Overview

Radiologists are recognizing that a significant portion of important imaging care occurs prior to and following the interpretation. For a variety of reasons, radiologists are not leveraging their role in providing the majority of that care. By utilizing their expertise, radiologists can expertly manage all aspects of imaging care prior to and following the interpretation to improve patient safety and outcomes and to deliver more cost-effective care. By leveraging information technology systems and processes, organized radiology can foster development and provision of the tools radiologists need at the point of care to optimize the pre and postinterpretation imaging care. Providing this type of care will improve patients’ outcomes and increase radiologists’ relevance to the health-care system. With proper incentives from policy-makers, optimized imaging care beyond the interpretation will improve patients’ care experience, improve the health of the population, and lower the per capita cost.

Imaging 3.0 is a term loosely modeled after the evolving concept of Web 3.0. Nova Spivak describes Web 3.0 as “more connected, more open, and more intelligent. It will transform the Web from a network of separately siloed applications and content repositories to a more seamless and interoperable whole” [1]. Parallels may be drawn to the next evolutionary stage of radiology practice. The label “Imaging 3.0” was chosen to signify a departure from the conventional way in which radiologists have engaged in health care. The constituent parts of the Imaging 3.0 framework are all selected to serve an overriding philosophy for the path forward for radiologists in the new, integrated health-care environment. Imaging 3.0 encompasses the entire imaging care pathway: from the point at which the referring clinician considers imaging to the delivery of actionable recommendations for the patient and their referring provider. The more traditional view of the radiologist’s role (to acquire images and generate a report on those images) is no less important in the new paradigm of Imaging 3.0, but it resides within an expanded concept of how radiologists contribute to value-based, integrated health-care delivery.

A significant portion of important imaging care occurs prior to and following the interpretation, but many radiologists are unaware of this and may not provide care effectively under the traditional paradigm. IT tools are critical elements and drivers of success. These tools must be developed and employed with the goal of providing the radiologist “just-in-time” information to keep the patient at the center of the system, delivering high-value imaging care. Organized radiology, specifically the American College of Radiology (ACR), is the natural convener and resource for the development of this Imaging 3.0 toolkit. The implementation of Imaging 3.0 will improve patients’ outcomes and
increase radiologists’ relevance to the health-care system and, with proper incentives from policy-makers, will allow radiologists to play their vital role in the delivery of high-value care.

**Background**

The triple aim of health care — to improve population health and health-care quality, to optimize patient experience of health care, and to control costs — is now embedded in health-care policy and payment design. Radiologists have tended to be viewed as part of the old “volume-driven,” transactional, and fragmented world of care delivery. This misperception has developed largely because radiologists frequently do not become involved until after the examination has been performed. Using the defense that “we are only doing what was ordered,” radiologists have abrogated their role in only providing appropriate imaging care. Yet the vast majority of the rapid rise in imaging utilization in the early years of this century has clearly resulted from the spectacular diagnostic possibilities afforded by technology such as CT and MR and the positive impact these modalities have on effective diagnosis and treatment. This is evident in a survey of 225 internal medicine physicians published by Fuchs and Sox [2], who considered CT and MRI the most important medical innovations of the last 30 years.

However, with decisions regarding appropriateness of imaging completely in the hands of the ordering physician, knowledge gaps, defensive medicine, and economically motivated self-referral have all contributed to overutilization [3,4]. Unfortunately, policy-makers and payers have chosen to respond to this increase in volume by across-the-board reimbursement cuts rather than by system redesign to incentivize the appropriate use of imaging. Faced with cascading cuts in reimbursement and recognizing the changing health-care policy, ACR leadership embarked on a clear-eyed evaluation of the ways in which radiologists could survive and thrive in this new world. Taking a fresh look at how radiologists might be able to provide maximum value to health-care delivery, our profession is realizing that this approach represents a tremendous opportunity to enhance the impact of imaging care on our patients [5]. Imaging 3.0 is the corresponding framework that allows radiologists to optimally position themselves for this transformation.

**Technical Details**

Imaging 3.0 principles can and should inform every step of the delivery of imaging care. From strategic planning (to ensure that patients and referring providers have access to the most appropriate and current technology) to optimizing imaging protocols, the philosophy that places the patient at the center of the care-delivery process should be paramount. This philosophy is captured in Figure 1, the Imaging 3.0 – Beyond Image Interpretation flowchart.
Specific attention to IT processes offers several important opportunities to apply the Imaging 3.0 paradigm. Radiologists can and need to be involved every step of the way, but a useful framework to consider the opportunities afforded by Imaging 3.0 looks at the process of imaging care in three phases: prior to imaging acquisition, during image acquisition and interpretation, and after acquisition. Clearly, overarching IT processes and tools inform the universe of Imaging 3.0 care.

**Overarching Processes and Tools**

**Meaningful Use and Certified Electronic Health Record Technology**

A radiology practice that espouses the principles of Imaging 3.0 will be committed to leveraging every opportunity to improve its technology infrastructure. It can certainly be argued that the applicability of Meaningful Use incentives to radiologists has not always been clear. In addition, busy practitioners who are focused on providing care to their patients may not have had time to spend the time needed to understand the regulations and profit from these incentives. This manual features an article on Meaningful Use by Krishnaraj et al, which is highly recommended to the reader. Other excellent resources are available from CMS, the Healthcare Information and Management Systems Society, and RadiologyMU.org. These resources may be used to inform and help radiologists participate in Meaningful Use incentive programs.

**Standards**

The use of evidence-based practices is important in the delivery of Imaging 3.0 care. Brent James’s seminal work at Intermountain Healthcare [6] has demonstrated the need to reduce variability to drive better outcomes. Are standards universally applicable? Of course not, but their use is an excellent framework from which to innovate.
Radiologists should acquire a working knowledge of IT standards because they impact important equipment purchasing and operational decisions that support the infrastructure enabling Imaging 3.0. An article by Carrino et al in this manual discusses the most important aspects of IT standards.

**Security and Privacy**

As previously stated, the Imaging 3.0 radiologist has the patient at the forefront of his or her practice decisions. We cannot provide the best imaging care to our patients if we do not act as their advocates and ensure that their imaging record is available freely to those who need it in care decisions; alternatively, it is critical that their imaging record be inaccessible to those who might try to access it inappropriately. Again, this is a responsibility of the Imaging 3.0 radiologist as a treating physician.

**Workflow Processes**

A radiology practice that adheres to the principles of Imaging 3.0 will have a constant process to document, critique, and improve its workflow processes. Informed by the philosophy of patient-centered imaging care, the Imaging 3.0 radiologist will always look for ways to improve departmental processes to better serve the health-care community. Examples include monitoring CT dose estimates via machine and technologists to discover opportunities for dose reduction, initiating projects to decrease patient wait times, improving turnaround time for reporting, working on communication of critical findings, or implementing systems that link prioritization of exams to be read to actual clinical status or future patient appointments.

**Business Intelligence Analytics**

As referenced above, the Imaging 3.0 practice involves a constant search of knowledge and improvement. Using key performance indicators and leveraging IT to share and communicate results is a key driver of Imaging 3.0 success. Part of the knowledge gained comes from business intelligence analytics and is expanded on in an article by Cook et al.

**Imaging 3.0 Prior to Imaging Acquisition and Interpretation**

Clinical Decision Support

The need to collectively work toward appropriate use of modern imaging is widely recognized. Radiologists have a tremendous opportunity to serve as leaders in this regard and rediscover their role as consultants to referring physicians and patients. Even as imaging utilization growth has flattened, every radiologist regularly encounters requests for the wrong imaging test or an imaging test that may not be helpful or may use excessive radiation considering the question at hand. Medicare rules often limit the ability of the radiologist to independently change the test that was ordered. A patient who has taken time off work and prepared for one particular exam will be understandably annoyed if the test their doctor requested is not performed for reasons that are often not easily understood by the patient.
Radiology benefit management companies (RBMs) have captured a large market share with commercial insurance carriers in their role as gatekeepers to high-cost imaging exams. Although these companies tout significant savings in terms of reducing advanced imaging utilization it is by no means clear that these reductions are intransient. Costs shift to providers who must employ staff to log hours on the phone to get imaging studies approved as well as manage steerage programs that divert patients away from trusted imaging providers; these consequences have limited the popularity of RBMs to the payers who employ their services. The algorithms by which RBMs determine the appropriateness of exams are opaque and may not be solely based on medical necessity and evidence.

The imaging armamentarium is filled with phenomenal tools, but choosing the right one can be a challenge. For a busy primary care provider or, as is expected to be the new normal under the Affordable Care Act, the mid-level provider, decision making regarding the type of imaging test best suited to answer the clinical question is hard enough.

The ACR Appropriateness Criteria® have been freely available to the health-care community since 1995. However, after licensing this intellectual property to the National Decision Support Company, the Appropriateness Criteria can be leveraged as an invaluable decision-support tool for providers. Whether embedded in the electronic health record system or accessed via computers or even mobile devices as a standalone, Web-based program, clinical decision support for imaging is a clear demonstration of the value of the radiologist in determining care pathways.

Some radiologists have expressed concern that the use of clinical decision-support tools would render their expertise irrelevant. The growing set of decision-support tools, which can be accessed by modality or based on indications/symptoms, though comprehensive, is by no means all-inclusive. Individual clinical situations and patient characteristics will require consultation with the radiologist. Priorities and preferences of the interdisciplinary or institutional team of physicians may impact the way in which decision support is implemented or modified to best serve the local standard of care. When the system indicates that a particular exam order is considered indeterminate or even inappropriate, the need for consultation with the imaging expert arises quickly. The Imaging 3.0 radiologist will be readily available by phone, secure messaging, or even online chat to aid the referring provider in choosing the appropriate imaging examination and to discuss the various alternatives.

The willingness of radiologists to overcome stereotypes about being the beneficiaries of the volume culture of fee-for-service medicine allows the ACR to tell a new and compelling story to policy-makers and payers about the key role that radiologists play in the delivery of high-value, cost-effective care. Imaging 3.0 is that story.

**Dose and Safety**

Although Imaging 3.0 is a new term for the discussion of the care process beyond the interpretation, much of the Imaging 3.0 toolkit has been in existence for decades. However, by placing these existing tools and concepts under the Imaging 3.0 umbrella we can highlight where ongoing programs are congruent with the goals of optimizing imaging care. One such initiative is patient safety during imaging.
As the imaging experts, radiologists are best positioned to ensure that imaging care is delivered as safely as possible. The ACR and the Radiological Society of North America (RSNA) formed the Joint Task Force on Adult Radiation Protection in 2009 with support of the American Society of Radiologic Technologists (ASRT) and the American Association of Physicists in Medicine (AAPM) to address concerns about the surge of public exposure to ionizing radiation from medical imaging. These organizations, as well scientific publications, media, and government have addressed radiation concerns in recent years. The various activities are nicely summarized in two publications by Amis et al [7,8].

ACR and RSNA have also collaborated to develop a comprehensive patient information resource on all issues revolving around imaging, RadiologyInfo.org. Of particular interest may be the Radiology Benefits and Risks Primer, which directly addresses patients' concerns about the use of radiation in medical imaging examinations. Patients can also learn about radiation dose from X-ray and CT exams from this trusted resource.

The Joint Task Force collaborated with the AAPM and the ASRT to create the Image Wisely® campaign with the objective of lowering the amount of radiation used in medically necessary imaging studies and eliminating unnecessary procedures. The Image Wisely Website offers resources and information to radiologists, medical physicists, other imaging practitioners, and patients.

The Image Gently® campaign is an initiative of the Alliance for Radiation Safety in Pediatric Imaging. The campaign goal is to change practice by increasing awareness of the opportunities to promote radiation protection in the imaging of children. Pledging to image wisely and gently and modifying imaging practices to adhere to the principles promulgated by these campaigns demonstrates this leadership.

The ACR Dose Index Registry should be used to allow practices to see aggregated radiation exposure, benchmark their groups against other practices, and correct issues if there are outliers.

The ACR was a founding member of the Choosing Wisely® campaign in collaboration with multiple other medical specialties under the auspices of the American Board of Internal Medicine. This widely publicized campaign seeks to change provider behavior regarding the use of diagnostic tests.

The aforementioned programs and collaborations all preceded the development of the Imaging 3.0 initiative, but all are comfortably within it. By demonstrating leadership in radiation safety and commitment to patient and provider education, radiologists are espousing the Imaging 3.0 philosophy.

**Imaging 3.0 During Image Acquisition and Interpretation**

**Education and Training/Qualifications**

Health-care IT has evolved rapidly and represents critical infrastructure to accomplish Imaging 3.0. As a result, radiologists should place a high value on their IT solutions and the staff supporting those resources. IT is generally perceived as a generic or one-size-fits-all support service that is interchangeable throughout an organization. The reality is that IT has
become subspecialized. The article by Flanders et al in this IT manual is designed to serve as a guide for you, the practicing radiologist, to build an effective IT division by considering education, training requirements, and suitable personnel qualifications. It also focuses on the critical role of the radiologist IT liaison in bridging gaps among organizations’ IT, medical, and administrative functions.

Additionally, attaining certification and accreditation by appropriate certifying bodies is critical to demonstrating quality and expertise to patients, peers, and payers. Facility accreditation, physician and technologist certification, and ongoing peer-review programs are all important in demonstrating this quality. Physicians should also demonstrate their commitment to quality and expertise by achieving certification by the ABR or equivalent (as delineated in the ACR Practice Guidelines and Technical Standards) and by meeting the requirements of the ABR Maintenance of Certification program. Radiologic and ultrasound technologists should be accredited by the ASRT and the American Registry for Diagnostic Medical Sonography, respectively. Peer review, continuing education, and the provision of a learning environment for all personnel in the imaging department represent the Imaging 3.0 commitment to high-value care.

**Image Acquisition**

At the image acquisition stage, the radiologist must work closely and proactively with medical physicists, radiologic technologists, and ultrasound technologists to develop protocols that combine the highest diagnostic accuracy with the safest and most comfortable patient experience. Minimizing radiation dose is a key focus. Finding a balance between reproducibility and standardization of image quality and the type of customization that is especially important in pediatric imaging will be critical.

**Archive and Retrieval**

Providing the highest quality imaging care requires comparison with relevant prior studies and secure storage of current data to facilitate future care. As outlined above, Imaging 3.0 requires that these steps in the IT process be invisible to the patient and referrer. A patient should never require a repeat study because prior imaging is not available. A referring physician should never have to delay a decision because a report is incomplete and awaiting prior studies. The responsibility for ensuring the availability of prior imaging data and the secure storage of the current study falls squarely on the shoulders of the Imaging 3.0 radiologist. It is not acceptable to blame IT or hospital administration. Imaging 3.0 requires the radiologist be part of the decision-making process regarding archiving and data storage solutions. We must act as advocates for our patients in this regard.

**Display**

Apart from the obvious need for image displays to support the work of the radiologist, Imaging 3.0 requires that attention be paid to the all-important work of consulting with referrers and patients regarding the information contained within the images. Consideration should therefore be given to how imaging information can be displayed in a way that optimizes those interactions. Please review the article on Displays by Hirschorn et al in this manual for all related issues to consider.
**Reporting and Communication**

Effective radiologist participation in the care-delivery process is at the heart of Imaging 3.0. An actionable, comprehensible, and appropriately communicated report is the most important product we deliver. Work is underway at the ACR to deliver content to IT vendors to enhance the delivery of imaging reports to referring physicians and patients alike. For more on reporting and communication, read the article by Weiss et al.

**Imaging 3.0 in the Postimaging Acquisition and Interpretation Period**

**Transmission and Communication**

Imaging 3.0 stresses the tremendous added value of the timely delivery of actionable, accurate reports on imaging exams to the point of care. With “length of stay” in the emergency department and in the hospital becoming a major efficiency measure it is crucial that such information be delivered in a secure, complete, and timely manner. The multiplicity of electronic health record vendors necessitates a nimble and flexible approach to ensure delivery of the report where and when the referring clinician requires it.

**RIS/EMR**

Making actionable imaging reports available seamlessly in the EMR is a key deliverable of Imaging 3.0 and is the subject of the article by McEnery. The use of structured reporting, the implementation of communication protocols around the reporting of critical results, and the ability to communicate securely with both referring providers and patients are all tools that can enhance a practice’s Imaging 3.0 performance.

**Communication With Mobile Devices**

Imaging 3.0 means delivering diagnostic decision support to our referring providers and imaging care to our patients in a way that is convenient and relevant for them. It is no longer acceptable to cite privacy concerns or software incompatibilities as reasons not to embrace mobile technology. The world runs on a mobile communication platform, and Imaging 3.0 challenges the radiologists to securely and accurately make imaging information available on mobile devices. Please refer to the article by Hirschorn et al for more detailed information on issues surrounding mobile devices.

**Practical Implications and Implementation**

Imaging 3.0 is a journey that individual radiologists and practices will travel at different speeds. It is important to remember that the philosophy of being at the center of care depends mostly on the willingness of radiologists to assume that position. Our radiology forefathers did not have sophisticated IT tools but perhaps occupied a more pivotal and direct role in the care-delivery process. Some of our most important IT advances have had unintended consequences and have removed us from our physician colleagues and patients. Payment system design has incentivized productivity over radiologist interaction with physician colleagues and patients. In the future, it will be wise to leverage IT tools to make us more available and visible. Radiologists must take on this leadership challenge now; it requires intense communication with our colleagues to align them (and imaging
operations) with our professional direction and vision for the future and hard work to motivate all individuals involved with the idea that, in the end, radiology and its patients will be better for these changes.

A useful first exercise for any practice or practitioner is to "walk" through the Imaging 3.0 workflow. Making optimal use of the tools already available and communicating those to the patient and referrer community is an excellent start. For example, a review of a practice's RIS and PACS capabilities can be used to determine where there are as yet unused opportunities to connect with patients and referrers. A practice that has already pledged to image gently and image wisely and has attained full ACR Accreditation can benefit from ensuring that these commitments to high-value care are widely communicated to its healthcare network.

Next, the practice should perform an assessment of the Imaging 3.0 tools and activities it is not currently active in and pursue as many as is practical. Some decisions, such as improving PQRS participation, may be practitioner-level decisions, whereas others such as adopting clinical decision support will be at the health-system level. A key parallel initiative should be for members of the radiology practice to become as active as possible in the health system's committees and workgroups. If the practice participates in a shared savings model, a seat on the governing board of the accountable care organization is ideal.

Questions to Ask Your IT Staff and Vendors

Imaging 3.0 and the philosophy of expanding the understanding of what constitutes imaging care should inform all interactions around IT. It is no longer enough for an IT tool to promote radiologist productivity. Although if that is the case, the tool's value should be measured in terms of the time it affords the radiologist to interact with referrers and patients. Ease of use for patients and referrers is a key deliverable for IT tools that should assume a much higher priority in the Imaging 3.0 practice. The goal of controlling costs, along with the greater number of integrated practices, makes it imperative that IT tools and systems are as cost-effective as possible. As such, an Imaging 3.0 value checklist for IT tools might include such questions as:

- How does this product help my patients?
- How does this product help the providers who refer patients to my practice?
- Does this product optimize my practice costs?
- Do I currently have a way to measure noninterpretive, value-added work performed by radiologists that benefits patient care but is not currently captured in work relative value units?

Dedicated ACR Imaging 3.0 Online Resources

The ACR maintains a dedicated collection of Web resources on the topic of Imaging 3.0. Among other items, several case studies are available on the site, including:

- Partnership for Success
- Better Together
- Class Act
- Bending the Cost Curve
• Value-based Payments
• Recognition for Radiology
• Fortresses With Moats
• Raising Standards

Other resources on this topic include frequently asked questions, overview of relevant organizations, the presentation “What is Imaging 3.0,” Accountable Care Organization information, the Imaging 3.0 track of the Radiology Leadership Institute, and other items.

Conclusion

The Imaging 3.0 initiative represents a framework designed to facilitate a profound culture and practice paradigm shift within radiology. It aims to equip the 21st century radiologist with the necessary knowledge, tools, and attitude to embrace a leadership role in evolving health-care delivery in general and imaging care in particular. By critically examining and leveraging all opportunities for value delivery in integrated imaging care, radiologists will be able to provide quality patient care under the new payment models. From this realization flows the need for investments in technology and human resources to ensure success. However, the radiologist in rural solo practice can embrace Imaging 3.0 concepts as successfully as a radiologist in a large integrated health system. The effective use of IT may serve as an important catalyst. An informed review of existing practice tools already available and applying the same Imaging 3.0 perspective to new technology acquisitions will enable radiologists to position themselves as vital constituents in cost-effective, high-value health care.

References


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