CHAPTER 3

ASSESSING AND IMPROVING THE QUALITY OF CARE IN CARDIOVASCULAR MEDICINE

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The Trustees of Hospitals should see to it that an effort is made to follow up each patient they treat, long enough to determine whether treatment given has permanently relieved the condition or symptom complained of . . . A layman could not enter authoritatively into the details . . . but he could insist that the End Results System should be used.—Ernest A. Codman

Quality is never an accident; it is always the result of high intention, sincere effort, intelligent direction and skillful execution; it represents the wise choice of many alternatives.—Willa A. Foster

For more than a century, there has been growing recognition of both the importance of, and rigor required to improve, the quality of health care. In the United States, health care expenditure accounted for nearly 17.5% of the gross domestic product in 2014 and is expected to reach 19.6% by 2024.1 In a recent report, the US health system ranked lowest among 11 countries with respect to access, equity, quality, efficiency, and healthy lives;2 despite spending the most on health care.3 Although there has been some improvement in the quality of health care in the United States over the past decade, it is nowhere near the level desired or expected, thus creating a critical challenge to the profession to provide higher value care to Americans.34 Despite many technologic and therapeutic advances, particularly in the cardiovascular field, the timely, systematic translation of new knowledge into clinical practice remains a challenge,7 as an ideal health care system should be able to rapidly deploy new knowledge to improve the value of health care.

It is often thought that high-quality health care is dependent on the increased discovery and delivery of novel diagnostic and therapeutic interventions. However, prior studies suggested that more use of expensive medical care was actually associated with worse quality and outcomes.6 7 Woolf and Johnson15 have extended this concept to mathematically quantify the trade-off between the development of new interventions and the more consistent delivery of known therapies. They argue that despite tremendous scientific and technologic advances, the failure to consistently deliver proven therapies dilutes and reduces the overall quality of a health care system. Thus, money spent on improving this actual delivery of care may be equally or even more critical than money spent on improving technology to result in improved quality of both routine and specialized health care. By using a mathematical nomogram (Fig. 3–1), it has been shown that it is easier to save lives by improving the delivery of care to all patients than by improving the efficacy of care through further technologic advances.8 For example, a new drug must yield dramatic, often unrealistic, increases in efficacy to do more good than could be accomplished by improving the delivery of care to all patients in need—the break-even point.9 In addition, such new therapeutic choices are usually more expensive than existing therapies, making Woolf and Johnson’s argument even more compelling.

Health care value, a key aspiration for the profession, is defined as patients’ outcomes and experiences, divided by cost. Moreover, high-value health care ought to be provided consistently and reproducibly across providers and institutions. These goals were highlighted in the Affordable Care Act, which was signed into law in March, 2010. A myriad of mechanisms to advance this goal, such as accountable care organizations, bundled payments, and value-based purchasing, that tie provider reimbursement to quality metrics and public reporting, are emerging to accelerate the focus of health care on value. Key strategies led by the profession and payers to advance evidence-based practice and to reduce variability include the development of clinical guidelines, performance measures, and appropriate use criteria. This chapter provides an overview of these tools in the context of accepted frameworks to maximize quality and safety and highlights emerging strategies to further improve care.

CARDIOVASCULAR CARE IN THE UNITED STATES

The United States invested an estimated $3.0 trillion dollars in health care in 2014, with a projected annual growth rate of 5.8% over the next 10 years (Fig. 3–2).1 For a country that spends more money than any other nation in the world, however, the United States ranks poorly on most standardized health indices11 and quality metrics.12 In the United States, cardiovascular disease (CVD) remains the leading cause of death and disability,4 with an estimated annual total cost of $656 billion in 2015.13 Such a magnitude of disease burden and cost demands careful scrutiny of the quality of care being delivered to elevate the value earned from the money invested.

PROGRESS IN CARDIOVASCULAR CARE

Cardiovascular medicine in the United States has benefitted enormously from the investment in scientific discovery and clinical research, leading to many advances in the knowledge and treatment of the disease process. Importantly, the past several decades have witnessed substantial improvements in age-adjusted mortality rates caused by CVD, coronary artery disease, and stroke,4 a likely reflection of the successful adoption of primary and secondary prevention, coupled with improved treatments for acute cardiac conditions. The new
Similarly, there have been reductions in hospitalizations for unstable AMI hospitalizations, mortality, and gender-based disparities. Cardiovascular professionals have led highly visible national initiatives to promote the use of evidence-based medicine in clinical practice.\textsuperscript{13,14} Acute myocardial infarction (AMI), in particular, has been at the forefront of quality initiatives, resulting in reduced AMI hospitalizations, mortality, and gender-based disparities.\textsuperscript{13,15-20} Similarly, there have been reductions in hospitalizations for unstable angina,\textsuperscript{19} heart failure,\textsuperscript{19,21} and ischemic stroke\textsuperscript{19} as well as reductions in associated mortality and readmissions.\textsuperscript{19} Despite this progress, differences still exist across racial and socioeconomic strata, indicating a need for further improvement.\textsuperscript{16,17,22-24} These developments are critical and underscore the systematic efforts of the profession in achieving meaningful improvements in outcomes throughout the United States. However, it must be noted that despite these successes, multiple studies have elaborately documented marked inconsistencies in cardiovascular care across geographic regions\textsuperscript{24-29} and in patient risk status.\textsuperscript{28,30,31} Collectively, these variations, some examples of which are reviewed in the subsequent section, underscore the thesis of the Institute of Medicine (IOM) that “there is not a gap between what the healthcare is now and what could be, but rather a chasm.”\textsuperscript{29}

\section*{Variability and Appropriateness of Health Care Delivery}

A critical goal of efforts to disseminate high-quality care is to ensure rational and efficient use of effective treatment to those who derive the most benefit.\textsuperscript{7} Yet, surveys evaluating processes of care have shown that, on an average, only one in two US adults receives recommended care when receiving health care services.\textsuperscript{23} An ideal health care system aims to minimize the variation in care provided so that patients who could derive the benefit receive the care, regardless of other factors such as gender, ethnicity, race, geographic location, and socioeconomic status. Studies have shown a number of sources of such variation.

\textbf{Variation by Clinical Status: The Risk-Treatment Paradox}

Beyond concerns about overall disparities in care, there is emerging evidence that among the patients eligible for treatments, those with the least potential to benefit are preferentially treated, whereas those with the most to gain are systematically undertreated. Referred to as
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... numerous investigators have shown that high-risk patients—who would be expected to benefit more than lower risk patients—are preferentially treated less aggressively, whereas lower risk patients are treated more aggressively. For example, although the use of bleeding avoidance strategies in percutaneous coronary intervention (PCI) (eg, radial access, bivalirudin, or closure devices) are most beneficial in patients at the highest risk of bleeding, the variations across physicians in treating the most high-risk patients shows marked variability and little evidence of tailoring treatment to risk (Fig. 3–3).

**Variation by Sociodemographic Factors**

Several studies have suggested marked variations in the use of evidence-based treatments of CVD as a function of gender, age, race, education, income, and insurance status. A study examining explanations for differences in treatment of myocardial infarction showed that although blacks lived closer to hospitals considered high-quality and having revascularization capability than whites, blacks were less likely than whites to be admitted to revascularization-capable and high-quality hospitals. Although recent data have suggested that some of these differences are narrowing, significant variations that can be avoided still persist. These differences in the processes of care run counter to established ethical principles of equity and underscore the need for tools to systematically elevate the quality of care for all.

**Variation by Providers, Facilities, and Geographic Regions**

Further emphasizing the need to monitor the quality of care has been the observation of marked variations in the processes of care by geographic region. Pioneering work from the Dartmouth Atlas series, a comprehensive evaluation of health care services provided to Medicare beneficiaries, has documented broad variation in the use of both diagnostic and treatment modalities in CVD as a function of the site of care. For example, in the first Dartmouth Atlas of Cardiovascular Health Care, Wennberg and colleagues found wide variations in the use of echocardiograms, ranging from 56 per 1000 beneficiaries in Portland, Oregon, to 339 per 1000 beneficiaries in Miami. Considerable differences were also observed in the use of angioplasty, with rates ranging from less than 3 to greater than 20 per 1000 patients, after adjustment for age, gender, and race. These patterns of unexplained variation extend into other processes of care and range from acute events, such as resuscitating patients experiencing a cardiac arrest, to heart failure. The challenge, of course, with documenting variations is knowing which rate is “right.” This had encouraged additional efforts to better assess variability, as described below (see Additional Use Criteria).

**FRAMEWORKS FOR ASSESSING THE QUALITY OF CARE**

It is estimated that, on average, it takes about 17 years for guidelines to be incorporated into clinical practice, even with an intervention as simple as aspirin use at the time of myocardial infarction. There can be several levels of barriers in effective implementation of clinical evidence and guidelines in routine practice. These exist at policy, societal, system/organizational, provider, and patient levels. In the following paragraphs, we describe the framework for quality metrics in the care of CVD and tools to improve the quality of care.

**DEFINING QUALITY**

Lohr and Schroeder broadly define quality of care as “the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge.” The US Agency for Healthcare Research and Quality has proposed a similar definition: “Quality healthcare means doing the right thing at the right time in the right way for the right person and having the best results possible.” The Institute for Healthcare Improvement recommends that to improve the United States’ health care system requires simultaneous pursuit of three aims, called the “Triple Aim”—improving the patient experience of care (including satisfaction), improving outcomes (of individuals and populations), and reducing the per capita cost of health care. Achieving the best quality of care as marked by highest quality patient outcome and experience with the lowest possible cost is what a health care system usually strives to achieve (see Fig. 3–2). Although the concept of quality health care is intuitive and relatively straightforward to understand, to actually measure, monitor, and improve quality necessitates the use of a clear conceptual framework that encompasses important relevant aspects of health care.

**FRAMEWORKS FOR QUANTIFYING QUALITY**

Conceptualizing quality is critically dependent on the perspective of the observer. This, in turn, influences the approach to quality assessment (QA), namely, determining who is being assessed, what processes are being monitored, and what expected outcomes are being evaluated. Health care is a complex multidimensional phenomenon with a myriad of factors influencing both the delivery and quality of care provided. Multiple organizations have undertaken initiatives to...
quantify delivery and quality and, in so doing, have pursued different goals, perspectives, and tools. The following sections highlight the two most common approaches for performing QA/quality improvement (QI) initiatives.

The Donabedian Framework

One of the earliest approaches to conceptualizing the components of QA was proposed by Donabedian.7 This framework considers quality as being comprised of three main domains: structure, process, and outcome. Structure refers to the attributes of settings where care is delivered and includes aspects that exist independently of the patient. Examples of structural attributes include provider training and experience, availability of specialized treatments, nurse-to-patient ratios, and treatment and discharge plans. Process refers to whether or not good medical practices are followed and incorporates concepts such as the medications given and timing of their administration, the use of diagnostic and therapeutic procedures, and patient counseling. Outcome refers to tangible measures that capture the consequences of care and range from manifestations of disease progression (eg, mortality and hospitalizations) to patient-centered outcomes of health status and treatment satisfaction. As noted by Donabedian, these three components of quality are interdependent and built on a framework that primarily focuses on the delivery of care that aids in linking delivery to outcomes.

The Quality Hexagon

The current driving force and roadmap for QI initiatives in American health care is the IOM’s landmark report, “Crossing the Quality Chasm: A New Health System for the 21st Century.”31 In this report, the IOM recognized substantial deficiencies in the current status of American medicine while concurrently recognizing that individual practitioners were deeply committed to providing high-quality care. They thus focused on the need for a major overhaul of the health care system with a view to placing the patient at the center of QI initiatives.

The IOM recognized the following principal thematic dimensions needed to guide QI in health care:

- Safety—avoiding injuries to patients from the care that is intended to help them
- Effectiveness—providing services based on scientific knowledge to those who could benefit while refraining from providing services to those not likely to benefit
- Patient-centeredness—providing care that is respectful of and responsive to individual patient preferences, needs, and values, and ensuring that patient values guide all clinical decisions
- Timeliness—reducing waits and sometimes harmful delays in care
- Efficiency—avoiding waste, including waste of equipment, supplies, ideas, and energy
- Equity—providing care that does not vary in quality because of personal characteristics such as sex, ethnicity, geographic location, and socioeconomic status

Both the Donabedian components and the IOM principles are landmark frameworks that have helped steer the health care system in the United States to improve quality and safety. To better understand the use of QA tools, we describe a prototypical framework that combines the IOM principles and the Donabedian components in the context of the delivery of health care (Fig. 3–5). Consider a patient who enters the health care system for management of an AMI. Delivery of care extends from the initiation of prehospital care by emergency medical services to treatment and posthospitalization follow-up. The structural component of QA/QI includes the systems responsible for the provision of care, the material resources on which those systems depend, and the organizational structures that guide their interactions. Patient care systems include the prehospital services, the emergency department, inpatient resources, and the outpatient system to

FIGURE 3–4. Slowness in adoption of aspirin therapy in acute myocardial infarction. ACC/AHA, American College of Cardiology/American Heart Association; AMI, acute myocardial infarction; ASA, acetylsalicylic acid; CCP, ISIS-2: Second International Study of Infarct Survival; ACC/AHA: American College of Cardiology/American Heart Association; PM, Performance Measure; ASA: Aspirin; AMI: acute myocardial infarction; CCP: Cooperative Cardiovascular Project; HCFA: Health Care Financing Administration.
which the patients are referred for postdischarge care (eg, availability of cardiac rehabilitation). Material resources refer to the personnel (their number, training, and competence) and equipment available for patient treatment, and organizational systems encompass an institution's policies and procedures, reminder systems, disease management programs, and quality measurement/improvement activities. Process of care largely centers on what providers "do" for patients, the treatments and educational actions that they take in managing the patient. It encompasses the judicious use of proven diagnostic and therapeutic modalities and the application of evidence-based interventions to optimize care and outcomes, such as those endorsed by clinical guidelines. In the setting of AMI, this includes, but is not limited to, timely reperfusion and administration of recommended medications (eg, aspirin, β-blockers). This delivery of optimal processes of care is articulated by the IOM concepts of high-quality care to include safety, efficacy, timeliness, equity, efficiency, and patient-centeredness. The outcomes of care include clinical events (eg, death, recurrent myocardial infarction, heart failure), patients' health status (their subsequent symptoms, function, and quality of life), satisfaction with care, and the costs of care.

Thus, depending on the perspective and goals of the entities involved, measurement of quality can be achieved across the spectrum of health care delivery using various relevant tools. In the following sections, we provide an overview of three such tools—clinical guidelines, performance measures, and appropriate use criteria—developed and promoted for QA/QI initiatives.

**TOOLS TO IMPROVE THE QUALITY OF CARDIOVASCULAR CARE**

To better understand and improve the quality of cardiovascular care, the profession, led by the American College of Cardiology (ACC) and American Heart Association (AHA), has created an infrastructure to advance QA/QI. These efforts include the development of data standards, evidence-based clinical guidelines, performance measures, and appropriate use criteria (AUC). Each of these tools serves a distinct yet complementary role in improving care (Fig. 3–6) and is described in detail in the following sections.
To measure and improve care, one first needs to know both how and what to measure. It is critical to have standardized data definitions that enable the reproducible collection of data across different hospitals and settings. To create the foundation for clear, explicit data capture, the ACC/AHA Clinical Data Standards were developed to serve as a foundation for implementing and evaluating the other ACC/AHA quality tools.28 These data standards are a set of standardized definitions of particular conditions and treatments that can and should be applied in both QA/QI activities and, importantly, clinical trials. Inclusion in clinical trials is particularly important to support both comparability across studies and their incorporation into guidelines, performance measures and clinical care. In particular, standardized definitions support the consistent definition of symptoms, comorbidities, and outcomes in many areas of CVD (e.g., acute coronary syndromes, congestive heart failure, PCI).46 The more these data standards are used in clinical trials, observational registries, and QA/QI efforts, the greater the ability will be to translate the emerging knowledge from clinical research to clinical care.

Clinical practice guidelines are written in the spirit of suggesting diagnostic or therapeutic interventions that appear to be effective (or not) for patients in most circumstances. They are the primary activity through which the rapidly evolving literature is synthesized for practicing clinicians and form the foundation for other quality tools, such as performance measures and AUC.47–51

The first clinical practice guideline was developed in 1984,52 when overutilization of pacemaker implantation led governmental regulators to ask the ACC and AHA to evaluate the available evidence and develop recommendations for practice. Since then, there has been an exponential growth in the work performed by the ACC/AHA Task Force on Practice Guidelines,46–55 which now currently monitors almost all areas of cardiovascular care.53 To remain current, the guidelines undergo periodic revisions and updates, as needed by emerging science. Importantly, the development of guidelines has shifted from procedure-related guidelines to disease-based guidelines, where the population of patients is more reflective of clinical care rather than being restricted to the subset of patients referred for a particular procedure. Although these guidelines are intended to assist providers in clinical decision making, they do so by describing broad principles and generally acceptable approaches for a particular disease condition.46–51

The creation of guidelines requires writing committees to systematically review the medical literature and to assess the strength of evidence for particular treatment strategies. This necessitates ranking the types of research from which knowledge is generated. Randomized controlled trials are given the highest weight. When these are not available, other study designs, including preintervention and postintervention studies, observational registries, and clinical experience are used. To transparently communicate the strength of a recommendation and the evidence on which it is generated, a class recommendation (Class I = strongly indicated, Class II A = probably indicated, Class II B = possibly indicated, or Class III = not indicated) and strength of the evidence (Level A evidence [data derived from multiple randomized trials] through Level C [data derived from expert opinion, case studies, or standard of care]) are provided.55

Despite being evidence-based, there are important limitations in the development of clinical guidelines. Although summarizing all of the available evidence is a requirement, it results in lengthy and difficult-to-read documents, sometimes longer than 400 pages. To address this, the ACC/AHA also publishes pocket guidelines, executive summaries, and web-based applications that are distillations of the key recommendations without the justification for those recommendations. Another limitation of guidelines is that they tend to become outdated as a result of an inherent time lag in the process of developing these documents. The ACC/AHA now releases timely focused updates to minimize the delay between the generation of new evidence and its incorporation into practice. Another important criticism is that the current method used to rank the strength of the evidence is focused on clinical trials that show some benefit, regardless of whether or not the amount of benefit is clinically important (or the benefit may be seen in a surrogate outcome, rather than a clinically meaningful outcome).54 Importantly, the summary of clinical trials, which report the average benefit across the entire population, fail to emphasize the heterogeneity of treatment benefit, whereby some patients may benefit greatly and others do not. Ongoing efforts, using Bayesian analyses and other modalities that can exploit the heterogeneity of treatment benefit, are being explored to improve the quality of the guidelines development process.51 Notwithstanding these limitations, clinical guidelines are an important resource that serve as the foundation for all other QI efforts in professional cardiology.

Performance measures

At times, the evidence supporting (or for avoiding) a particular diagnostic or therapeutic action is so strong that failure to perform such actions jeopardizes patients’ outcomes. Performance measures represent that subset of the guidelines for which the strongest evidence exists and for which their routine use (or avoidance) is felt to be an important advance to elevating quality.55–57 Creating performance measures entails a distinct methodology from that of guidelines creation55–57 and, as such, is undertaken by a separate ACC/AHA Task Force writing committee. Performance measures are often constructed as a set of measures that quantify a range of health care processes and outcomes (Fig. 3–7) and are designed to identify multiple points in the continuum of care.

for which clinical inertia—the failure to implement or titrate recommended therapies—can occur.\textsuperscript{56,59} Once the relevant domains are identified, then those guideline recommendations with the strongest evidence and highest correlation with clinically meaningful outcomes are selected for performance measure creation. Constructing process-of-care performance measures requires the explicit articulation of the denominator of eligible patients, what constitutes compliance with the measure, over what period of care such compliance is needed, what source of data will be used to define these characteristics, and how the measure will be analyzed and reported.\textsuperscript{57} Once prototypical measures are proposed, their feasibility, interpretability, and actionability need to be established. In contrast to performance measures for processes of care, outcomes of care can also serve as performance measures if they fulfill established criteria and have the capacity to be risk-adjusted for patient characteristics present prior to the initial delivery of care.\textsuperscript{60}

Various organizations are involved in the development of performance measures. Scientific bodies such as the ACC and the AHA are involved in the science behind these performance measures. However, organizations such as the Centers for Medicare & Medicaid Services, the Joint Commission, the National Quality Forum, the National Committee for Quality Assurance, and the Ambulatory Quality Care Alliance play key roles in either developing performance measures or adjudicating their value for national QI efforts. Established performance measures are now assuming an important role in public accountability and pay-for-performance initiatives.\textsuperscript{51,62} These are rapidly evolving initiatives and warrant the attention of clinicians in their recommendation, interpretation, and application. In addition to the more traditional clinician-focused conceptualization of performance measures, patient participation as part of performance measures is encouraged to improve patients’ outcomes, including health status.\textsuperscript{63} Similarly, challenging the historical exclusions of resource utilization and costs considerations in guideline developments and performance measures (although often implicitly considered), newer documents have started to consider cost in measure selection.\textsuperscript{64}

### APPROPRIATE USE CRITERIA

Over the past several decades, the United States has witnessed a substantial increase in the use of diagnostic testing and therapeutic procedures in cardiovascular care. For example, the National Heart, Lung, and Blood Institute estimated that more than 1.3 million coronary angiography procedures were performed in 2008, an increase of almost 350% since 1979.\textsuperscript{65} However, this increase was not uniform and had marked regional variations, such as that documented by the Dartmouth Atlas.\textsuperscript{66}

Given the nation’s increasing concerns about the escalating costs of health care, there was a pressing need to understand such regional variability. This has led to the conceptualization of appropriateness, which includes underuse (the failure to provide services from which the patient would benefit), misuse (performing procedures in the correct patients but doing so in a manner that results in harm; see Performance Measures), and overuse (where tests and procedures may not be needed or even be harmful to the patient). Inappropriate use of tests and therapies clearly accelerate costs to both patients and society and exposes patients to potential harms.

To address the demand for clearer insights into the appropriateness of care, the ACC, along with the AHA and other professional organizations, created a framework to begin evaluating the selection of patients for specific diagnostic tests and therapeutic interventions. In 2005, the ACC published their methodology for creating appropriate use criteria in cardiovascular imaging.\textsuperscript{67} They defined a procedure as appropriate if “the expected incremental information, combined with clinical judgment, exceeds the expected negative consequences by a sufficiently wide margin for a specific indication that the procedure is generally considered acceptable care and a reasonable approach for the indication.”\textsuperscript{68}

The AUC differ from clinical guidelines and performance measures in several important ways. First, they estimate the relative benefits and harms of a procedure or a test for a specific indication. This is done by first creating prototypical patient scenarios commonly encountered in clinical practice. Using guidelines, clinical evidence, and contemporary practices as a guide, an expert committee then evaluates the strength of the indication for that procedure or test. After an adaptation of the RAND Delphi approach,\textsuperscript{69} a multistep process is pursued that engages the multidisciplinary expert panel to individually and collectively rate the appropriateness of a test. Ratings range from inappropriate (1–3), to uncertain (4–6), to appropriate (7–9).\textsuperscript{57} The mean value of the collective responses and the degree of agreement with these ratings are then reported and form the initial AUC for that procedure or test. This methodology is continually updated as experience accrues,\textsuperscript{70} which changes the nomenclature and expands the AUC framework for all cardiovascular technologies and procedures.

The AUC thus help identify what specific tests and procedures to perform and when and how often and, as such, have the potential to more transparently document the clinical rationale for performing tests and procedures. They overcome the limitation of the Dartmouth Atlas by providing a framework against which to judge observed variations. Since 2005, published AUC documents have assessed many areas of cardiovascular medicine, such as echocardiography (both transthoracic and transesophageal, as well as pediatric cardiology),\textsuperscript{71} stress echocardiography,\textsuperscript{72} cardiac computed tomography\textsuperscript{73} and cardiac magnetic resonance imaging,\textsuperscript{74} single-photon emission computed tomography myocardial perfusion imaging,\textsuperscript{75} joint criteria for utilization of cardiovascular imaging,\textsuperscript{76} utilization of imaging in heart failure,\textsuperscript{77} multimodality detection and risk assessment of stable ischemic heart disease,\textsuperscript{78} diagnostic catheterization,\textsuperscript{79} coronary revascularization,\textsuperscript{80} and peripheral vascular ultrasound and physiological testing.\textsuperscript{81} Future directions for these efforts are to explicitly contrast the relative appropriateness of alternative diagnostic modalities for specific clinical indications. Adoption of AUC in routine practice has resulted in marked improvement in certain areas of cardiovascular care, such as coronary revascularization. A study examining the appropriateness of PCI showed that between July 2009 and September 2010, 98.6% of PCIs were classified as appropriate, 0.3% uncertain, and 1.1% inappropriate for acute indications (AMI and high-risk unstable angina).\textsuperscript{82} However, for nonacute indications, 50.4% were classified as appropriate, 38.0% uncertain, and 11.6% inappropriate. Similarly, although there was minimal variation in the proportion of inappropriate PCI across hospitals for acute indications, there was substantial variation for nonacute indications (median hospital rate, 10.8%; interquartile range, 6.0%–16.7%).\textsuperscript{82} In a separate study, inappropriate PCIs for nonacute indications were more common in men, whites, and patients who had private insurance, suggesting overuse in traditionally privileged groups.\textsuperscript{83} Recently, the trends in appropriateness over time have been reported. This showed that since the publication of the original AUC for coronary revascularization in 2009 there were significant reductions in the volume of nonacute PCI, particularly among those classified as inappropriate nonacute PCIs (26.2%–13.3%).\textsuperscript{84} Despite this, hospital-level variation of inappropriate PCIs persisted (median, 12.6%; interquartile range, 5.9%–22.9%) in 2014.\textsuperscript{85}

Although AUCs are a promising method for the profession to guide the more cost-effective use of expensive technology, there are potential challenges with the AUC. First, developing AUC is limited by rigorous scientific evidence for a number of common clinical scenarios. Thus, validation of these criteria—establishing that those with more appropriate indications obtain more benefit from the procedure than...
those with less appropriate indications—is important. Although this has been shown for the coronary revascularization AUCs, it has not yet been assessed for the other AUC ratings. Second, AUC are a general guide to clinical care and cannot possibly address the many extenuating factors that might lead to very rational decisions in real-world practice. This has an important implication on the interpretation of AUC results in clinical practice. In the use of performance measures, inclusion and exclusion criteria for the denominator often mean that the expected goal of compliance with performance measures is 100%. This will not be the case with AUC. There will be patients who are rated as uncertain or inappropriate, using the coarse definitions with which the AUC were created, who would clearly benefit from a procedure. However, it is unlikely that such patients will differ markedly by practice. Thus, those practices that are outliers, as compared with others, warrant careful evaluation of their treatment practices. For example, finding that a practice in which less than 50% of patients are deemed appropriate will raise concerns of overuse, whereas a practice in which 100% of patients are considered appropriate may suggest underuse of the procedure in patients who might benefit. More experience with the use of AUC will improve their use and interpretation as the country struggles to maximize the value of cardiovascular care.

**LEVERAGING THE TOOLS TO IMPROVE QUALITY: ONGOING QUALITY INITIATIVES**

Although clinicians work hard to provide the highest quality of care to their patients and usually believe that they are accomplishing this goal, without explicitly measuring one’s performance it is impossible to know how well one is doing. The infrastructure of tools, including data standards, guidelines, performance measures, and AUC, especially when supplemented with outcomes measures, can create a powerful infrastructure to assess and improve the quality of cardiovascular care. Outcomes that are proving to be increasingly actionable assessments of care include long-term mortality, readmission rates, and patient-centered outcomes, as assessed by such measures as the Seattle Angina Questionnaire and the Kansas City Cardiomyopathy Questionnaire. Often, these are most efficiently executed when integrated into prospective data collection systems. Over the past decade, several national registries have been developed to support the prospective collection of data for assessing performance and guidelines compliance within hospitals. These include, for example, procedural registries, such as the ACC National Cardiovascular Data Registries (NCDR) for cardiac catheterization/PCI, implantable cardioverter defibrillator implantation, and carotid stenting, as well as disease-based clinical registries, such as the AHA Get with the Guidelines registries for heart failure and stroke and the Acute Coronary Treatment and Intervention Outcomes Network, or ACTION, acute coronary syndrome registry. To supplement these inpatient registries, as a prelude for examining the transitions of care to the outpatient settings, new initiatives of the AHA and ACC seek to quantify the quality of outpatient care. The ACC’s Practice Innovation and Clinical Excellence, or PINNACLE, and the AHA’s Get with the Guidelines—outpatient registries are examples of these new efforts. All of these registries require a substantial commitment from hospitals and practices to abstract the necessary data for these registries, but in return, they receive benchmarked assessments of their performance, with which they can develop local QI programs to improve care. It is expected that registries will be even more important given that they are closely intertwined with performance measure development. Registries will be crucial in assessment of different types of measures, such as process measures, risk-adjusted outcome measures and resource use measures, all of which are important to patients, clinicians, purchasers, and other stakeholders.

Some of the most exciting opportunities to improve care come from the combination of these registries and national coalitions to target significant gaps in care. A dramatic example of this is the Door-to-Balloon (D2B) initiative. The ACC, in partnership with 38 partner organizations, worked to increase the proportion of patients with ST-segment elevation myocardial infarction receiving primary PCI within 90 minutes of hospital presentation. Launched in 2006, this initiative sought to improve the proportion of ST-segment elevation myocardial infarction patients receiving prompt reperfusion from approximately 50% to more than 75%. This program supplemented data collected through the NCDR CathPCI registry with explicit recommendations about how to improve performance (Fig. 3–8), including (1) activation of the catheterization laboratory (cath lab) by emergency department physicians, (2) single-call activation of the cath lab, (3) expectations of having the cath lab team assembled within 30 minutes, (4) prompt data feedback to the emergency department and cath lab staff, and (5) activation of the cath lab based on prehospital ECGs and targeted times to first ECG acquisition for chest pain patients within 10 minutes. Between January 2005 and September 2010, this effort led to a decline in median D2B...
FUTURE DIRECTIONS: PATIENT-CENTERED QUALITY OF CARE

This chapter outlines the challenges and opportunities to improve the quality of care. Although data continue to emerge regarding the variability in care and the poor association between the intensity and costs of care with outcomes, there are emerging opportunities to systematically study and improve care. Through the use of guidelines, performance measures, AUC, and expanded outcomes assessments, the health care delivery system has an ever-increasing opportunity to assess and improve its care. When combined with national commitments to improve care, dramatic improvements in both the processes (eg, D2B times) and outcomes (eg, the reduction in AMI mortality) can occur. Although past accomplishments are exciting, they also create a compelling case to expand these efforts in other areas, such as heart failure and arrhythmias. They also challenge the profession to consider new directions to assess and improve care.

Understanding outcomes from patients’ perspectives and incorporating their preferences into QI efforts are particularly exciting directions for the field. During the past decade, a focus on patient perceptions of care and patient satisfaction has emerged as an important concern in health care systems.92 Studies that have examined the association between patients’ perceptions of quality and other objective measures of performance have consistently demonstrated that patients’ perceptions of quality differ from technical aspects of care (such as processes of care).93,94 One emerging strategy to link patients’ perceptions with QA/QI has been the development of patient-centered tools that explicitly quantify patients’ perceptions of their health status (their symptoms, function, and quality of life).95 These range from disease-specific health status measures as a means to assess the control of patients’ symptoms to patient satisfaction surveys, such as the Consumer Assessment of Healthcare Providers and Systems.95 Over the next few years, these tools are expected to be used more frequently because they have been endorsed by various performance measures.96–98 The Centers for Medicare & Medicaid Services is also examining hospital-level patient reported experience of care and risk-adjusted Medicare spending for hospitalizations and 30-day post–hospital care using data from Hospital Consumer Assessment of Healthcare Providers and Systems.99 The use of patient-centered indicators will increase the focus of quality measurement on aspects of health care that matter most to patients.

SHARED DECISION MAKING

An important objective of the Affordable Care Act is to provide patient-centered care. The IOM defines patient-centered care as “care that is respectful of and responsive to individual patient preferences, needs, and values . . . that patient values guide all clinical decisions.”100 From patients’ perspective several characteristics were identified as indicators of quality and safety such as respect for patient’s values, preferences, and expressed needs; clear, high-quality information and education for patients and families; physical comfort; emotional support; involvement of families and friends, as appropriate; coordinated care; continuity of care; and access to care.101 Delivering patient-centered care will be an important indicator of future quality metrics.

For some acute conditions, there is clearly one dominant treatment strategy (eg, surgery for acute appendicitis, and antibiotics for acute bacterial meningitis). However, for many chronic conditions there can be more than one equally effective alternative, with different side-effects profiles and other attributes related to the quality of life. The value of a treatment from a clinician’s perspective can be different from a patient’s, and it can also vary between any two patients. Therefore, the benefits and potential harms of any therapy can have different meaning and implications for any two given patients. Shared decision making involves discussion of treatment options between a clinician and patient, including benefits and harms, understanding patient’s values and preferences, and letting the patient decide what can be the best treatment choice for him or her.102 This can be facilitated with the use of decision aids, which are evidence-based tools delivered online, or as materials in a print or video format informing patients of the risks and benefits, relative effectiveness, and costs of a treatment. A Cochrane review of 115 clinical trials showed that use of decision aids was associated with improvement in patients’ knowledge, accurate risk perceptions, values concordant medical decisions, reduced level of internal decisional conflict, and fewer patients remaining passive or undecided.103 In addition to patients receiving the proper treatment for themselves,104 using decision aids was also associated with lower health care costs.105,106 Efforts to certify decision aid standards are in progress.107 It has been suggested that the use of decision aids should be developed as a quality metric and tied with reimbursement; how to quantify the quality of decision making is still being developed.108

One important consequence of explicitly measuring and integrating patient-centered outcomes will be the ability to explicitly define patients’ preferences in medical decision making. This will alter the current framework for interpreting adherence to guidelines and performance measures. Guidelines and performance measures seek to reduce the variation in cardiovascular care (Fig. 3–9A). Using this paradigm, improvement in outcomes occurs as variations in practice decrease, resulting in both a favorable shift in performance and a narrowing of the distribution of performance. Although variation in clinical practice caused by differences in physician and hospital treatment is a poor indicator of quality, variations in practice caused by patient preference may reflect better care—care that is tailored to the individual goals and preferences of patients. This progressive idea stems from the philosophy that inclusion of patient preferences in medical decision making reflects higher quality of care (Fig. 3–9B). However, the current guidelines, performance measures, and most quality improvement programs are aimed at reducing variation, and consequently, variation in practice caused by patient preference may be misrepresented as poor quality. More research is needed to better define when variation is caused by patient preference, as opposed to clinicians’ failure to apply evidence into practice.

CONCLUSION

The measurement and creation of interventions to improve the delivery of health care is an immensely exciting field and one that is growing in importance. It is fundamental to the goals of medicine—improving patients’ outcomes. It is becoming increasingly important for the medical profession to accelerate its focus on health care quality and developing clinically and scientifically valid methods for quantifying and improving care. In the current era of increasing costs and growing scrutiny of the rational use of care, our profession has an ever-greater responsibility to reproducibly provide care that maximizes the benefits,
decreases the risks and costs of care, and is most resonant with patients’ individual goals and values. Professional organizations, including the ACC and AHA, are developing the tools to measure and improve care, and outcomes researchers are developing novel approaches for the analysis and interpretation of these data. Collectively, we all have the opportunity to elevate care so that the IOM’s guiding principles of quality can be realized and care can be routinely delivered that is safe, effective, timely, efficient, equitable, and patient centered.

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