept 12.

10. Schoenfeld AR, Al-Damluji MS, Horwitz LI. Sign-out snapshot: cross-sectional evaluation of written sign-outs among specialties. *BMJ Qual Saf.* 2013 Aug 30.

11. Starmer AJ, Spector ND, Srivastava R, et al. Changes in Medical Errors after Implementation of a Handoff Program. *N Engl J Med.* 2014;371(19):1803–1812.

Medication Reconciliation

1. Joint Commission 2005 National Patient Safety Goals; Medication Reconciliation. Available at: http://www.fojp.com/Focus_2005_1.pdf. Accessed October 14, 2013.

2. Resar RK. Medication safety interface: medication reconciliation. In: Proceedings of the International Summit on Patient Safety. 2002.

3. Vira T, Colquhoun M, Etchells E. Reconcilable differences: Correcting medication errors at hospital admission and discharge. *Qual Saf Health Care.* 2006 April;15(2):122-126.

4. Forster AJ, Murff HJ, Peterson JF, et al. The incidence and severity of adverse events affecting patients after discharge from the hospital. *Ann Intern Med.* 2003;138:161-167.

5. Forster A J, Clark H D, Menard A, et al Adverse events among medical patients after discharge from hospital. *Can Med Assoc J.* 2004;170:345-349.

6. Baker G R, Norton P G, Flintoft V, et al The Canadian Adverse Events Study: the incidence of adverse events among hospital patients in Canada. *Can Med Assoc J.* 2004;170:1678- 1686.

7. Bates D W, Boyle D L, Vander Vliet M B, et al. Relationship between medication errors and adverse drug events. *J Gen Intern Med.* 1995;101;99-205.

8. Wilson R M, Runciman W B, Gibberd R W, et al The quality in Australian health care study. *Med J Aust.* 1995;163:458- 471.

9. Thomas E J, Studdert D M, Burstin H R, et al. Incidence and types of adverse events and negligent care in Utah and Colorado. *Med Care.* 2000;38;261-271.

10. Rozich J D, Resar K R. Medication safety: one organization's approach to the challenge. *J Clin Outcomes Manage.* 2001;827-834.

11. Rozich JD, Howard RJ, Justeson JM, et al. Patient safety standardization as a mechanism to improve safety in health care. *Jt Comm J Qual Saf.* 2004;30(1):5-14.

12. Pronovost P, Weast B, Schwarz M, et al Medication reconciliation: a practical tool to reduce the risk of medication errors. *J Crit Care.* 2003;18:201-205.

13. Lau HS, Florax C, Porsius AJ, et al. The completeness of medication histories in hospital medical records of patients admitted to general internal medicine wards. *Br J Clin Pharmacol.* 2000;49(6):597-603.

Surgical Checklist

1. Gawande AA, Zinner MJ, Studdert DM, Brennan TA. Analysis of errors reported by surgeons at three teaching hospitals. *Surgery.* 2003;133(6):614-621.

2. Lossius HM, Heltne JK, Brattebø G. Implementation of checklists in health care; learning from high-reliability organizations. *Scand J Trauma Resusc Emerg Med.* 2011;19:53-59.

References

3. Haynes AB, Weiser TG, Berry WR, Lipsitz SR, Breizat AH, Dellinger EP, et al. A surgical safety checklist to reduce morbidity and mortality in a global population. *N Engl J Med.* 2009;360:491-499.

4. Cima RR, Deschamps C.Role of the surgeon in quality and safety in the operating room environment. *Gen Thorac Cardiovasc Surg.* 2013 Jan;61(1):1-8.

5. Pronovost P, Needham D, Berenholtz S, Sinopoli D, Chu H, Cosgrove S, et al. An intervention to decrease catheter-related bloodstream infections in the ICU. *N Engl J Med.* 2006;355:2725-2732.

6. Pronovost PJ, Goeschel CA, Colantuoni E, Watson S, Lubomski LH, Berenholtz SM, et al. Sustaining reductions in catheter related bloodstream infections in Michigan intensive care units: observational study. *BMJ.* 2010;340:c309-315.

7. Verdaasdonk E, Stassen L, Widhiasmara P, Dankelman J. Requirements for the design and implementation of checklists for surgical processes. *Surg Endosc.* 2009;23:715-726.

8. Schimpff SC. Improving operating room and perioperative safety: background and specific recommendations. *Surg Innov.* 2007;14:127-135.

9. Brennan, Troyen A.; Leape, Lucian L.; Laird, Nan M, et al. Incidence of Adverse Events and Negligence in Hospitalized Patients. *N Eng J Med.* 1991;324(6):370-376.

Patient Education

1. American Hospital Association. A patient's bill of rights. Available at: http:// www.patienttalk.info/AHA-Patient_Bill_of_Rights.htm. Accessed 09/26, 2013.

2. Brenner LH, Brenner AT, Horowitz D. Beyond informed consent educating the patient. *Clinical Orthopedics and Related Research.* 2009;467:348-351.

3. Irador DO. Informed consent for surgery: A historical review. *West African Journal of Medicine.* 2006;25(4):301-304.

4. Chan Y, Irish JC, Wood SJ, et al. Patient education and informed consent in head and neck surgery. *Archives of Otolaryngology-Head and Neck Surgery.* 2002;128(11):1269-1274.

5. The Doctors Company. Effective informed consent- fostering a dialogue. Available at: http://www.thedoctors.com/KnowledgeCenter/PatientSafety/articles/CON_ID_004878. Accessed 10/26, 2013.

6. Falagas ME, Korbila IP, Giannopoulou KP, Kondilis BK, Peppas G. Informed consent: How much and what do patients understand? *American Journal of Surgery.* 2009;198(3):420-435.

7. Williams S, Haskard K, DiMatteo M. The therapeutic effects of the physician-older patient relationship: Effective communication with vulnerable older patients. *Clinical Interventions in Aging.* 2007;2(3):453-467.

8. Shokrollahi K. Request for treatment: The evolution of consent. *Annals of the Royal College of Surgeons of England.* 2010;92:93-100.

9. Ronco M, Iona L, Fabbro C, Bulfone G, Palese A. Patient education outcomes in surgery: A systematic review from 2004 to 2010. *International Journal of Evidenced-Based Healthcare.* 2012;10:309-323.

10. Suhonen R, Leino-Kilpi H. Adult surgical patients and the information provided to them by nurses: A literature review. *Patient Education and Counseling.* 2006;61:5-15.

11. American College of Surgeons: Surgical Patient Education. Ten questions to ask before having an operation. Available at: http://www.facs.org/patienteducation/patient-resources/surgery/tenquestions.html. Updated 2008. Accessed October 14, 2013.

12. Keulers BJ, Scheltinga MRM, Houterman S, Van Der Wilt GJ, Spauwen PHM. Surgeons underestimate their patients' desire for preoperative information. *World Journal of Surgery.* 2008;32:964-970

13. Jacobs V. Informational needs of surgical patients following discharge. *Applied Nursing Research.* 2000;13(1):12-18.

14. American Medical Association. Health literacy program. Available at: http:// www.ama-assn.org/ama/pub/about-ama/ama-foundation/our- programs/public-health/health-literacy-program.page. Updated 2013. Accessed October 11, 2013.

15. Miller MJ, Abrams MA, Earles B, Phillips K, McCleeary EM. Improving patient-provider communication for patients having surgery: Patient perceptions of a revised health literacy-based consent process. *Journal of Patient Safety.* 2011;7:30-38.

16. National Assessment of Adult Literacy. Basic reading skills and the literacy of America's least literate adults: Results from the 2003 national assessment of adult literacy. . 2009;Supplemental Studies.

17. My Byline Media. Readability formulas. Available at: http://www.readabilityformulas.com/free-readability-formula-tests.php. Updated 2013. Accessed October 14, 2013.

18. National Assessment of Adult Literacy. A nationally representative and continuing assessment of English language literacy skills of American adults. Available at: https://nces.ed.gov/naal/.2011. Updated 2011. Accessed September 13, 2013.

19. U.S. Department of Education, National Institute of Literacy. Illiteracy statistics. Available at: http://www.statisticbrain.com/number-of-american-adults-who-cant-read/. Updated April 28, 2013. Accessed October 14, 2013.

Professionalism

1. Medical professionalism in the new millenium: a physician charter. *J Am Coll Surg.* 2003;196: 115-118.

2. Code of professional conduct. *J Am Coll Surg.* 2003;197: 603-604.

3. Whittemore AD. The impact of professionalism on safe surgical care. *J Vasc Surg.* 2007;45: 415-419.

4. Rosenstein AH, O'Daniel M. A survey of the impact of disruptive behaviors and communication defects on patient safety. *Jt Comm J Qual Patient Saf.* 2008;34: 464-471.

5. Smith I. The Joint Commission guide to improving staff communication. Oakbrook Terrace, IL: Joint Commission Resources, 2005.

6. Rosenstein AH, O'Daniel M. Impact and implications of disruptive behavior in the perioperative arena. *J Am Coll Surg.* 2006;203: 96-105.

7. Bosk C. Forgive and Remember: Managing Medical Failure. Chicago, IL: University of Chicago Press, 1979.

8. Hutter MM, Rowell KS, Devaney LA, et al. Identification of surgical complications and deaths: an assessment of the traditional surgical morbidity and mortality conference compared with the American College of Surgeons National Surgical Quality Improvement Program. *J Am Coll Surg.* 2006;203: 618-624.

The Modern Morbidity and Mortality Conference

1. Mitchell E, et al. Improving the Quality of the Surgical Morbidity and Mortality Conference: A Prospective Intervention Study. *Acad Med.* 2013 Jun;88(6):824-830.

2. Hutter M. et al. Identification of Surgical Complications and Deaths: An Assessment of the Traditional Surgical Morbidity and Mortality Conference Compared with the American College of Surgeons-National Surgical Quality Improvement Program. *J Am Coll Surg.* 2006;203:618-624.

3. Kim M. et al. Improvement in Educational Effectiveness of Morbidity and Mortality Conferences with Structured Presentation and Analysis of Complications. *J Surg.* 2010 67:400-405.

4. McVeight T, et al. Increasing Reporting of Adverse Events to Improve the Educational Value of the Morbidity and Mortality Conference. *J Am Coll Surg.* 2013;216:50-56.

5. Orlander J. et al. The Morbidity and Mortality Conference: The Delicate Nature of Learning from Error. *Acad. Med.* 2002;77:1001-1006.

6. Pierlussi E, et al. Discussion of Errors in Morbidity and Mortality Conference. *JAMA.* 2003;290:2838-2842.

7. Murayama KM, et al. A critical evaluation of the morbidity and mortality conference. *Am J Surg.* 2002 Mar;183(3):246-250.

8. Johna S, et al. Patient safety in surgical residency: root cause analysis and the surgical morbidity and mortality conference–case series from clinical practice. *Perm J.* 2012 Winter;16(1):67-69.

9. Mitchell EL, et al. SBAR M&M: A feasible reliable and valid tool to assess the quality of surgical morbidity and mortality conference presentations. *Am J Surg.* 2012 Jan;203(1):26-31.

SECTION IV: PUTTING QUALITY INTO PRACTICE

Developing a Quality Curriculum at an Independent Academic Medical Center

1. Leenstra JL, et al, Validation of a method for assessing resident physicians' quality improvement proposal. *Journal Gen Int Med.* 2007;22(9):1330-1334.

Venous Thromboembolism

1. Gould MK, Garcia DA, Wren SM, Karanicolas PJ, Arcelus JI, Heit JA, et al. Prevention of VTE in nonorthopedic surgical patients: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest.* 2012;141(2 Suppl):e227S-77S. Epub 2012/02/15.

2. Hirsh J. The treatment of venous thromboembolism. Nouvelle revue francaise d'hematologie. 1988;30(3):149-53. Epub 1988/01/01.

3. Bell WR, Simon TL. Current status of pulmonary thromboembolic disease: pathophysiology, diagnosis, prevention, and treatment. *American Heart Journal.* 1982;103(2):239-62. Epub 1982/02/01.

4. Dunmire SM. Pulmonary embolism. Emergency medicine clinics of North America. 1989;7(2):339-54. Epub 1989/05/01.

5. Agnelli G, Bolis G, Capussotti L, Scarpa RM, Tonelli F, Bonizzoni E, et al. A clinical outcome-based prospective study on venous thromboembolism after cancer surgery: the @RISTOS project. *Annals of Surgery.* 2006;243(1):89-95. Epub 2005/12/24.

6. van der Meer FJ, Koster T, Vandenbroucke JP, Briet E, Rosendaal FR. The Leiden Thrombophilia Study (LETS). Thrombosis and haemostasis. 1997;78(1):631-5. Epub 1997/07/01.

7. Sabiston DC, Jr. Pathophysiology, diagnosis, and management of pulmonary embolism. *American journal of surgery.* 1979;138(3):384-391. Epub 1979/09/01.

8. Kakkar VV, Stringer MD. Prophylaxis of venous thromboembolism. *World journal of surgery.* 1990;14(5):670-678. Epub 1990/09/01.

9. Zhan C, Miller MR. Excess length of stay, charges, and mortality attributable to medical injuries during hospitalization. *JAMA.* 2003;290(14):1868-1874. Epub 2003/10/09.

10. Guyatt GH, Akl EA, Crowther M, Gutterman DD, Schuunemann HJ. Executive summary: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest.* 2012;141(2 Suppl):7S-47S. Epub 2012/03/15.

11. Rogers SO, Jr., Kilaru RK, Hosokawa P, Henderson WG, Zinner MJ, Khuri SF. Multivariable predictors of postoperative venous thromboembolic events after general and vascular surgery: results from the patient safety in surgery study. *Journal of the American College of Surgeons.* 2007;204(6):1211-21. Epub 2007/06/05.

12. Caprini JA. Thrombosis risk assessment as a guide to quality patient care. Disease-a-month: DM. 2005;51(2-3):70-8. Epub 2005/05/19.

13. Bates SM, Jaeschke R, Stevens SM, Goodacre S, Wells PS, Stevenson MD, et al. Diagnosis of DVT: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest.* 2012;141(2 Suppl):e351S-418S. Epub 2012/02/15.

References

14. Kearon C, Kahn SR, Agnelli G, Goldhaber S, Raskob GE, Comerota AJ. Antithrombotic therapy for venous thromboembolic disease: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition). *Chest.* 2008;133(6 Suppl):454S-545S. Epub 2008/07/24.

15. Kearon C, Akl EA, Comerota AJ, Prandoni P, Bounameaux H, Goldhaber SZ, et al. Antithrombotic therapy for VTE disease: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest.* 2012;141(2 Suppl):e419S-94S. Epub 2012/02/15.

Urinary Tract Infection

1. Saint S. Clinical and economic consequences of nosocominal catheter-related bacteriuria. *American Journal Infection Control.* 2000;28:68-75.

2. Saint S, Kowalski CP, Kau.fman SR et al. Preventing hospital-acquired urinary tract infection in the United States: a national study. *Clin Infect Dis.* 2008;46:243-250.

3. Stephan F, Sax H, Wachsmuth M et al. Reduction of urinary tract infection and antibiotic use after surgery: a controlled, prospective, before-after intervention study. *Clin Infect Dis.* 2006;42:1544-1551.

4. Wald HL, Ma A, Bratzler DW, Kramer AM. Indwelling urinary catheter use in the postoperative period: analysis of the national surgical infection prevention project data. *Arch Surg.* 2008;143:551-557.

5. Klevens RM, Edwards JR, Richards CL, Jr, et al. Estimating health care-associated infections and deaths in U.S. hospitals, 2002. *Public Health Rep.* 2007;122:160-166.

6. Cox CE. Nosocomial urinary tract infections. *Urology.* 1988;32:210-215.

7. Kalinin M. American College of Surgeons National Surgical Quality Improvement Project Return on Investment Calculator. Available at: http://www.acsnsqip.org/ROICalc/.2007. Accessed August 30, 2011.

8. Tambyah PA, Knasinski V, Maki DG. The direct costs of nosocomial catheter-associated urinary tract infection in the era of managed care. *Infect Control Hosp Epidemiol.* 2002;23:27-31.

9. Berenguer CM, Ochsner MG, Jr., Lord SA, Senkowski CK. Improving surgical site infections: using National Surgical Quality Improvement Program data to institute Surgical Care Improvement Project protocols in improving surgical outcomes. *J Am Coll Surg.* 2010;210:737-741, 741-733.

10. Bratzler DW. The Surgical Infection Prevention and Surgical Care Improvement Projects: promises and pitfalls. *Am Surg.* 2006;72:1010-1016; discussion 1021-1030, 1133-1048.

11. Springer R. The Surgical Care Improvement Project-focusing on infection control. *Plast Surg Nurs.* 2007;27:163-167.

12. Surgical Care Improvement Project: Summary of Changes for 10-01-2009 through 03-31-2010. In Centers for Medicare and Medicaid Services. Available at: www.qualitynetorg. Accessed June 19, 2017.

13. Owen RM, Perez SD, Bornstein WA, Sweeney JF. Impact of surgical care improvement project inf-9 on postoperative urinary tract infections: do exemptions interfere with quality patient care? *Arch Surg.* 2012;147:946-953.

14. Darrah DM, Griebling TL, Silverstein JH. Postoperative urinary retention. *Anesthesiol Clin.* 2009;27:465-484, table of contents.

15. Dolin SJ, Cashman JN. Tolerability of acute postoperative pain management: nausea, vomiting, sedation, pruritus, and urinary retention. Evidence from published data. *Br J Anaesth.* 2005;95:584-591.

16. Zaouter C, Kaneva P, Carli F. Less urinary tract infection by earlier removal of bladder catheter in surgical patients receiving thoracic epidural analgesia. *Reg Anesth Pain Med.* 2009;34:542-548.

17. Marret E, Remy C, Bonnet F. Meta-analysis of epidural analgesia versus parenteral opioid analgesia after colorectal surgery. *Br J Surg.* 2007;94:665-673.

18. Basse L, Werner M, Kehlet H. Is urinary drainage necessary during continuous epidural analgesia after colonic resection? *Reg Anesth Pain Med.* 2000;25:498-501.

19. Benoist S, Panis Y, Denet C et al. Optimal duration of urinary drainage after rectal resection: a randomized controlled trial. *Surgery.* 1999;125:135-141.

20. Givens CD, Wenzel RP. Catheter-associated urinary tract infections in surgical patients: a controlled study on the excess morbidity and costs. *J Urol.* 1980;124:646-648.

Readmissions

1. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *N Engl J Med.* 2009;360:1418-1428.

2. Centers for Medicare and Medicaid Services Office of Information Products and Data Analysis. "National Medicare Readmission Findings: Recent Data and Trends." Available at: . Accessed online December 2012.

3. The Patient Protection and Affordable Care Act. 111th United States Congress. March 23, 2010.

4. Centers for Medicare and Medicaid Services. "Hospital Inpatient Prospective Payment Systems for Acute Care Hospitals and the Long-Term Care Hospital Prospective Payment System and Fiscal Year 2013 Rates." Federal Register August 31, 2012:77(170). Available at: http://www.gpo.gov/fdsys/pkg/FR-2012-08-31/pdf/2012-19079.pdf. Accessed November 2012.

5. Birkmeyer JD, Gust C, Baser O et al. Medicare payments for common inpatient procedures: implications for episode-based payment bundling. *Health Serv Res.* 2010;45:1783-1795.

6. Porter ME. A strategy for health care reform: toward a value-based system. *N Engl J Med.* 2009;361:109-112.

7. Kassin MT, Owen RM, Perez SD et al. Risk factors for 30-day hospital readmission among general surgery patients. *J Am Coll Surg.* 2012;215:322-330.

8. Lucas DJ, Haider A, Haut E, et al. Assessing readmission after general, vascular, and thoracic surgery using ACS-ACS NSQIP. *Ann Surg.* 2013;258:430-439.

SECTION V: CREATING AN EFFICIENT SYSTEM FOR PATIENT CARE

1. Oxford University Press. Available at: www.oxforddictionaries.com. Accessed May 30, 2017.
2. Johnson J, Miller S, Horowitz SD. Systems-Based Practice: Improving the Safety and Quality of Patient Care by Recognizing and Improving the Systems in Which We Work. (In Advances in Patient Safety: New Directions and Alternative Approaches (Vol.2: Culture and Redesign) Agency for Healthcare Research and Quality; 2008 August. Battles, H., JB Keyes, et al, eds.
3. Vincent C, Moorthy K, Darzi A. Systems Approaches to Surgical Quality and Safety. From Concept to Measurement. *Annals of Surgery.* 2004;239(4):475-482.
4. Weick KE, Sutcliffe KM. 2007. Managing the Unexpected. 2nd ed. San Francisco: Jossey-BassThe Accreditation Council for Graduate Medical Education (ACGME). Program Requirements for Graduate Medical Education in General Surgery. ACGME.org.
5. Chassin MR, Loeb JM. High-Reliability Health Care: Getting There from Here. The Joint Commission. The Millbank Quarterly. 2013: Vol. 91 (3), 459-490. Also available at www.jointcommission.com.
6. Shortell SM, Singer SJ. Improving Patient Safety by Taking Systems Seriously. *JAMA.* 2008;299(4):445-447.
7. American Academy of Emergency Medicine. Available at: www.aaem.org/em-resources/position-statements. 2005.
8. American Academy of Emergency Medicine. Available at: www.aaem.org/em-resources/position-statements. 2006.
9. Pines JM, Isserman JA, Kelly JJ. Perceptions of Emergency Department Crowding in the Commonwealth of Pennsylvania. *West J Emerg Med.* 2013. February;14(1):1-10.
10. Taubman SL, Allen HL, Wright BJ, Baicker K, Finkelstein A. Medicaid Increases Emergency-Department Use: Evidence from Oregon's Health Insurance Experiment. Science 2014; Vol.343, #6168 (263-268).
11. New England Healthcare Institute (now known as the Network for Excellence in Health Innovation) A Matter of Urgency: Reducing Emergency Department Overuse. A NEHI Research Brief. March 2010. Available at: http://www.nehi.net.
12. Hoot N, Aronsky D. Systematic Review of Emergency Department Crowding: Causes, Effects, and Solutions. Annals of Emergency Medicine. Volume 52, No.2, August 2008. (125–136).
13. Improving the Efficiency of Hospital-Based Emergency Care. The National Academies Press. 2007.
14. Eitel DR, Rudkin SE, Malvehy MA, Killeen JP, Pines JM. Improving service quality by understanding emergency department flow: a White Paper and position statement prepared by the American Academy of Emergency Medicine. *J Emergency Medicine.* 2010;38:70-79.
15. Sun B, et al. Effect of Emergency Department Crowding on Outcomes of Admitted Patients. *Annals of Emerg Med.* 2013;61(6):605-611.
16. ACEP. Emergency Department Crowding: High-Impact Solutions. September 8, 2009. Available at: http://www.acep.org/WorkArea/downloadasset.aspx?id=37960.
17. Baker S, Esbenshade, A. Partnering Effectively with Inpatient Leaders for Improved Emergency Department Throughput. *Advanced Emergency Nursing Journal.* 2015;Vol 37, No.1, pp.65-71.
18. Cima RR, et al. Use of Lean and Six Sigma Methodology to Improve Operating Room Efficiency in a High-Volume Teriary Care Academic Medical Center. *J Am Coll Surgery.* 2011;213:83-94.
19. Smith CD, Spackman T, Brommer K, Stewart MW, Vizzini M, Frye J, Rupp WC. Re-Engineering the Operating Room Using Variability Methodology to Improve Health Care Value. *J Am Coll Surg.* 2013; 216:559-570.
20. Ehrenwerth J, Escobar A, Davis EA, et al. Can the attending anesthesiologist accurately predict the duration of anesthesia induction? *Anesth Analg.* 2006; 103:938-940.
21. van Veen-Berkx, et al. Scheduling Anesthesia Time Reduces Case Cancellations and Improves Operating Room Workflow in a University Hospital Setting. *J Am Coll Surg.* 2016:223:343-351.
22. Haynes AD, et al. A Surgical Safety Checklist to Reduce Morbidity and Mortality in a Global Population. *N Engl J.Med.* 2009;360:491-499. January 29, 2009.
23. World Alliance for Patient Safety. WHO Guidelines for Safe Surgery. Geneva: World Health Organization, 2008.
24. Patterson P. Seeking a cure for ASCs' block schedule gridlock. OR Manager 2011; 27:11.
25. Story P. *Optimizing Your Capacity to Care: A Systems Approach to Hospital and Population Health Management.* CRC Press: 2016.
26. Centers for Medicare and Medicaid Services. Readmissions Reduction Program. http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html. Accessed May 1, 2013.
27. U.S. Department of Health and Human Services Agency for Healthcare Research and Quality. "HCUP Nationwide Inpatient Sample." Available at: http://hcupnetahrq.gov/HCUPnetjsp. Accessed online December 2012.
28. Leeds IL, Sadiraj V, Cox JC, et al. Assessing clinical discharge data preferences among practicing surgeons. *J Surg Res.* 2013;184:42-48 e43.
29. Porter ME. A strategy for health care reform—toward a value-based system. *N Engl J Med.* 2009; 361:109-112.
30. Porter ME. What is value in health care? *N Engl J Med.* 2010;363:2477-2481.
31. Agency for Healthcare Research and Quality. "Re-engineered discharge project dramatically reduces return trips to the hospital." Available at: http://www.ahrq.gov/research/mar11/0311RA1.htm. Accessed May 16, 2012.
32. Jack BW, Chetty VK, Anthony D, et al. A reengineered hospital discharge program to decrease rehospitalization: a randomized trial. *Ann Intern Med.* 2009;150:178-187.

References

33. Graumlich JF, Novotny NL, Nace GS, Aldag JC. Patient and physician perceptions after software-assisted hospital discharge: cluster randomized trial. *J Hosp Med.* 2009; 4: 356-363.

34. Graumlich JF, Novotny NL, Stephen Nace G et al. Patient readmissions, emergency visits, and adverse events after software-assisted discharge from hospital: cluster randomized trial. *J Hosp Med.* 2009;4:E11-19.

SECTION VI: CONTINUING THE CONVERSATION: EMERGING AREAS IN QUALITY AND SAFETY

Value: Teaching High-Value, Cost-Conscious Care to Surgical Residents

1. Keehan SP, Sisko AM, Truffer CJ, et al. National health spending projections through 2020: economic recovery and reform drive faster spending growth. *Health Aff (Millwood).* 2011;30:1594-1605.

2. Emanuel EJ, Fuchs VR. Who really pays for health care? The myth of "shared responsibility". *JAMA.* 2008;299: 1057-1059.

3. Institute of Medicine. The Healthcare Imperative: Lowering costs and improving outcomes. Washington, DC: National Academies Press, 2010.

4. Fuchs VR. Eliminating "waste" in health care. *JAMA.* 2009;302:2481-2482.

5. Berwick DM, Hackbarth AD. Eliminating Waste in US Health Care. 2012;307:1513-1516.

6. Institute of Medicine. Best Care at Lower Cost: The Path to Continuously Learning Health Care in America. Washington, DC: National Academy Press, 2012.

7. Emanuel EJ, Steinmetz A. WIll physicians lead on controlling health care costs? *JAMA.* 2013;310:374-375.

8. Porter ME. What is value in health care? *New England Journal of Medicine.* 2010;363:2477-2481.

9. Medical professionalism in the new millenium: a physician charter. *J Am Coll Surg.* 2003;196:115-118.

10. Cooke M. Cost consciousness in patient care–what is medical education's responsibility? *N Engl J Med.* 2010;362:1253-1255.

11. American College of Physicians. High Value Care Curriculum. Available at: http://hvc.acponline.org/curriculum.html.

12. Smith CD. Teaching high-value, cost-conscious care to residents: the Alliance for Academic Internal Medicine-American College of Physicians Curriculum. *Ann Intern Med.* 2012;157:284-286.

13. Patel MS, Davis MM, Lypson ML. The VALUE Framework: training residents to provide value-based care for their patients. *J Gen Intern Med.* 2012;27:1210-1214.

14. American College of Surgeons. Choosing Wisely.

15. Wells PS, Anderson DR, Rodger M, et al. Evaluation of D-dimer in the diagnosis of suspected deep-vein thrombosis. *N Engl J Med.* 2003;349:1227-1235.

16. Yamaki T, Nozaki M, Sakurai H, Takeuchi M, Soejima K, Kono T. Prospective evaluation of a screening protocol to exclude deep vein thrombosis on the basis of a combination of quantitative D-dimer testing and pretest clinical probability score. *J Am Coll Surg.* 2005;201:701-709.

17. McCulloch P, Cook JA, Altman DG, Heneghan C, Diener MK. IDEAL framework for surgical innovation 1: the idea and development stages. *BMJ.* 2013;346: f3012.

18. Ergina PL, Cook JA, Blazeby JM, et al. Challenges in evaluating surgical innovation. *Lancet.* 2009;374:1097-1104.

19. The IDEAL Collaboration. Available at: http://www.ideal-collaboration.net/framework/.

20. Cook JA, McCulloch P, Blazeby JM, Beard DJ, Marinac-Dabic D, Sedrakyan A. IDEAL framework for surgical innovation 3: randomised controlled trials in the assessment stage and evaluations in the long term study stage. *BMJ.* 2013;346: f2820.

21. Ergina PL, Barkun JS, McCulloch P, Cook JA, Altman DG. IDEAL framework for surgical innovation 2: observational studies in the exploration and assessment stages. *BMJ.* 2013;346: f3011.

22. Hirst A, Agha RA, Rosin D, McCulloch P. How can we improve surgical research and innovation? The IDEAL framework for action. *Int J Surg.* 2013;11:1038-1042.

23. Fried GM. The challenges of change: presidential address to the 69th annual meeting of the Central Surgical Association Madison, Wisconsin, March, 2012. *Surgery.* 2012;152:509-516.

24. Lee CN, Ko CY. Beyond outcomes–the appropriateness of surgical care. *JAMA.* 2009;302:1580-1581.

25. Fitch K, Bernstein SJ, McDonnell J, Kahan JP. The RAND / UCLA Appropriateness Method User's Manual. http://www.rand.org/content/dam/rand/pubs/monograph_reports/2011/MR1269.pdf: RAND Corporation, 2001.

26. Lawson EH, Gibbons MM, Ko CY. Appropriate use of surgical procedures for patients with cancer. *Surg Oncol Clin N Am.* 2012;21:479-486, ix.

27. Yermilov I, McGory ML, Shekelle PW, Ko CY, Maggard MA. Appropriateness criteria for bariatric surgery: beyond the NIH guidelines. *Obesity* (Silver Spring). 2009;17: 1521-1527.

28. Waljee JF, Rogers MA, Alderman AK. Decision aids and breast cancer: do they influence choice for surgery and knowledge of treatment options? *J Clin Oncol.* 2007;25: 1067-1073.

29. Makary Ma, Segev DL, Pronovost PJ, et al. Frailty as a predictor of surgical outcomes in older patients. *J Am Coll Surg.* 2010;210:901-908.

30. Bilimoria KY, Liu Y, Paruch JL, et al. Development and evaluation of the universal ACS NSQIP surgical risk calculator: a decision aid and informed consent tool for patients and surgeons. *J Am Coll Surg.* 2013;217:833-842 e831-833.

31. Jena AB, Seabury S, Lakdawalla D, Chandra A. Malpractice risk according to physician specialty. *N Engl J Med.* 2011;365:629-636.

32. Minami CA, Chung JW, Holl JL, Bilimoria KY. Impact of Medical Malpractice Environment on Surgical Quality and Outcomes. *J Am Coll Surg.* 2013.

33. Asch DA, Volpp KG. What business are we in? The emergence of health as the business of health care. *N Engl J Med.* 2012;367:888-889.

34. Choosing Wisely Campaign. Available at: http://www.choosingwisely.org. Accessed May 10, 2013.

35. Teaching Value Project. Available at: http://www. teachingvalue.org.

Patient-Reported Outcomes and the Recovery Period

1. Moore FD. Getting well: the biology of surgical convalescence. *Ann N Y Acad Sci.* 1958;73:387–400.

2. Stucky C-CH, Pockaj BA, Novotny PJ, *et al*. Long-term follow-up and individual item analysis of quality of life assessments related to laparoscopic-assisted colectomy in the COST trial 93-46-53 (INT 0146). *Ann Surg Oncol.* 2011;18:2422–2431.

3. Lee L, Tran T, Mayo NE, Carli F, Feldman LS. What does it really mean to "recover" from an operation? *Surgery.* 2014;155:211–216.

4. Basch E, Torda P, Adams K. Standards for Patient-Reported Outcome–Based Performance Measures. *JAMA.* 2013;310:139–140.

5. Birkmeyer JD. Progress and challenges in improving surgical outcomes. *Br J Surg.* 2012;99:1467–1469.

6. Di Maio M, Basch E, Bryce J, Perrone F. Patient-reported outcomes in the evaluation of toxicity of anticancer treatments. *Nat Rev Clin Oncol.* 2016;13:319–325.

7. Perelman J, Closon M-C. Impact of socioeconomic factors on in-patient length of stay and their consequences in per case hospital payment systems. *J Health Serv Res Policy.* 2011;16:197–202.

8. Lee L, Dumitra T, Fiore JF, Mayo NE, Feldman LS. How well are we measuring postoperative "recovery" after abdominal surgery? *Qual Life Res Int J Qual Life Asp Treat Care Rehabil.* 2015;24:2583–2590.

9. Kluivers KB, Riphagen I, Vierhout ME, Brölmann HAM, de Vet HCW. Systematic review on recovery specific quality-of-life instruments. *Surgery.* 2008;143:206–215.

10. Waljee JF, Ghaferi A, Cassidy R, *et al.* Are Patient-Reported Outcomes Correlated with Clinical Outcomes After Surgery? A Population-Based Study. *Ann Surg.* 2016;264:682–689.

11. Gutacker N, Bojke C, Daidone S, Devlin N, Street A. Hospital variation in patient-reported outcomes at the level of EQ-5D dimensions: evidence from England. *Med Decis Mak Int J Soc Med Decis Mak.* 2013;33:804–818.

12. Kleinbeck SV, Hoffart N. Outpatient recovery after laparoscopic cholecystectomy. *AORN J.* 1994;60:394, 397–398, 401–402.

13. Mayo NE, Feldman L, Scott S, et al. Impact of preoperative change in physical function on postoperative recovery: argument supporting prehabilitation for colorectal surgery. *Surgery.* 2011;150:505–514.

14. Basch E. Patient-Reported Outcomes: Harnessing Patients' Voices to Improve Clinical Care. *N Engl J Med.* 2017;376:105–108.

15. Aldrete JA, Kroulik D. A postanesthetic recovery score. *Anesth Analg.* 1970;49:924–934.

16. Myles PS, Weitkamp B, Jones K, Melick J, Hensen S. Validity and reliability of a postoperative quality of recovery score: the QoR-40. *Br J Anaesth.* 2000;84:11–15.

17. Myles PS, Hunt JO, Fletcher H, Solly R, Woodward D, Kelly S. Relation between quality of recovery in hospital and quality of life at 3 months after cardiac surgery. *Anesthesiology.* 2001;95:862–867.

18. Eypasch E, Williams JI, Wood-Dauphinee S, *et al.* Gastrointestinal Quality of Life Index: development, validation and application of a new instrument. *Br J Surg.* 1995;82:216–222.

19. Urbach DR, Harnish JL, McIlroy JH, Streiner DL. A measure of quality of life after abdominal surgery. *Qual Life Res Int J Qual Life Asp Treat Care Rehabil.* 2006;15:1053–1061.

20. Myles PS, Hunt JO, Nightingale CE, *et al.* Development and psychometric testing of a quality of recovery score after general anesthesia and surgery in adults. *Anesth Analg.* 1999;88:83–90.

21. Myles PS, Reeves MD, Anderson H, Weeks AM. Measurement of quality of recovery in 5672 patients after anaesthesia and surgery. *Anaesth Intensive Care.* 2000;28:276–280.

22. Wu CL, Rowlingson AJ, Partin AW, *et al.* Correlation of postoperative pain to quality of recovery in the immediate postoperative period. *Reg Anesth Pain Med.* 2005;30:516–522.

23. Wolfer JA, Davis CA. Assessment of surgical patients' preoperative emotional condition and postoperative welfare. *Nurs Res.* 1970;19:402–414.

24. Prieto JM, Atala J, Blanch J, et al. Psychometric study of quality of life instruments used during hospitalization for stem cell transplantation. *J Psychosom Res.* 2004;57:201–211.

25. van der Meij E, Huirne JA, Bouwsma EV, et al. Substitution of Usual Perioperative Care by eHealth to Enhance Postoperative Recovery in Patients Undergoing General Surgical or Gynecological Procedures: Study Protocol of a Randomized Controlled Trial. *JMIR Res Protoc.* 2016;5:e245.

26. Aaronson NK, Ahmedzai S, Bergman B, et al. The European Organization for Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. *J Natl Cancer Inst.* 1993;85:365–376.

27. Ware JE, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care.* 1992;30:473–483.

28. Antonescu I, Carli F, Mayo NE, Feldman LS. Validation of the SF-36 as a measure of postoperative recovery after colorectal surgery. *Surg Endosc.* 2014;28:3168–3178.

29. EuroQol Group. EuroQol–a new facility for the measurement of health-related quality of life. *Health Policy Amst Neth.* 1990;16:199–208.

References

30. Paddison JS, Sammour T, Kahokehr A, Zargar-Shoshtari K, Hill AG. Development and validation of the Surgical Recovery Scale (SRS). *J Surg Res.* 2011;167:e85-91.

31. Kleinbeck SV. Self-reported at-home postoperative recovery. *Res Nurs Health.* 2000;23:461–472.

32. MacKenzie CR, Charlson ME, DiGioia D, Kelley K. A patient-specific measure of change in maximal function. *Arch Intern Med.* 1986;146:1325–1329.

33. eldman LS, Kaneva P, Demyttenaere S, Carli F, Fried GM, Mayo NE. Validation of a physical activity questionnaire (CHAMPS) as an indicator of postoperative recovery after laparoscopic cholecystectomy. *Surgery.* 2009;146:31–39.

34. Spitzer WO, Dobson AJ, Hall J, *et al.* Measuring the quality of life of cancer patients: a concise QL-index for use by physicians. *J Chronic Dis.* 1981;34:585–597.

35. Fazio VW, O'Riordain MG, Lavery IC, *et al.* Long-term functional outcome and quality of life after stapled restorative proctocolectomy. *Ann Surg.* 1999;230:575-584-586.

36. Horvath KJ. Postoperative recovery at home after ambulatory gynecologic laparoscopic surgery. *J Perianesthesia Nurs Off J Am Soc PeriAnesthesia Nurses.* 2003;18:324–334.

Surgical Palliative Care

1. Dunn G, Martensen R, Weissman D. Surgical palliative care: a resident's guide. American college of surgeons Chicago: Cuniff-Dixon Foundation. 2009:107-32.

2. Bulletin of the American College of Surgeons. Vol.90, No. 8, August 2005.

3. Barbas A, Zani, S. Education, Training, and Certification in Palliative Surgery and Surgical Palliative Care. J Palliative Care Med 2012, S2. Available at: http://dx.doi.org/10.4172/2165-7386.S2-002. Accessed May 1, 2017.

4. Cooper Z, Courtwright A, Karlage A, Gawande A, Block S. Pitfalls in communication that lead to nonbeneficial emergency surgery in elderly patients with serious illness: description of the problem and elements of a solution. *Ann Surg.* 2014;260:949-57.

5. Ortman JM, Velkoff VA, Hogan H. An aging nation: the older population in the United States.

6. Kwok AC, Hu YY, Dodgion CM, Jiang W, Ting GV, Taback N, et al. Invasive procedures in the elderly after stage IV cancer diagnosis. *J Surg Res.* 2015;193:754-63.

7. Understanding The Treatment Preferences of Seriously Ill Patients.

8. Wright AA, Keating NL, Balboni TA, Matulonis UA, Block SD, Prigerson HG. Place of death: correlations with quality of life of patients with cancer and predictors of bereaved caregivers' mental health. *J Clin Oncol.* 2010;28:4457-64.

9. Olmsted CL, Johnson AM, Kaboli P, Cullen J, Vaughan-Sarrazin MS. Use of palliative care and hospice among surgical and medical specialties in the Veterans Health Administration. *JAMA Surg.* 2014;149:1169-75.

10. Chow WB, Rosenthal RA, Merkow RP, Ko CY, Esnaola NF. Optimal Preoperative Assessment of the Geriatric Surgical Patient: A Best Practices Guideline from the American College of Surgeons National Surgical Quality Improvement Program and the American Geriatrics Society. *Journal of the American College of Surgeons.* 2012;215:453-66.

11. Kass-Bartelmes BL, Hughes R. Advance care planning: preferences for care at the end of life. *Journal of pain & palliative care pharmacotherapy.* 2004;18:87-109.

12. Benson WF and Aldrich N. Advance Care Planning: Ensuring Your Wishes Are Known and Honored If You Are Unable to Speak for Yourself, Critical Issue Brief, Centers for Disease Control and Prevention. 2012. https://www.cdc.gov/aging/pdf/advanced-care-planning-critical-issue-brief.pdf. Accessed May 1, 2017.