Costs of Quality and Safety in Radiology

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Abbreviations: ABC = activity-based costing, CPT = Current Procedural Terminology, RCC = ratio of costs to charges

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Introduction
Calculating value in health care is often attributed to the following equation: value = (outcomes + patient experience)/cost, where outcomes are dependent on quality and safety procedures. What are the costs of quality and safety in radiology? What are the costs associated with providing excellent imaging services? What are the costs of providing poor services? What is the cost associated with a substantial diagnostic error? This article explores these questions and discusses (a) approaches to calculating costs in medicine, (b) the typical approach to budgeting and accounting for quality and safety in medicine, (c) the approach of calculating the cost of quality and safety used in some industries and the implications of using this approach in the health care industry, and (d) the increased significance of accurate costing in radiology in general and as it pertains to quality as medical payment models move to value-based payments.

With the movement toward at-risk population health management–related payment models, a core factor for the success and survival of health care organizations has become understanding and decreasing costs. In medical specialties such as radiology, understanding models for procedure-based costing will become increasingly important. Using bottom-up models for procedure-based costing, such as time-driven activity-based costing, is more advantageous than using the inaccurate ratio of costs to charges approach; however, these approaches are more resource intensive when compared to top-down approaches. Understanding the costs of quality is also important for creating an accounting and budgeting process that reflects the total cost of quality. The costs of quality are divided into two main categories: the cost of control (also referred to as the costs of conformance) and the costs of failure of control (also referred to as the costs of nonconformance). The costs of control are the expenditures that occur to ensure quality. The costs of noncontrol are the expenses that arise from the lack of quality and safety. The cost of control has two subcategories: prevention costs and appraisal costs. The cost of noncontrol also has two subcategories: internal failure costs and external failure costs. Adopting a mind-set that takes into account the costs of control, or the costs to ensure high-quality care, and the costs of noncontrol, or the hidden costs of poor-quality care, will be essential for successful health care organizations in the future.
TEACHING POINTS

- Procedure-based costing is most accurate if calculated at the detailed imaging code level rather than at the more global CPT code level.
- When calculating procedure-based costing, there are essentially two categories of approaches to use. These include the top-down approach of RCC and the bottom-up approach of ABC.
- The costs of quality are divided into two main categories: the costs of control (also referred to as the costs of conformance) and the costs of failure of control (also referred to as the costs of nonconformance).
- The costs of failure of control (the hidden costs of a lack of quality) are significant and are typically underrepresented when budget decisions are made.
- Understanding the true costs of quality, related to both the costs of ensuring high-quality care and the costs of failure in providing high-quality care, will become an essential element for successful health care operations and successful radiology departments.

Costing in Medicine

To frame a discussion of the costs related to quality, it is advantageous to discuss some basic concepts pertaining to costs in medicine and how these costs are estimated. A full review of costing in health care and radiology is beyond the scope of this article. An excellent review on this topic was written by Rubin (1) and published in Radiology in 2017.

Historically, the understanding of costs in radiology and in medicine in general has been rudimentary, and the methods used by most to calculate costs have been inaccurate (1). Authors have used the terms cost, charge, price, and fee interchangeably. The historic lack of sophistication in understanding costs has increasing significance for radiology for multiple reasons. With the change in reimbursement models from fee-for-service models (in which radiology departments are revenue centers) to value-based care models (in which radiology departments are cost centers), the need for radiology departments to understand and articulate their costs is essential (1).

When a single bundled payment is made to a central finance department for an episode of care, a radiology department needs to both document its related costs and demonstrate the value provided to receive an allocation of and the appropriate proportion of funds to the department (1). Those in radiology departments should also have a better understanding of the costs related to dealing directly with patients.

With the growing number of patients with health insurance with high-deductible plans in the United States, large out-of-pocket payments are becoming more common. Patients and families with required high co-payments related to imaging studies often demand justification for the charge and will often go to other facilities with lesser charges. To illustrate the scope of the issue, note that the inability to pay medical bills is the principal cause of personal bankruptcy in the United States (2), and approximately one-third of diagnostic testing is not medically indicated (3).

When defining costs in medicine, it is essential to understand from whose perspective the costs are being defined. The cost is different from the perspectives of the health care provider, the patient, the insurance company, and society in general (1). In other words, the cost is relative (1). From the perspective of a patient who undergoes an imaging study, his or her perspective of cost will equate to the amount of the co-payment for the procedure, lost wages owing to time missed at work, and the costs of travel, including paying to park to undergo the procedure. From the perspective of the imaging provider, the costs relate to all of the components of providing the procedure, plus the desired margin. To insurers, the costs are related to how much they will have to pay the provider for the imaging study, plus the desired margin. For the purposes of this article, cost will be discussed in relation to the health care provider.

When estimating product-related costing (in this case, an imaging procedure), estimates of all departmental expenses related to providing that particular imaging procedure are calculated. Such expenses can be direct or indirect. Direct expenses include related variable costs, which are dependent on the volume of the procedure performed. In radiology, such variable costs include expenses related to supplies, contrast agents, and overtime and other volume-related labor expenses (1). Direct expenses also include fixed costs, which are not dependent on the volume of procedures performed. Examples of fixed costs in radiology include costs related to equipment purchase and depreciation and most staffing- and physician-related expenses (1). Indirect costs, also referred to as overhead, are items that cannot be allocated to a specific procedure (1,4). In radiology, these expenses include electricity use, patient and employee facilities, environmental services, and allocated costs for other shared institutional services (e.g., human resources and security, finance, and legal services).

Current Procedural Terminology Codes and Imaging Codes

Once direct and indirect costs are calculated, they can be allocated to a specific imaging procedure. The U.S. Centers for Medicare & Medicaid Services defines 8680 medical activities with Current Procedural Terminology (CPT) codes, 840 of
which are related to medical imaging studies (1). Although this may seem like a significant number, the level of complexity regarding the number of specific procedures is much greater than the number of CPT codes. Because of this complexity, institutions use imaging codes, which are currently variable and defined at the local level. While CPT codes are used primarily for billing purposes, imaging codes are used locally to define specific imaging studies for the purposes of providing accurate physician ordering, routing examinations between information systems, and completing administrative tasks such as linking specific standardized report templates to certain procedures (5).

The relationship between CPT codes and imaging codes can be confusing. There are many examples where one CPT code can be associated with multiple imaging codes. Conversely, there are examples of one imaging code that is associated with multiple CPT codes (5). There are also cases where a CPT code does correlate with a single imaging code. An example of an imaging code that is associated with multiple CPT codes is the imaging code for “MRI of the head and total spine,” which is associated with the CPT codes for “MRI head,” “MRI cervical spine,” “MRI thoracic spine,” and “MRI lumbar spine.”

An example of a CPT code associated with multiple imaging codes is the CPT code for “US abdomen limited” in pediatrics. Under this specific CPT code, there are multiple imaging codes for limited abdominal US examinations, tailored to specific diagnostic indications. These imaging codes include “Ultrasound pylorus” to rule out hypertrophic pyloric stenosis, “Ultrasound right upper quadrant” to evaluate for gallstones or liver disease, “Ultrasound appendix” to rule out appendicitis, “Ultrasound intussusception” to rule out intussusception, and “Ultrasound fluid” to perform a survey to rule out ascites or intra-abdominal abscesses (5). Although each of these imaging codes is billed under the same CPT code, they are different imaging protocols that require a different amount of time to perform and interpret and therefore have different costs. Procedure-based costing is most accurate if calculated at the detailed imaging code level rather than at the more global CPT code level.

**Calculating Procedure-based Costing**

When calculating procedure-based costing, there are essentially two categories of approaches to use. These include the top-down approach of the ratio of costs to charges (RCC) and the bottom-up approach of activity-based costing (ABC) (1).

Top-down approaches to costing have the advantage of requiring little effort to perform but the disadvantage of being highly inaccurate (1,6–8). The RCC process estimates costs by multiplying the institutional charge for a certain procedure by a locally set RCC rate (1). The method is not influenced by resource costs or usage rates and has been shown to be inaccurate (1,6). All industries except medicine primarily use costs to determine charges; only in medicine are charges used to determine costs (1).

Another top-down approach to calculating costing is using relative value units (RVUs). This approach has both the same benefit of easy calculations and the same limitation of inaccuracy as those seen with RCC calculations (6), as RVUs are calculated on the basis of average values.

In a bottom-up approach, or ABC, a value-stream analysis is performed to create a process-flow map that identifies all steps needed to perform a specific task. The cost of each task is allocated to the specific procedure on the basis of usage. This process is then used to estimate the overall cost of the procedure (1). The advantage of this approach is a greater degree of accuracy than that of top-down approaches, partly because the ABC process allocates overhead on the basis of usage (1). Although this approach was advocated as useful more than 30 years ago (9), it is still not prevalent in radiology departments.

Time-driven ABC, a more accurate costing method than ABC but one that is more time consuming, is gaining attention currently. In time-driven ABC, each task is allocated a time-based cost rate. The time that a specific task takes for a procedure is measured. The time is then multiplied by the time-based cost rate for each task associated with the procedure, and the result is used to estimate the actual cost (10–12). The labor of extracting information from the medical record or measuring the time manually in person with a stopwatch often limits the applicability of this technique.

**Traditional Approach to Budgeting and Accounting in Medicine**

Despite the relative lack of sophistication used in procedure-based costing in current radiology departments, the level of sophistication pertaining to budgeting and accounting relative to quality and safety is even less sophisticated.

The typical mind-set one has pertaining to quality is that higher quality requires higher costs—that more is better. To have a higher-quality product, it takes more supplies, equipment, or labor. The economist Paul Krugman (13) wrote, “Productivity isn’t everything, but...it is almost everything,” which is a notion that can be used to describe accounting in the health care industry. This productivity mind-set used in budgeting in
most health care systems typically ignores the costs of poor quality.

Larger radiology departments and certainly health care organizations will typically have an accounting unit related to quality and safety. Smaller departments may only have line items related to quality and safety expenses in their general administrative accounting unit. If one were to look through the items pertaining to quality and safety in those budgets, one would likely see that these include items related to personnel expenses, such as the salaries and benefits of quality managers and safety specialists. There may also be a percentage of a physician’s time related to his or her oversight of a quality and safety program as a vice chair of quality or chief quality officer.

There may also be expenses related to obtaining certifications (eg, service certifications from the American College of Radiology or physician certifications from the American Board of Radiology), participating in national registries, or obtaining consultations for regulatory site visits from the Joint Commission or local or state oversight groups. There probably are not many items in those budgets that are not similar to the items previously mentioned.

Cost of Quality: Industrial Perspective versus Radiology Department Perspective

Many industries account for quality and safety costs in a way that is different from the traditional approach used in medicine. This approach was first described by Armand Feigenbaum (12) in 1956. The approach is often referred to as total quality control (12,14,15) and is summarized in the Figure.

The costs of quality are divided into two main categories: the costs of control (also referred to as the costs of conformance) and the costs of failure of control (also referred to as the costs of nonconformance). The costs of control are the expenditures that occur to ensure quality. The costs of noncontrol are expenses that arise from the lack of quality and safety. The costs of control category has two subcategories: prevention costs and appraisal costs. The costs of noncontrol category also has two subcategories: internal failure costs and external failure costs.

Prevention Costs

The first subcategory of costs of control is prevention costs, which arise from efforts to keep defects from occurring (12,14,15). In industry, prevention costs arise from expenses related to (a) quality planning, (b) statistical process control, (c) quality information systems, (d) quality training and workforce development, (e) product design, (f) systems development, (g) daily management systems, and (h) employee evaluations (12,14,15).

In radiology departments, prevention costs can include expenses related to (a) protocol standardization, (b) standardized report template creation, (c) department dashboards and scorecards, (d) daily-readiness huddles, (e) regulatory readiness (Joint Commission and American College of Radiology certifications, American Board of Radiology physician certifications, College of American Pathologists inspections [in nuclear medicine], and state inspections), (f) trainee work hour restrictions, (g) critical results notifications, (h) annual faculty and staff evaluations, and (i) evaluation processes such as ongoing professional practice evaluation efforts. Currently, many of the quality and safety items that are likely to be seen in radiology-related budgets would fall in this category.

Appraisal Costs

The second subcategory of costs of control is appraisal costs. These are the costs related to issues detected during inspections and audits (12,14,15). Appraisal costs represent the expenses of the inspections themselves and not the expenses related to fixing the problems that were actually detected. In industry, appraisal costs arise from (a) material tests and inspections, (b) acceptance testing, (c) equipment testing, (d) quality audits, (e) field testing, and (f) supplier ratings (12,14,15).

In radiology departments, appraisal costs include (a) new equipment testing, (b) protocol
transition for new equipment, (c) scheduled machine calibration and phantom studies, and (d) time for peer review.

**Internal Failure Costs**
The costs related to failure of control, or non-conformance, are typically not accounted for or substantially considered when budgeting in the medical field. These are the costs related to a lack of quality that are often referred to as the hidden costs of quality. Perhaps more appropriately, they should be referred to as the hidden costs of a lack of quality.

The first subcategory within the costs of non-conformance is internal failure costs. These are the costs that arise from defects caught internally before they reach the customer (12,14,15). In industry, internal failure costs include expenses related to wasted materials, scrap materials, reworking, and failure analysis (12,14,15).

In radiology departments, internal failure costs include (a) repeat imaging owing to initial errors or lack of quality imaging; (b) repeat imaging owing to an incorrect study initially being ordered and performed; (c) near-miss–related improvement projects; (d) root cause analysis teams and resulting action plan implementation; (e) process redesign; (f) education and reeducation efforts; (g) service delays related to down equipment; and (h) loss of confidence among hospital administrative leaders, internal referring physicians, or departmental staff and faculty. The final item can have significant costs related to disengagement of the workforce.

**External Failure Costs**
The second subcategory within costs of failure of control is external failure costs. These are costs related to defects that reach the customer or, in the case of health care, the patient (12,14,15). In industry, external failure costs arise from complaints related to product warranties, services, liabilities, and returns (12,14,15).

In radiology departments, external failure costs are related to (a) patient and family dissatisfaction, (b) external referring physician dissatisfaction, (c) lost referrals, (d) ease-of-access challenges and related loss of business, (e) malpractice costs, (f) third-party payer refusal to pay owing to the occurrence of a medical error, (g) additional patient care expenses in the setting of at-risk population–based management contracts, (h) increased length of stay owing to misdiagnosis, (i) distracted staff and faculty, and (j) poor morale and disengagement. These costs can be highly significant and, in items such as the costs of poor morale and staff disengagement, difficult to measure. As an example, one children’s hospital estimated a 22% decrease in the costs related to preventable harm in the year following the launch of a quality improvement program (16).

**Importance of the Cost-of-Quality Mind-set in Health Care**
Health care organizations and radiology departments would benefit from adopting the mind-set of industry in how it views and accounts for costs and savings related to quality. The costs of failure of control (the hidden costs of a lack of quality) are significant and are typically underrepresented when budget decisions are made. Organizations choose consciously or unconsciously to pay for poor quality. The cost of quality in a thriving company is as high as 15%–20% of total sales (15). In an average-performing company, it can be as high as 40% (15). In health care organizations, it is possible that this number is approximately half of revenues. Adopting accounting practices or the approach that considers the costs of control and the more hidden costs of failure of control would better position health care organizations.

In the current environment, it is telling that we even ask the question “What is the cost of quality?” Certainly, it reflects that we do not have a total cost-of-quality mind-set established. In medicine, it also reflects the typical administrative structure and mind-set that currently exist. Hospital administrative structures almost always have a quality and safety department that operates separately from those administrative units that run care operations—the operational leaders of care units. When quality and safety is seen as a separate entity with a separate accounting unit, it can foster a lack of ownership of quality and safety by the operational unit leaders.

This is not a sustainable mind-set to provide highly reliable care. Operational leaders must own the quality and safety aspects of their operations to provide highly reliable care. They must see quality and safety issues as a high, or perhaps the highest, priority. How the costs of poor quality are accounted for must also be owned by operational leaders. The quality and safety infrastructure is there to lead, support, design, monitor, and advocate for the quality and safety agenda. The quality and safety leadership also shares the successes and failures of those efforts with the operational leaders.

Asking “What is the cost of quality?” should be an intuitive part of practicing health care delivery owing to the shift to value-based payment models. With the movement toward at-risk population health management–related payment models, understanding and decreasing costs have become core factors in the success and survival of health care organizations. Understanding the true costs
of quality, related to both the costs of ensuring high-quality care and the costs of failure in providing high-quality care, will become an essential element for successful health care operations and successful radiology departments.

**Conclusion**

In medical specialties such as radiology, understanding models for procedure-based costing will become increasingly important. Using bottom-up models for procedure-based costing, such as time-driven ABC, is more advantageous than using the inaccurate RCC approach, but it has the disadvantage of being much more resource intensive. Understanding the costs of quality is also important. Adopting a total cost-of-quality approach, which takes into account the costs of control (ie, the costs to ensure high quality) and the costs of noncontrol (ie, the hidden costs of poor quality), will be essential for successful health care organizations in the future.

**References**