The Value of Imaging Part II: Value beyond Image Interpretation

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Although image interpretation is an essential part of radiologists' value, there are other ways in which we contribute to patient care. Part II of the value of imaging series reviews current initiatives that demonstrate value beyond the image interpretation. Standardizing processes, reducing the radiation dose of our examinations, clarifying written reports, improving communications with patients and providers, and promoting appropriate imaging through decision support are all ways we can provide safer, more consistent, and higher quality care. As payers and policy makers push to drive value, research that demonstrates the value of these endeavors, or lack thereof, will become increasingly sought after and supported.

Key Words: Imaging appropriateness; Patient communication; Standardization; Lexicon.

With payers and policy makers increasingly scrutinizing the value of medical imaging, opportunities abound for radiologists and radiology health services researchers to meaningfully and rigorously demonstrate value. In the first of a two-part report from the Radiology Research Alliance Task Force on the Value of Imaging in Healthcare, we described various definitions of value and outline challenges in measuring it from both the patient encounter and the larger societal perspective. In this second part, we detail several actionable opportunities for the imaging community to demonstrate its value to patients, payers, ordering providers, health systems, and society at large.

A survey of physicians on the most important health-care innovations in the last 30 years ranks computed tomography (CT) and magnetic resonance imaging (MRI) as the most important (1). But, as discussed in Part I of this series, defining and demonstrating the value of imaging can be difficult. Furthermore, although image interpretation remains the cornerstone of radiologists' contributions to patient care, there are many additional opportunities for radiologists to add value to patient care. Boland and colleagues describe these steps in the first of his Imaging Value Chain series (Fig 1) (2).

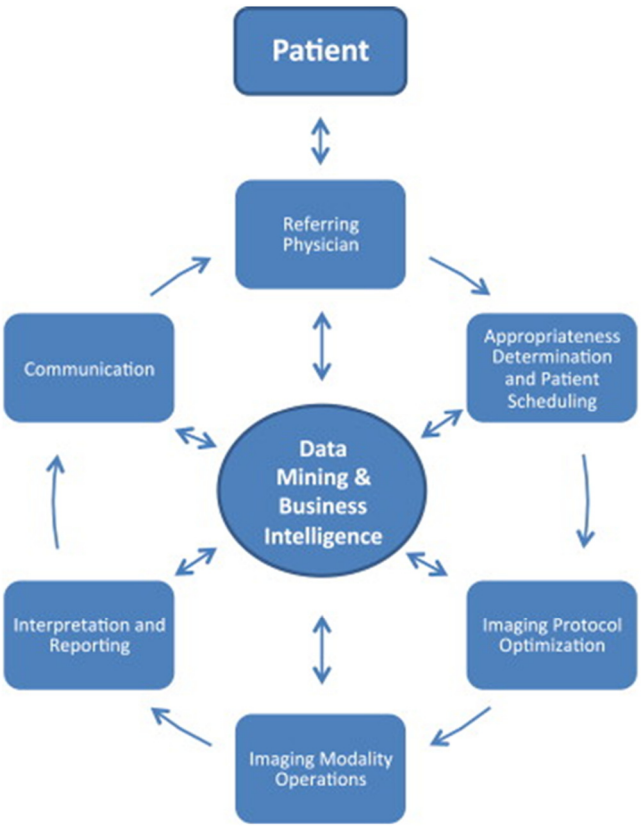

Figure 1. Schematic representation of the imaging value chain, reproduced with permission from publisher (Elsevier). (Color version of figure available online).

In this second part of our series, we explore the value chain further and outline initiatives for academic radiology

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departments to consider in enhancing their value to patients, referring clinical practices, payers, and a variety of other stakeholders. These all represent actionable opportunities for radiology professionals to gather evidence to demonstrate their value and for innovative investigators to pursue new research.

STANDARDIZATION

Numerous opportunities exist for radiologists to improve the value of imaging through standardization. Proper implementation with widespread support can result in the ultimate win–win: improved care with less cost. Variation is not only costly, adding some $700 billion in annual costs to our health-care system (3), but it also raises questions about the quality and efficiency of resource allocation and use—issues increasingly important in a fragile health-care delivery system with only finite resources. Although the sources of variation are not always clear, studies have demonstrated that variations in measures such as hospitalization rates depend on many factors other than illness (4). Nevertheless, it is impossible to build an evidence-based best practice guideline that perfectly fits all patients' needs and preferences. The key is to eliminate unwarranted variation when evidence-based guidelines exist while recognizing that not every situation may be covered by guidelines or that patient preferences may require deviation.

Perhaps the best-known example of standardization in radiology is the creation of Digital Imaging and Communications in Medicine standards. This now permits images to be shared and viewed on different Picture Archival and Communication Systems (PACS) systems, thereby improving efficiency and reducing duplicate imaging. Other recent standardization initiatives that can positively affect patient outcomes include radiation dose registries to reduce variation in dose, guidelines for management of incidental and other common imaging findings, standardization of examination nomenclature, structured reporting, and clinical ordering decision support.

Wide variation exists in radiation doses patients receive across institutions; the US Food and Drug Administration measured average doses for noncontrast head CT scans in 2000 and 2001 across 203 institutions and found a 10-fold variation (5). With the goal of establishing regional and national benchmarks to reduce radiation doses, the American College of Radiology (ACR) recently created its Dose Index Registry in 2011. Two years later, more than 750 facilities were registered (6). This registry allows facilities to compare their CT dose indices regionally and nationally (7). Participating facilities receive semiannual reports that provide comparisons of dose indices for each procedure relative to all others. More recently, the ACR added the capability to compile reports comparing data across an institution's own facilities, scanners, and protocols, providing even more actionable information for further dose reduction efforts (8).

One of the biggest hurdles for this registry has been the enormous variability in examination nomenclature (6,9). More than 1000 different names, for example, were found to denote a CT scan of the head. In response, the ACR Dose Registry Index utilizes the Radiological Society of North America RadLex Playbook, which provides a comprehensive set of standard names that enables institutions to map their own terms to common Playbook terms (10). Such common language enables radiologists to more easily meet emerging regulatory requirements and participate in national quality initiatives, in addition to helping them improve the quality of patient care (11).

Opportunities for standardization of practice also exist for image interpretation and reporting. There are an increasing number of society-endorsed guidelines for the management of imaging findings. For example, the ACR has recently begun publishing white papers on the management of incidental findings (12). However, adherence to guidelines still remains variable. Radiologists' adherence to the Fleischner Society Guidelines for pulmonary nodules, for example, has been reported to be between 34% and 82% (13,14).

Some guidelines provide a lexicon for result reporting as well as standard recommendations for results. Aside from improved radiology report formatting, the use of standard language in radiology reports is crucial to the quality of patient care; consistent terminology, syntax, and recommendations make actionable information easier to find and understand. The best example is the longstanding Breast Imaging Reporting and Data System (BI-RADS®, ACR) for breast imaging, which has been shown to be successful in unambiguously communicating results and recommendations (15). Similar lexicons such as Liver Imaging Reporting and Data System (LI-RADS™ ACR), Prostate Imaging Reporting and Data System (PI-RADS™), Head Injury Imaging Reporting and Data System (HI-RADS, ACR), and Lung Reporting and Data System (LungRADs™, ACR) are under development or in early stages of use (16). Standardized reporting can be further encouraged by decision support systems that are currently being developed to prompt radiologists to use clinical guidelines at the time of dictation. For example, the identification of an adrenal nodule may trigger a template to document relevant imaging features and suggest appropriate management (17).

Unwarranted variation can also take the form of either over- or underutilization. Over the past decade, the medical community has made significant gains in the delivery of underused care in the ambulatory setting, but reductions in overutilization have been more modest (18). There are many examples of overutilization in radiology; for example, one study found that 9–14% of CT pulmonary angiograms performed for the evaluation of patients with pulmonary emboli could be avoided based on clinical criteria that incorporate a negative D-dimer (19). An example of underutilization within radiology was highlighted in a 2012 study reporting a decline in the rate of bone density testing following the implementation of Medicare reimbursement reductions for office-based dual-energy X-ray absorptiometry scan in Medicare-eligible patients without private insurance (20).

IMAGING APPROPRIATENESS AND DECISION SUPPORT

To address both over- and underutilization, radiologists must collaborate with their clinical colleagues to establish guidelines on appropriate imaging and to develop decision support tools to make these guidelines actionable. In an effort to reduce both cost and radiation dose, the Centers for Medicare and Medicaid Services (CMS) and other policy makers are pursuing incentives to curb inappropriate imaging. At present in most markets, radiology benefits managers decide which studies are appropriate and will be reimbursed. But often, those decision-makers lack expertise and their approval processes lack transparency (21). The ACR and 25 other national societies representing multiple specialties, including the American Medical Association (AMA), have voiced their opposition to the use of radiology benefits managers to assess imaging appropriateness in a letter to the CMS (22). Moving forward, as patients become directly responsible for an increasing proportion of their own medical costs, the interests of both physicians and patients in imaging appropriately may be increasingly aligned.

Although decision support tools may be a more welcome way to curb inappropriate imaging, encouraging clinicians to image appropriately will continue to pose challenges. First, there is limited availability of nationally accepted evidence-based guidelines. Although the ACR developed the Appropriateness Criteria over two decades ago, and guidelines now exist for more than 200 clinical conditions (23), it remains unclear how often ordering providers use these guidelines in daily practice. A survey of physicians of multiple specialties revealed that only two out of 126 surveyed physicians consulted such criteria as their first source of information when deciding the best imaging technique for their patients (24).

Incorporating decision support into the electronic physician order entry system would help raise awareness of appropriate imaging guidelines, and also potentially make the process more seamless. To date, however, only few studies provide direct evidence that these guidelines reduce inappropriate imaging at the point of care (25–28). To gather more evidence on the impact of clinical decision support at order entry, the CMS recently supported a 2-year demonstration project to assess the effectiveness of decision support systems in reducing inappropriate imaging for 12 advanced imaging exams deployed across five conveners representing diverse practice settings (29). The recently reported results were unimpressive—most (60%) of the orders were not covered by guidelines and could not be rated. Only one convener showed an increase in the rate of appropriate imaging with an accompanying decrease in inappropriate orders, and there was no significant difference in the rate of utilization before and after intervention. Furthermore, fewer than 50% of physicians in the study felt that the information provided was useful in their clinical practice. Many reported frustration with the user interface and system workflow. But the methodology used in that demonstration project has been criticized. Major contributors to the study's findings (e.g. poor integration of the decision support systems and unreliable appropriateness scoring) have improved dramatically since the study was initiated (30,31). Congress recently indicated its support of clinical decision support tools, recently passing legislation that specifically mandates the utilization of appropriate use criteria. A decision support mechanism will be required for any advanced imaging ordered for Medicare beneficiaries beginning in 2017 (32).

Although the results of the CMS demonstration project were disappointing, decision support systems have been shown to be successful when employed in more targeted manners, such as using a clinical decision rule (CDR) for a specific indication. Whereas the Appropriateness Criteria provides the likelihood that an exam will be useful for answering a clinical question, a CDR uses a decision tree to delineate the conditions in which an exam should or should not be ordered, "similar to following specific directions on a map rather than numeric indicators for the appropriateness of the roads ahead (33)." Examples of CDRs include the Ottawa Ankle Rules and the Pediatric Emergency Care Applied Research Network traumatic brain injury rules (34). Using CT head exams as a control, the Virginia Mason Medical Center has incorporated guidelines for lumbar spine magnetic resonance (MR) examinations for low back pain, brain MR examinations for headache, and sinus CT examinations for sinusitis. In all three scenarios, Virginia Mason investigators have concomitantly demonstrated a statistically significant decrease in the utilization of all three examinations, but there was no change in the volume of head CT examinations. Importantly, as an alternative to these examinations, the provision of prompt specialist consultation or therapy was made available when indicated (26). Examples of successful targeted decision support interventions outside of radiology exist, such as a system that promotes the judicious use of antibiotics (35). However, there are relatively few targeted and robust CDRs for specific indications. To make a broad impact, decision support systems may need to incorporate targeted guidelines, some of which may be developed locally, as well as the more broad-based recommendations of the ACR Appropriateness Criteria. On the other hand, incorporating too many sources can be confusing, and incorporating new guidelines are time-consuming and expensive for local health systems to maintain. A single comprehensive source, such as ACR Select (the decision support platform for the ACR Criteria), offers an online repository that can be updated by national experts as necessary (36). Nonetheless, some departments, particularly academic departments, may need the flexibility to incorporate local guidelines and support research protocols.

Although practices will be required to integrate decision support into order entry systems beginning in 2017, meaningful changes in practice patterns will also likely require continued development of robust evidence-based guidelines by multidisciplinary teams to ensure buy-in from ordering providers, changes in financial incentives, and legislative reform to reduce the fear of litigation for practices that conform to

national guidelines. Greater collaboration between radiologists and referring physicians will be necessary to facilitate these changes, so radiologists should pursue leadership roles in the development of guidelines and the implementation of user-friendly, efficient decision support systems. Ideal decision support systems may ultimately include the opportunity for phone, virtual, or face-to-face discussion, so radiologists need to be open to such technological and cultural iterations. These interactions have become less frequent in the era of PACS but remain crucial in complex medical decision-making.

PATIENT–RADIOLOGIST COMMUNICATION

To many patients, radiology is identified only by the equipment used or by the technologist who administers the scan, instead of by the radiologist's interpretation and diagnosis (37). Many patients erroneously believe that the physician ordering the examination is also the physician interpreting the study (37). Because of the limited contact that radiologists have with patients, radiologists often have an invisible role as physicians (38). There have been several efforts to facilitate communication between patients and physicians in some subspecialties, such as breast imaging; however, numerous factors continue to pose a barrier to patient–physician communication: radiology offices are often distant from patient rooms; there is frequently a lack of consulting rooms; radiologists are usually busy and focused on a work list; and there is a common belief among radiologists that a clinical encounter adds little value to the imaging report (37,38).

It is essential for the future of radiology—being the clinical specialty that it is—to achieve public recognition of its increasingly important role. Many opportunities exist for radiologist contact with patients during the examination in addition to direct communication of imaging results, providing patient-friendly imaging reports and online education materials, and advocating for the construction of radiologic facilities that promote comfortable interactions between patients and radiologists (37,38). The general public's perception of radiologists has been the target of several outreach campaigns by the ACR, including the Face of Radiology Campaign and Imaging 3.0 (39,40), with the latter also advocating radiologists to become more visible to referring clinical colleagues (41).

Recent survey results showed that most patients prefer to receive imaging examination results from radiologists at the time of examination rather than later from referring physicians (42,43). Furthermore, patients also prefer to have prompt access to radiologic results, regardless of the specific findings (42,43). Many health-care systems already use direct online portal systems for patient access to reports, an approach that is preferred by some patients (44). Although referring clinicians and radiologists tend to support disclosure of imaging results to patients by radiologists (45), there remains concern about patients' understanding of report content. Some referring physicians are concerned that disclosing results directly to patients could result in increased patient anxiety or confusion, negative impact on the referring physician workflow, and loss of control over patient–physician relationship (46). Direct communication to patients has already been in effect in breast imaging for nearly two decades and is an opportunity for radiologists to increase their visibility to the patient and potentially to provide more direct care. Further investigation is needed to understand the effect of direct communication on patients' perception.

Another important step toward patient-centered care in radiology is the use of simple and understandable language during patient communications. This includes both radiology reports on patient portals (46) and online education materials. A recent study reported that 80% of Americans use the Internet as a source of health-care information (47). And, although the AMA has claimed that the average adult American reads at an eighth-grade level (48), the few available studies show that the readability of online education materials on radiology websites exceeds the general reading level of the public (49,50). Redesign of these websites is strongly recommended to broaden the patient population that could benefit from them.

REFERRING PHYSICIAN–RADIOLOGIST COMMUNICATION

Structured Radiology Reports

Radiology reports are the main, and sometimes only, means of communication between radiologists and referring physicians (51). Information from radiology reports is used for billing purposes (52), and in some practices for research and pharmaceutical trials (53). In an era in which the use of PACS is widespread, providing easy access to both images and reports, radiologist consultation by referring physicians declined by as much as 82% for plain radiography and 44% for cross-sectional imaging, further emphasizing the importance of meaningful and actionable radiology reports (54). Ambiguity and other poor communication can result in patient care mismanagement and ultimately in malpractice suits (52). It is therefore crucial to understand the preference of referring physicians, who are the main consumers of radiology reports, regarding the formatting and contents of reports.

The value of structured reports was recognized at the 2007 Intersociety Conference, and members of the 53 participating national radiology societies recommended the use of structured reports, citing ease of information extraction as its principal benefit (55). Structured reports ideally divide information into meaningful sections with consistently ordered information using a standard lexicon. Surveys of referring physicians demonstrate a strong preference for structured and itemized radiology report as opposed to free-text reports. Additionally, reports that include comments on normal and abnormal imaging findings (56–58) and recommendations on further needed imaging studies (57,58) are also perceived more favorably. Oncologists, for whom imaging-derived tumor measurements serve as quantitative biomarkers in guiding patient

treatment, prefer reports with dedicated structured measurement sections, for example, in the format of a table (53). With recent technological advances, radiology reports can now include quantitative metrics such as size of a target lesion over a specific time period in the format of graphs and tables, and hyperlinks to key images or positive imaging findings described in the text. Recent work has shown that including relevant images in the report saves time, increases referring physician confidence in deciding treatment plans, and meaningfully alters patient management (59). Referring physicians are particularly supportive of multimedia-enhanced radiology reports (60,61) and most would preferentially refer patients and peers to facilities offering more meaningful image- and graphics-enriched reporting platforms (61). The use of standard lexicons such as Bi-RADS clarifies findings and recommendations and thus nicely complements such multimedia initiatives.

Radiology Consults

A variety of methods is available to improve clinicians' ability to interact with radiologists in ways other than reading radiology reports. These include traditional methods such as in person consultation, telephone, and paging. E-mail and other digital communication tools—including instant message and online "face-to-face" consultations—can also be employed. Although improving communication with referring physicians without any loss in radiologist throughput remains challenging, it is also a rewarding endeavor, both professionally and monetarily, if it becomes a component of reimbursement, as CMS and other payers shift from rewarding volume to value (62).

Radiologists can pursue a number of strategies to improve communication and visibility. One is participating in daily inpatient rounds with other clinical specialties. Mamlouk et al. (63) reported a novel educational experience with radiology residents serving as consultants on internal medicine rounds. They aimed to increase the visibility of the radiologists by having them participate in team rounds, educate referring physicians about imaging protocols and radiation dosing, and educate patients about what radiologists do on a daily basis. Videoconferencing is another form of face-to-face consultation with referring clinicians. Khandheria et al. (64) performed such a pilot study, developing a tablet application for videoconferencing using a concomitant PACS interface. Such tools have several possible applications, including increased communication with clinicians, intraoperative surgeons, other radiologists, and even patients. Finally, one structural consideration to improve communication capabilities between radiologists and referring physician is relocating the reading room. Tillack and Borgstede (65) reported that radiology reading rooms with close proximity to certain specialists, specialty clinics, or the emergency room increase referring physician–radiologist face-to-face interactions.

Participation in multidisciplinary conferences such as tumor boards can increase the visibility of radiologists, their interaction with colleagues, and all the while improve patient care through improved provider communication. Quantifying the value of participation in these conferences, however, can be difficult, as there is often no radiology report or clinical note will be generated in patient's medical record, and therefore, the time spent in these conferences cannot be billed (66). But, practices that track such efforts can demonstrate considerable value to their institutions (67).

Telephone and face-to-face communications require radiologist and referring providers to be available simultaneously. This is often not a practical or efficient method of communication—there are other Health Insurance Portability and Accountability Act (HIPAA)-compliant online tools that allow asynchronous communication. A common use for such a tool is the "wet read." Mates and colleagues describe a tool that allows the preliminary interpreting physician to enter a preliminary report, which the referring provider can then acknowledge (68). When a final report is rendered, the interpreting radiologist determines if there is a significant discrepancy, which can then be notified to the referring physician or emergency department for reconciliation. Although this system was locally developed and deployed, other commercially preliminary report communication systems are available, although they may not provide the features of feedback and discrepancy notification.

Reinterpretation of Outside Radiology Images

The reinterpretation of outside images at tertiary referral centers is one way that academic radiologists can enhance value by providing additional subspecialty information, all the while reducing the need for repeat imaging and its incumbent cost and radiation dose. Such second-opinion services can be applied in a number of settings but have been specifically studied in transfers to tertiary trauma centers (69–72). Sodickson et al. (69) reported a retrospective series of more than 1000 emergency department transfer patients with outside images uploaded to PACS. For patients with successfully imported images, the mean number of imaging studies performed after transfer was significantly lower compared with that of patients with failed imports. Importantly, secondary subspecialty interpretations can alter the clinical management; in one study, 21.7% of 773 exams referred to a pediatric tertiary care hospital had major discrepancies between the secondary and original interpretation. Of the 96 cases where the final diagnosis could be independently verified, the secondary interpretation was concordant with the final diagnosis in 90.2% (75).

Although secondary interpretations are often requested informally as a "curbside consult," undocumented interpretations that change management may create liability exposure for radiologists—such interpretations may be inadequate because of the urgent nature of the request for information or may be misinterpreted and misquoted by the requesting physician (73). Formal interpretations are accordingly encouraged. A formal review process is particularly important in academic centers where on-call residents are asked to review outside

imaging without attending supervision. In one study, a process for submitting these exams for formal interpretation allowed attending oversight of 106 resident-interpreted exams over an 8-month period while providing a new source of revenue for the academic department (74).

CONCLUSIONS

As policy makers and payers continue to push providers to deliver increasingly high value care, academic radiologists should align their clinical and research interests accordingly. Quality initiatives that deliver safer, higher quality, and more efficient care will increasingly be rewarded. Research that demonstrates the value (or not) of various initiatives will as well be increasingly sought and supported. Together, these efforts will enhance the perception of radiology's value to patients and a variety of other stakeholders. Standardizing imaging practices, promoting appropriate imaging, and improving communication with patients and referring providers will collectively move the specialty in this direction.

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