INTRODUCTION. Each quarter, the AJR will publish the transcripts of the Masters of Radiology panel discussion hosted by Dr. Howard P. Forman and Dr. Marcia C. Javitt. The panel will review topics of importance to the field of radiology and share their unique insight into how these issues are shaping or will shape the future of the specialty.

Javitt: We define radiology extenders as practitioners who work under the supervision of radiologists: physician assistants, nurse practitioners, “super” technologists. These physician extenders provide certain types of care that previously were given by radiologists to address the increasing demand for radiology services in the face of staff–physician shortages and declining reimbursement.

The radiology extender is a complex topic. The pros and cons of this issue depend largely on your specialty, your location, and your department. Radiology extenders definitely make us more efficient at our jobs from a labor standpoint and can help address acute staffing shortages or situations in which there are limits on the amount of time worked by house officers. They have allowed us to improve our efficiency and workforce capabilities, can improve the patient’s access to care, and can reduce repetitive tasks that we often find ourselves facing. On the downside, these challenges are complex as well. House officers may have trouble relating to the radiology extenders. There may be a loss of direct or indirect subsidies for medical education.

There is also the risk of problems with patient acceptance and with satisfaction and performance issues on the part of residents. Additionally, the Centers for Medicare and Medicaid Services may recalculate how procedures that are performed by radiology extenders are reimbursed, which could significantly impact the reimbursement for our work. What’s more, once you train radiology extenders, they can then go out and work for nonradiologists. In short, if someone has a way to make us more efficient, then more power to them if they can implement that plan.

Monsees: We took all of these issues into consideration when we contemplated radiology extenders as we tried to figure out how to improve our efficiency. And because we’re in breast imaging, there were financial issues, so we had to figure out a way to be fiscally responsible to the department as well. We did not want to use radiology extenders to do procedures; we wanted to limit those to our residents and fellows. However, we decided we needed some class of individual to help us become more efficient.

We do a lot of communications, including a great deal of direct interaction with patients, because we’re dealing with breast imaging. We decided to try to see how they could help us in this regard, and we resolved to try nurses—they [nurses] have now become very important to our process. They don’t duplicate our technical staff and, in fact, are revered by our technical staff. They are also now a constant in the lives of our patients and play an important role in the continuity of care.

We weren’t sure how we would do this, but we started this program about 6 or 7 years ago and hired an experienced oncology nurse. Even though she didn’t have experience in breast imaging, she was very smart and compassionate and really wanted to learn a new field. And you talk about an investment—it did take a long time to train and educate her about breast imaging. It took a long time before she could pull her own weight, I’d say a minimum of 6 months.

There was the understanding that she would work with us as a seasoned professional, that she would make suggestions, and that we’d also make suggestions as to how she could help us and perform some of the time-consuming tasks we were doing. One of the things that we had
her do was interface with our patients and their referring physicians when we’d recommend a breast biopsy.

The nurses are there to deliver and deal with the information, spend time with the patient to ensure the quality and continuity of care, and keep in touch with our surgical colleagues as well as referring clinicians. The nurses act as our surrogates in areas that we define together. They obtain the pertinent clinical history, including the patient’s medications. They then go on to talk to the patients and their families and, afterward, they field calls from the patients and triage information coming in to us. They collect information from the patients, and we’ve trained them to call patients and relate results. We used to do this all ourselves, but it is very time consuming, so now the nurses do this and they do it well.

After the biopsies, they work for many of us, so there is a kind of economy of scale as they check on all the biopsies for six different breast imaging radiologists; they present the pathology to us, and we review them with the nurses. Once we determine whether a result is concordant or discordant, they inform the patient of the results, go over the next steps with the patient, and then addend our reports with the pathology results. They contact the referring physicians and, if need be, help coordinate with the surgical nurses to get the patient an appointment.

I think they have definitely made us more efficient because they do some of the things that we used to do, but we still do the imaging and the procedures. They are better at certain tasks because they have more time to engage in a lengthy discussion, and they are natural at putting patients at ease and comforting and encouraging them—they’ve been at it longer.

They are now so well known by the community of physicians and practices that if the nurse in clinical oncology has a patient who needs to get in, they talk to each other rather than calling us, which saves us time. They also work with our trainees on communication procedures so that patients don't fall through the cracks. They are a constant for our patients, which is a good thing because we know that in a training environment, you can have a cast of thousands with residents and fellows coming and going, but these nurses are always there. They are consummate professionals.

Larson: Our brief experience has been similar. We have one radiology assistant who works in fluoroscopy. He has been universally well received by staff radiologists, radiology residents and fellows, and clinicians. He focuses on organizing the schedule for the day, managing patient flow, and performing routine procedures such as enemas and upper gastrointestinal series. Through repetition, he has become very skilled in the technical aspects of fluoroscopy.

This has been beneficial to the trainees as well because his ability to help them with the technical aspects of fluoroscopy is what they often lack most in their training. Furthermore, he provides a valuable connection between radiologists because he works with all of them and knows how they all do things. In this setting, with routine procedures that are done repetitively, we’ve found him to be very helpful.

Norbash: These types of novel workforce solutions, in my opinion, ask us to look at ourselves in a self-critical manner to understand possible operational improvements in the services we traditionally provide. As I think about it, for this type of exercise we need to define the roles of the individuals within the department. At the same time, to do this successfully, we need to define organizational structure not only within the department but, just as important, within the housing institution. As one specific example, let’s assume you plan on adding nurse practitioners into a department for the first time. Does the larger institution have clear lines of structure, responsibility, and reporting for such individuals? Is there a preexisting structure for reporting to nurse management, or will such an introduction result in administrative orphans?

Even more important, there has to be a context of understanding for these individuals in the larger institution. Therefore, to tackle such a challenge, you must determine how you structure these pathways, categories, and lines of reporting and responsibility.

In terms of capital investments, we have to critically decide how to best structure the department and where to make investment additions. From the operations perspective, there may be areas where such additions seem intuitively apparent—such as nurses’ aides or transporters—especially when such introductions are weighed in light of very specific limiting tasks, such as starting IVs, contacting patients preprocedurally, turning over rooms in fluoroscopy or special procedures, or decreasing cycle times in CT.

It is more than simply looking at radiology extenders in a cookie-cutter role; it is looking at how these individuals perform with specific views to throughput contributions, increasing patient satisfaction, improving safety, and increasing job satisfaction for all team members. Such an approach likely starts with an operational perspective to look outside direct patient care to rethink the technology structure or the organizational structure. For instance, how does your IT group work within the department, or how do you work with other departments? Do you allow other departments, such as pathology, to use your image-storage systems? In other words, can such rethinking of the operational structure and labor investment afford the opportunity for radiology to show its added value to other departments?

Radiology is known for novelty and innovative fashion, and every opportunity is a chance to assert these leadership traits. There are natural barriers when working with human resources, such as configuring a job description to attract individuals to fill these positions and do a good job, and to do this in an era of constrained resources can be challenging. Use every opportunity to add value to the entire system rather than simply focusing on a short-term or short-sighted bottom line to create a patient-centered environment.

Kaye: We, like Dr. Monsees, use physician assistants in interventional radiology, not only in a procedural but also in talking to the patients and their families. We do a lot with technologists, not necessarily technologists with advanced degrees, but also those who are our most experienced and best ones. We have a group of super technologists who help coordinate the patient flow in our women’s imaging center but who are also available to help the technologists do follow-up views so that they don’t need to hunt down the radiologists as much.

They review the prior mammography reports before the patient gets there, so they have a pretty good idea when follow-up views or follow-up examinations might be necessary. If they have a question, they’ll ask the physicians when they have the time at the beginning of the day; that helps the throughput of patients in diagnostic mammography and minimizes the number of repeat views that have to be ordered by the radiologists.

We have practice-wide chief technologists in every technique for all of our imaging centers. Obviously, they get paid a premium, and they are responsible for specific assignments. For instance, with CT, we audit the radiation dose for each type of scan. We have projects where we want to standardize protocols throughout the organization,
and we have issues that come up from patients. All of these generally get directed first to the chief technologist, who also is integral to the selection of new imaging equipment. The standard is that we have the technologist have everything ready for the physician who is going to do an ultrasound-guided biopsy so that little time is wasted preparing for the procedure. That is how we use radiology extenders.

Beauchamp (e-mail): Delivering high-quality care in radiology is challenging. Doing so in a cost-effective patient–family centered fashion is an extraordinary feat. In our practice, physician extenders (physician assistants and advanced registered nurse practitioners) have been essential in our efforts to be extraordinary. Their impact is manifest in a multitude of areas:

- Increased physician efficiency—exam protocling, assessing appropriateness of exams requested, discussing results with referring physicians, generating preliminary reports, obtaining informed consent, overseeing the stress portion of the cardiac stress test, fluoroscopy, procedural assistance, or postprocedural rounding and patient follow-up.
- Increased radiology practice satisfaction—minimizing efforts of radiologists outside of image interpretation and imaging-guided intervention. Physician extenders can fill gaps in resident and fellow coverage and provide preliminary assessment of images.
- Improved patient–family centered care based on physician extenders spending more time with the patient and family. The physician extender training often places a greater emphasis on patient–family interaction.
- Implementation of clinical services that have a lower profitability—we have generated new revenue from procedures that our department previously would not perform. For example, in the past, ultrasound would only mark for paracentesis and thoracentesis, and our radiologist would only perform these procedures if the clinical service had failed or ultrasound guidance was deemed necessary. Performing these procedures with direct ultrasound guidance is safer for the patient and generates revenue for the department. Our physician extenders now handle all of the nontargeted liver biopsies for staging of hepatitis C virus. Additional coverage allows the residents and fellows on service to have dedicated teaching and lectures and the flexibility to attend teaching conferences. Physician assistants and nurse practitioners are recognized Medicare providers and can bill independently.
- Improvement of the academic mission—physician extenders can be contributors to the education and research mission. When they are contributing to the educational mission, they are appointed as teaching associates. They are also able to “cover” clinical areas during resident and fellow conferences.

Importantly, physician extenders can also be loss leaders. It is important to delineate job expectations and to track performance metrics. Specifically, there are well-established metrics for physician performance (relative value units, publications), but the measures for the roles of physician extenders are not as clearly established. We have appointed a director of the physician extender section, and we carefully consider observed versus expected contribution in the roles defined.

Messinger (e-mail): We, representing ourselves as a large multispecialty group serving four (soon to be five hospitals) and 10 outpatient centers (soon to be 12), have taken an active role to see where we can best use allied health professionals to become more efficient; control costs; and, most important, achieve the goal of superb patient care.

The role of the physician assistant in interventional radiology is well established in those practices that act as admitting and treating physicians. However, it is more difficult to adapt the physician assistant to diagnostic radiology needs. Instead, we are considering hiring nurse practitioners to assist us in two special areas. The first is in mammography. Many of our centers perform diagnostic mammography, and that requires us to provide patients with a verbal report followed by same-day formal interpretation of the results.

We are committed to staffing all of our multidiagnostic centers with a radiologist; however, even if diagnostic mammograms are offered at the site, this does not mean that a mammographer needs to be present. In those centers, we plan to add an allied health professional to use acquired skills in relating the findings and discussing further recommendations with the patients. The mammographers will be in a central office interpreting the findings and relaying them to the allied health professional.

The advantages of this system include

- A constant in relating to patients’ needs
- Superspecialization maintaining the core strength of the practice
- Avoidance of a call for change in reimbursement
- An opportunity to effectively manage workforce requirements.

We presently use former “super mammography” technologists in our advanced-imaging breast centers as care coaches. These individuals are devoted to creating a positive experience for patients undergoing breast interventional procedures. This has been a terrific success and has freed up a significant amount of time for the interventional mammographers.

A second area where allied health professionals should be helpful in our practice is with coronary CT angiography (CTA). When this procedure becomes a standard alternative in the emergency workup for chest pain, it will require a significant amount of time and effort in preparation and monitoring before, during, and after the examination. The appropriately trained allied health professional will free up a significant amount of time for the reading radiologist and provide a strong foothold in the development of the program, which should be centered in the radiology department.

Forman: There is obviously a broad number of ways that radiology extenders, particularly physician assistants, radiology assistants, and physician associates, can help us, and there is a legitimate risk involved as well, both in terms of compliance within the practice and in terms of turf and competitiveness.

Javitt: To effectively implement radiology extenders, we need to apply industry-wide a statement of understanding of their role and the scope of their position. Given the number of organizations that would be involved, this will be a daunting task. There are state medical boards as well as oversight organizations for nurses and technologists. Hospital bylaws can be problematic. There are potential issues relating to reimbursement, dependent on whether general or direct physician supervision is going on, and the need for staff physician and radiologist input. Furthermore, a clear set of rules and guidelines as to how these individuals function will need to be developed. I know the American College of Radiology (ACR) has been somewhat involved in this, but we need to go further.

Forman: It is interesting that nurse practitioners do represent more of a professional threat than physician assistants or physician associates. The assistants and associates are dedicated toward only practicing in the context of the physician, but because nurse practitioners, on the other hand, have a greater deal of independence as part of their training and their position in health care, they represent a completely different threat than the physician associate and physician assistant.
Kaye: The genesis of a lot of these positions has to do with empowerment or career advancement of professionals with whom we have a close association. One of the reasons that led the ACR to support the development of the radiologist assistant was to provide a career-development path for nonphysicians. This is something that is turning from a snowball to an avalanche.

Forman: This is either a problem or a solution of our own making and is the reason we’re addressing this question today. How do we, as presumed leaders in the specialty, without a mandate, try to have our colleagues function in a way that promotes patient care without threatening the future sustainability of our profession?

Javitt: I think the practice of ultrasound is a good test case for how we do this. Technologists have pretty much taken over the performance of ultrasound in most practices, and most physicians don’t lay hands on patients in ultrasound anymore. In my view, that makes it even more mission critical that we have radiology residents taught to independently perform and interpret ultrasound scans.

In my facility, the residents take call without the technologists. They have to know how to independently perform and interpret these studies. When these residents have to supervise technologists on the job, they are better able to identify technical pitfalls and problem cases. This is a microcosm of the larger issues we are talking about here. I think we need to put the brakes on and take a look at what we’re doing to ourselves. We have to examine what we value and how we implement these extended functions.

Forman: Let’s move on to the second question, which is where should we be making our own human capital investment? How do we best invest in the future of the specialty? Should we be investing time, energy, and actual money in developing radiology extenders and similar nonradiologist support or make a greater investment in our own residents and other professionals?

Javitt: I view this issue much in the same way that I view nuclear energy. Nuclear energy can be a very effective, useful energy source, but it can also be used as a weapon of destruction. We’re in a similar situation with this question. I think we should look at parallel tracks and use radiology extenders to allow us to do what we do best, which is to interpret images. When we are freed up from repetitive tasks and minor procedures that can be done with minimal or no supervision, then we’re better empowered to do what we are trained to do.

Coupled with this, we also have to automate some of the tasks, such as computerized order entry, scheduling, and things that assist in physician support. The goal of all of these options is to increase workflow, reduce delays, and reduce costs. Simultaneously, we need to improve the accuracy and clarity of our reports for our end users, who are the patients and referring physicians, so that they can rely on us for a great work product.

Monsees: I’ve seen the same sort of challenges that others have spoken about in situations where we train individuals who then go out and work for others. For example, the surgeons who are trying to learn breast ultrasound; often, it is the hiring of a good technologist that has allowed them to take a part of our practice. A great deal of this is happening in the private sector, both here in St. Louis and around the country.

In medical meetings, they are now teaching breast ultrasound and biopsy techniques. In fact, the American College of Surgeons has implemented its own accreditation program for breast ultrasound, breast ultrasound-guided biopsies, and stereotactic biopsies so that surgeons will be able to perform these procedures instead of radiologists.

What allows them to do this are the people we’ve trained who go and help them; otherwise, I don’t think they’re very good at targeting things, specifically stereotactically. But the technologist who has worked under an expert radiologist can go and translate that technology and make that happen. So, undoubtedly, we have to be careful who we train, and it can be a double-edged sword, unquestionably. As far as information systems, we have to stop and think about what we can bring to the marketplace and how we can serve as a resource for patients and referring physicians.

We need to look at what we do well and stay ahead of the pack while exploring new service opportunities. Due to the amount of attention focused on the concept of individualized screening, we have, for a long time, been looking at who is high risk and who is not. We do this because one of the things we offer is supplemental screening with MRI (although some facilities use ultrasound) to high-risk patients in addition to mammography. We decided to try and do this right, given that the U.S. Preventive Task Services is telling primary care physicians that they need to talk to their patients about the pros and cons of breast cancer screening. They really don’t know a lot about risk assessment, and patients tend to overestimate their risk.

So now we’re prepared to go live with a new information system that includes a risk-assessment tool that we’ve built. It asks each patient a series of questions that will enable us to assess risk, and we will then provide the information to patients and their providers. This is something that is really needed and will help establish us as credible professionals in the breast community.

It will enable us to be the front door where patients come in and get their initial information. Of course, someone will have to manage the process and answer the phones, so we’re going to train a nurse to handle this. What I think we need to do is look for technologic opportunities, and this is one that we’ve come up with. I hope it is going to be value added and not create just more busy work.

Forman: So, how reproducible would this type of program be on a national level?

Monsees: I think it would be easily replicable on the national level. There is actually a paucity of risk-assessment tools out there, and I think that is why physicians have had trouble with it in the past. But some [programs] don’t cover all the aspects, so we’ve tried to build everything into our risk-assessment model. We’re going to look at it as a 5-year risk, which is important if you’re going to recommend breast MRI and as a lifetime risk.

However, it involves more than just the radiology department—it also involves risk-assessment counselors and those who can address risk-reduction strategies. It’s about more than just radiologic services, so we’ve invited our colleagues to be a part of this, to ensure that there is a buy-in from everybody. It should be reproducible from a risk-assessment model, but on an individual basis, it goes beyond that. You can’t just assess the risk; you also have to provide the people and services for follow-up.

Norbash: I think we have to broaden the scope of our engagement and look at this from two external perspectives: from patients’ point of view starting from the first encounter, through the last encounter and from referring physicians’ point of view from their first encounter to their last encounter. We need to know what the referring physician and patient are each seeking from A to Z.

Sometimes we may have a tendency for tunnel vision and focus on a small and limited part of a problem. For instance, just because we can turn out our reports faster doesn’t mean we’ve added value if we can’t get the final product to everyone who wants or needs it in an efficient, timely manner.
manner. Many solutions can be put into place, but without the right framework, your efforts to meet the needs of your customers, whether patient customers or referring-physician customers, could likely fall short. Systems can only be as good as the people who operate them.

So, if you’re not truly, fundamentally customer-service oriented or, for instance, if you have a lot of shift workers rather than professionals, chances are you’re not going to achieve the level of service that you are seeking, and you can’t guarantee your book of business or even your continued survival in the ever-shifting status quo. Systems are good, and systems can work well, especially when they include people who are positive and change-oriented, are fundamentally driven to improve the operation, and happen to be working with good systems.

You can find systems that are behind the state-of-the-art, and in the hands of motivated people, it is possible to have good results and add value. Investing in human resources, providing people with recurring opportunities to learn about the systems, and creating a culture of excellence are fundamental principles that can’t be neglected because we feel compelled to make large capital investments in a decision system rather than look at how such systems are used by the proper human capital and how they fundamentally and positively enhance practice.

Kaye: I’m a big believer that our business is an information-service business; just as important as image interpretation, it’s essential to gather the right information and get it out to treat a patient. For example, in our practice and department, we have nonphysician and non-technologist trainers who know the information systems, train each category of personnel to use them in the right way, and serve as a resource when there are questions. It might not be perfect, but it is better than if we didn’t have that level of quality assurance.

I view these people as radiology extenders because otherwise the radiologist would be spending valuable time trying to work out the glitches in the system.

A hot topic today is “commoditization.” We sit in front of a monitor all day. We don’t have as much interaction with our patients and referring physicians; we’re risking becoming obsolete. To improve this, we now have instant-messaging capability so that everybody from the technologist scanning the patient to the radiologist interpreting an image can communicate no matter where they’re located. We’ve asked our radiology information system vendor to extend this to our Web-based product so we can have instant availability for our referring doctors.

Recently, I met with the chief of surgery and chief of trauma to try and recapture some of those radiology rounds they used to make in the department to go over complex cases; they don’t do that much anymore. We’re trying to come up with ways to reintroduce that step, such as purchasing some tablet computers so they can have access to images at the patient’s bedside and having the residents and attending physicians make the rounds with them maybe once a week. We’re also looking at applying for a grant to study the use of social media in consultation as a way of combating that faceless nature of radiology. So, I think information technology has a lot of potential solutions.

Beauchamp (e-mail): In his book published in 1964 titled Human Capital, Gary Becker equated the importance of managing capital, whether that capital be equipment, supplies, or personnel. Specifically, not managing human capital is as detrimental to economic return as failure to manage nonhuman assets. The human investment can include emotional support, skills development, career advancement, and health care. Unfortunately, outside of the context of our residency training programs, we pay inadequate attention to this maintenance. We routinely calculate a net present value for a multimillion dollar scanner, but we do not consider what is needed for return on investment when it comes to our faculty.

The Scottish philosopher Adam Smith emphasized the relationship between division of labor and human capital. This emphasis is directly relevant to the role of the physician extender in the effort to gain a return of investment for a radiologist. The optimal environment is one in which an individual is able to focus efforts where they bring a value that cannot be provided by other members of the team. In the case of the radiologist, this includes image interpretation, integration of available clinical information and image interpretation to provide a clinical diagnosis, and performing imaging-guided procedures. It is also one where the skills can be brought to bear in an efficient environment unencumbered by non-value-added steps. As discussed, the physician extender can assist in optimizing the efficiency, accuracy, and patient-family centeredness of care delivered in a radiology department. They can do so at a lower cost.

Importantly, the role of the physician extender should be established in a way that maximizes their sought-after optimal environment given their skills, training, and career goals. This includes training, quality standards, and performance oversight defined with a specificity equivalent to the radiologist.

Lastly, there are a number of tasks that should be transferred to the appropriate support personnel. One should not discriminate the need to manage human capital based on cost if the team is to attain the synergy of mutual respect and ownership of challenges and opportunities.

Messinger (e-mail): How we use technology to solve workforce problems is much more difficult to answer. For example, what can we do to further enhance the PACS solutions? Are we taking advantage of the appropriateness criteria and using technology to educate our referring doctors? And, will reimbursement, as I think it should, be better for those who drive outcomes by doing less but more effective imaging? Can we use technology to market our practice and emphasize what makes us special (e.g., fetal MRI, cardiac CTA, advanced breast imaging)?

These are important questions, not only on a national level but also on the local community level. I believe these challenges will probably require less-traditional methods to reach our full potential and that technology will be a key component of that effort.

Javitt: I’d like to make one last comment about how I see the radiology report of the future. I see it as a multimedia product that will include annotated images that can be comprehended by the reader. Additionally, I envision that it will be linked to computer-aided diagnosis systems and other intelligent ways to look at critical findings. Perhaps the report could be voice-activated. I view all of these possibilities as fused together to create a very accurate report in a very structured product that will eliminate waste and inefficiencies in our current practices. And I think radiology extenders belong in that equation and may actually be an integral part of it.

Forman: I think this all ties in nicely with peer review and with how we can show to the public, both explicitly and implicitly, what our value is as opposed to the value of imaging. I think we often become confused about the value of imaging and the value of the radiologist, and what I’m hearing here today is very much about the value of the radiologist and any means that we can use to improve the value of what we add to patient care.

Larson: We often focus on the specter of technology marginalizing our value by making it easier for others to do what we do. However, if we use the technology appropriately, we can achieve results that are dif-
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difficult for others to replicate, even if they have the same tools. For example, Thomas Friedman of the New York Times foretold that teleradiology would spell a grim future for U.S. radiologists. In reality, even with teleradiology, other countries have difficulty replicating our productivity because of how hard we work and how we have structured our work processes. The regulatory process has (appropriately) helped us in this regard as well. I believe the same is true of our interpretation quality. As performance measurement and improvement tools become more sophisticated, we can demonstrably raise the bar, helping prevent those who lack the same commitment and expertise from diluting the market.

Beauchamp (e-mail): The intent of introducing automation into a process is to improve output. However, it is important to begin with a definition of “improved” in the context of your organization. Automation should not be applied prior to understanding the mission, vision, and values of the organization. Once established, strategic objectives and tactics can be defined and areas appropriate for automation can be prioritized. For example, our core values as a department are defined based on the Institute of Medicine (IOM) principles of patient safety, effectiveness, patient centeredness and equity, timeliness, and efficiency. This approach led us to emphasize automation for processes such as critical results reporting, radiation safety monitoring, and paperless and filmless operations.

Adhering to this value system also ensures that we do not lose focus on the aspects of radiology that bring value as we seek to optimize output. Specifically, automation can depersonalize. Efforts in automation must be checked against tracking the impact on patient centeredness and radiologist–clinician interaction. The unintended consequence could include poor quality of service, the loss of referrals, and an environment that is unappealing to individuals who are focused on customer service.

Automation gains not will also be realized if automation is superimposed on a poorly defined process. Parsimony is the key. Specifically, prior to automation of a process, it should be flow mapped, with unnecessary steps removed. It is essential to remove steps that do not bring value to the output. A “lean” process can be automated with lesser expense, lesser cost, and lesser frustration. Moreover, once automated, it will be easier to measure, analyze, improve, and control the process, and process output of an automated process will be more straightforward. If automation adds a step without bringing value to the output, you have increased your cost and your complexity.

It is also important to consider the manner in which automated processes interface with each other. As we develop our automation strategies and tactics, we do not proceed to implementation without considering the critical dependencies, i.e., what has to be in place to ensure that information flow is not disrupted such that automation of a single process does not create systems challenges. This approach, for example, enabled us to prioritize the need for a single radiology information system across our multiple hospital system as well as a master patient index. The critical automation dependency of high fidelity information transfer across systems is greatly benefited by the Integrating the Healthcare Enterprise (IHE) initiative.

It is easy to identify processes where automation brings value in a radiology department. Revisiting critical results reporting as an enabler of IOM principles, there is a need to have the ordering physician’s contact information automatically flow from the admission, discharge, transfer–order entry system to the radiologist on the PACS–radiology information system voice recognition so they instantly know who and how to contact the ordering doctor about a result. We need to consider utilizing automation in contacting referring physicians with critical results. Other examples include

- The exchange of laboratory data between the laboratory electronic medical record and the radiology information system so that information is available to the radiologist at the time of electronic protocoling of a CT or contrast-enhanced MRI
- Reporting uses information from the examination or protocol code (not the Current Procedural Terminology [CPT] code), which means the report can automatically reflect what was actually done to the patient, resulting in less input on the radiologist’s part, fewer steps in generating the report, a more standardized billing process, and fewer billing denials
- Providing a link button between the PACS and the electronic medical record, through which a radiologist can automatically view a patient’s notes, thus reducing the need for manual medical record number entry and repeat logging into different electronic medical records
- More experimental, natural language processes and artificial intelligence to tag critical results in radiology, automating prompting for communication and automating auditing of critical results.

Additionally, a key area for automation is in generating the dashboards needed to monitor productivity and quality. There is not enough time in the day, or at least affordability of personnel, to manually monitor and generate the reports needed to optimize a radiology department. Automation can be applied to generate real-time automated dashboards and graphs that display the department’s current situational status. Although this involves an initial investment, minimal long-term resources are required to keep these dashboards running (report turnaround time, patient throughput per technique, peak demand times per day, etc.) without the need to run ad hoc radiology information system searches.

The final question we are considering is how do you determine who is “techno-savvy”? We are fortunate that radiology attracts individuals with an affinity toward technology. However, detecting the savvy is a process of taking the time to know your people. I look for individuals committed to having an impact and who are leveraging information technology to get there—that is, improving the quality, efficiency, or revenue of your practice. Such individuals are more easily identified when you have an organization that identifies and rewards individuals who demonstrate initiative and motivation and that fosters a culture where those who embrace the culture of continuous improvement are empowered.

One can also find techno savvy individuals by searching beyond the clinical domains of the department. The educators in my department who are seeking a scaleable impact do so by leveraging technology. Among the most impactful researchers are individuals capable of managing the substantial information output inherent in imaging sciences investigation.

FOR YOUR INFORMATION

The entire panel discussion, responses to all questions and photos and biographies of our panel are available online at www.ajronline.org.