IT in health care has evolved rapidly over the past 20 years. The rise of the computer is at the core of these changes. Most agree that although these technologies have revolutionized the practice of medicine, they have additionally fostered a data revolution that is simultaneously useful and disruptive. The effective use and implementation of the right IT tools are critical to the success of the imaging profession. This article serves as a guideline to radiologists on how to build an effective IT division within an imaging enterprise from the perspective of leadership, management, and human resources. We address the process for building an IT team from the ground up and also provide recommendations for modifying an existing IT group to make it more effective. Paramount to this discussion is the concept of the imaging informatics professional and the advantage this type of training brings to a radiology department. In addition, we focus on the critical role of the physician informaticist as a liaison to bridge gaps among the IT, medical, and administrative functions in an organization.

Key Words: Physician informaticist, training, education, human resource, administration, leadership, qualifications, responsibilities

OVERVIEW

Health care IT has evolved rapidly and inexorably in the past 20 years. Physicians from the baby boomer generation have witnessed the digital transformation of health IT. Fundamentally, the dissemination of the digital computer is at the core of these changes; it has facilitated the development of a new set of diagnostic tools, which the medical community adopted over a relatively short period of time. IT has also spawned a new set of health care data aggregation and communication methods. Although most will agree that such technology has revolutionized the practice of medicine, it has also fostered a data revolution that is simultaneously useful and disruptive. The volume of patient data readily available to the modern practitioner is immense, and the effective use and implementation of the right IT tools is one potential solution to health data overload.

Diagnostic imaging has been one of the principal areas of innovation in the health IT space. For more than a decade, most radiology departments have been both filmless and paperless and have employed sophisticated workflow processes to improve efficiency, patient safety, and quality. These processes have an impact on every aspect of radiology functions, including decision support, order entry, scheduling, patient and protocol management, image review and display, postprocessing, reporting, billing, communications, and critical results reporting. Each component of these functions involves both traditional and specialized interfaces among radiologists, technologists, schedulers, managers, administrators, referring health care providers, and patients. Effective management of these interactions is critical to operational success of the modern radiology department. Teams of highly skilled individuals are required to maintain the uniquely specialized IT processes and infrastructure of the modern radiology department.

Unfortunately, despite radiology’s tremendous dependence on its IT tools, informatics expertise and leadership remains undervalued in far too many radiology departments and is not perceived as strategically integral to the success of the organization. As departments face declining revenues and increased workload, less focus is placed on expanding IT infrastructure to meet strategic goals. The
value of an effective IT group in successfully meeting daily operational goals and many of the cost-containment and regulatory changes facing radiology cannot be overestimated.

The IT department is generally perceived as having generic or one-size-fits-all support services that apply equally well to departments throughout a health care organization; an individual that replaces a desktop computer in the emergency department may be assumed to have skills sufficient to plan network topography for a PACS deployment. The reality is that IT has become sub-specialized. The traditional IT support model is to staff the radiology department with IT personnel with skillsets limited to maintaining existing equipment. All too frequently, these IT professionals have no specific expertise in imaging informatics or clinical radiology. Additionally, the vast differences between an IT staff member with general support skills versus one who has evolved into an imaging informatics professional (IIP) may receive little recognition. Mission-critical decisions, such as purchasing, deployment, training, and even implementation, may be delegated to individuals with insufficient experience and training. Moreover, in some settings, critical IT decisions are often made at the administrative level and not necessarily by those who use the hardware/software or by IT staff with the expertise to critically evaluate such highly specialized technology. In addition, because diagnostic imaging is often a hospital-based or ancillary service, support of this function is often relegated to peripheral IT managers who are otherwise tied directly into laboratory or pathology services.

Because diagnostic radiology is so tightly linked to and dependent on its information systems, diagnostic radiologists are unable to deliver safe and high-quality service without a fluid and effective IT infrastructure. Effective IIPs have a unique outlook and perspective compared to their non-IIP IT peers; they view themselves as health care professionals first, with specialty training in IT. This fundamental difference in the philosophical approach to their role differentiates IIPs from general IT employees. Paramount to creating this type of specialized mindset is the recruitment of requisite leadership to build the IT division and exploit IT to its full capacity to augment the clinical mission of a successful imaging enterprise.

This article is designed to serve as a guide for practicing radiologists to build an effective IT division by considering leadership, management, and human resources. We address the process for building an IT team from the ground up and also provide recommendations for modifying and improving the effectiveness of an existing IT group. Critical to this discussion is the concept of the IIP and the differential advantage that such training brings to a radiology department. We also focus on the critical role of the physician informaticist in bridging gaps among IT, medical, and administrative functions within an organization.

THE PHYSICIAN INFORMATICIST

Value/Role

Although imaging-based information systems are ever expanding, the role of informatics is still not well understood. Generally, informatics can be defined as the science of information flow in a decision-making process. In most industries, this process is embodied in well-defined management processes handled by information systems management personnel. However, in medicine, the workflow and information needs of personnel with clinical knowledge are often not well understood by nonclinical IT staff. This gap in understanding can lead to misalignment of clinical needs with the information tools provided by IT departments.

Too often, the term informatics is used interchangeably with IT, which is similar to mistaking an architect for a contractor. Just as an architect designs a building to optimally meet the needs of its inhabitants, an informaticist designs the information flow to meet the needs of personnel with clinical knowledge. A physician who is cross-trained in informatics has a unique skillset that can bridge the gap between clinical needs and IT resources. Many organizations fail to recognize the many benefits of having a clinical information “architect” in their leadership arsenal, and at the same time underestimate the risks of not addressing the responsibilities of this role. Department chairs and private practice group leaders would do well to consider the following ways in which physician informatics expertise and leadership can help them meet their objectives.

Informatics Drives Quality

According to an article in a previous issue of this journal, “Quality is the extent to which the right procedure is done in the right way at the right time, and the correct interpretation is accurately and quickly communicated to the patient and referring physician” [1]. As quality increasingly becomes a critical issue for radiology, informatics will play an increasingly important role in implementation of a successful strategy. Informatics tools can be used at each step—from ordering and scheduling, to exam acquisition and interpretation, to report generation and delivery. The ability to measure, monitor, and improve quality at each step of the workflow is essential to not only operate efficiently and effectively, but also to comply with increasing regulatory requirements and combat the threat of commoditization of radiology services [2].

The field of informatics puts the enabling technologies at the center of quality efforts. Although various IT systems can be purchased and installed to perform a vast array of functions, informatics leaders can provide the clinical context and guidance necessary to change processes and behaviors to improve performance. Moreover, if IT systems are implemented without informatics input and guidance, they may become an actual liability, should they fail to align with the needs of the clinicians, and be subsequently subverted and/or abandoned.
Informatics Drives Decisions

Medical imaging generates massive amounts of data, which are often locked in proprietary data silos (PACS, an RIS, electronic medical records [EMRs]). The size, complexity, and distributed nature of the data can make seeing the big picture impossible, which in turn hampers strategic decision making. Recent developments in the areas of business intelligence/analytics and dashboards are designed to remedy this problem by normalizing and centralizing data for easier analysis.

However, although technical staff members know how to access the data, they often do not know clinicians’ and administrators’ questions. Conversely, administrators and clinicians do not know what data are available to query or what questions may be possible or impossible to answer. In addition, they may not have the analytics training to formulate the question appropriately for a database query. In many circumstances, when they do articulate a question, it is of limited scope, takes a long time for the technical team to answer, and may have omitted an essential element. Such a process often feels as if it is more problematic than beneficial. In such cases, clinicians and administrators may disengage from the process of data discovery and thereby lose valuable opportunities to improve clinical and operational decisions. A clinical informaticist can bridge this divide because they can (1) understand the clinical context or scientific opportunity, (2) understand the underlying data potential, and (3) articulate hypotheses to the technical team and help troubleshoot possible problems.

Informatics Drives Efficiency

Efficiency is the ability to accomplish a job with minimal time and effort. Informatics techniques can help increase efficiency by tracing the flow of information through an organization and highlighting redundancies and inefficiencies. A physician informaticist can visualize the whole workflow within the clinical mission context and identify ways to minimize radiologists’ and technologists’ work efforts. Examples include minimizing unnecessary steps or the number of disparate systems, removing humans as integrating agents, integrating workflows, and eliminating paper as the transport vehicle for information. Focusing on workflow can boost efficiency by minimizing the number of steps, minimizing waste, and reducing the chance of error (ie, doing more with less). This refrain may become more familiar as payment models shift from fee for service to capitated payments.

Responsibilities

The physician informaticist may have many roles and responsibilities depending on the size and scope of the imaging operation or practice. As institutions of all sizes deploy EMRs, physicians with expertise in imaging, such as radiologists, need to fill the role of the radiology physician informaticist because radiology department needs typically differ substantially from those of other institutional departments. Several important characteristics and activities are required of the physician informaticist, including the ability to be a visionary, innovator, bridge, facilitator, and evangelist.

Visionary. The physician informaticist sits at the nexus of 2 knowledge domains (clinical and informatics)—a unique and powerful viewpoint. This vantage point allows the informaticist to take a much broader look at the clinical workflow, anticipate needs, and apply effective informatics techniques to maximally leverage IT resources and set the information strategy. This individual can step out of the daily grind to make sure the team is headed in the right direction and can take the time to “sharpen the saw” or, in other words, help the team work more efficiently by optimizing IT resources [3].

Innovator. Clinical domain expertise paired with informatics skills is a powerful combination to drive innovation. The physician who can think in terms of both clinical needs and informatics concepts can make connections not seen by either side alone. Maximizing workflow efficiency and providing just-in-time decision

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<table>
<thead>
<tr>
<th>Role/skill</th>
<th>Basic IT (PC, networking, disk, display)</th>
<th>Advanced IT (Server admin, Storage admin, Networking, backups, software)</th>
<th>Imaging IT (DICOM, HL7, IHE)</th>
<th>Clinical Workflow (technologist, interpretation, patient tracking)</th>
<th>Business (Project management, billing, operations, analytics, regulatory)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
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<tr>
<td>System administrator</td>
<td>x</td>
<td>x</td>
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<tr>
<td>PACS administrator</td>
<td>x</td>
<td>x</td>
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<tr>
<td>RIS administrator</td>
<td>x</td>
<td>x</td>
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<td></td>
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<tr>
<td>Applications specialist</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Digital imaging manager</td>
<td>x</td>
<td>x</td>
<td></td>
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<tr>
<td>Informaticist</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

Note: HL7 = health level 7; IHE = Integrating the Healthcare Enterprise; PC = personal computer; RIS = radiology information system; DICOM = Digital Imaging and Communications in Medicine.
support and effective business analytics are means by which physician informaticists will play the role of innovators to connect needs to solutions.

**Bridge.** The physician informatics champion can serve as a communication bridge between the clinical and IT staff. The fact that these 2 groups do not speak the same “language” and are often at odds is no secret. With a foot in both worlds, the physician informaticist can translate the needs of the clinical service into requirements more easily understood by the technical group, and vice versa. In addition, an important role for the informatics leader is to consider how radiology informatics fits into a larger organizational construct and to bridge potential gaps. In private practice, where the imaging group may manage all staff and infrastructure, this issue is not likely to arise. However, in large academic centers it can be a challenge, and each center may have a different philosophy in this regard.

The physician informaticist can play a key role in strategic planning in several instances. For example, in an increasing number of hospital infrastructures, dedicated PACS networks are unnecessary. Thick-client workstations (ie, dedicated applications physically loaded and operating on each client workstation) are facing obsolescence. Virtualization of mass storage is replacing more costly dedicated image storage systems. Some might argue that imaging IT is mature enough to be merged with enterprise IT. In this centralized model, radiology-centric expertise may guide and direct the operations, but the resources are part of the enterprise IT structure. In this environment, the inertia of the centralized model must be counter balanced with the preservation of domain expertise. Maintaining this balance is a challenge for the physician informaticist.

As another example, in some radiology practices, separate, dedicated storage and infrastructure may be necessary and/or preferable. However, this construct can create challenges when coordination with the enterprise IT is needed, and friction between departments may occur when priorities compete. The physician informaticist can mitigate these challenges by serving on cross-discipline IT committees and promoting frequent communication. Ideally, the radiology IT group would invite participation from enterprise IT in its coordination meetings. In this scenario, the radiology physician informaticist should strive for a good working relationship with the chief information officer and chief medical information officer.

**Facilitator.** The physician informaticist may also facilitate information sharing across the group. As the “go-to” person for informatics, the informaticist will naturally become the organization’s knowledge hub. As radiologists and technologists in the trenches encounter new needs or discover existing system shortcomings in the course of daily operations, they will have assistance from someone who can capture and inventory ideas and place them into the context of the overall informatics strategy.

**Evangelist.** Another important role of the physician informaticist is to be a visible group presence, which should include a position on practice/faculty leadership committees. An informatics evangelist works to promote the principles of informatics in the department at every potential opportunity. These efforts may be in the form of short, ad hoc “elevator pitches,” as well as prepared formal presentations. These interactions may occur with clinical staff at leadership and general faculty meetings and with IT staff at technical meetings. The physician informaticist helps both clinical and technical personnel understand that good informatics is a discipline, not just a set of tools. The evangelist approach to this role follows the advice of Thomas Edison: “There’s a better way to do it—find it” [4].

**Organizational Relationships**

To ensure the long-range success and satisfaction of both the informaticist and the organization, it is critical that

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**Table 2. Interventions to remediate a dysfunctional IT group based on symptoms and root cause identification**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Potential Root Cause(s)</th>
<th>Potential Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Bluffing” about reasons for downtimes</td>
<td>Knowledge/skills gap</td>
<td>Conference attendance, CIIP</td>
</tr>
<tr>
<td>Radiologists don’t know IT staff</td>
<td>Poor service orientation, poor relationships&lt;br&gt;(1) Poor relationship with vendor&lt;br&gt;(2) Lack of knowledge about latest offerings&lt;br&gt;(3) Budgetary constraints</td>
<td>Daily IT walk-throughs in reading rooms&lt;br&gt;(1) Have physician champion and IT meet with vendor at major meeting&lt;br&gt;(2) Assign staff to assess the “latest and greatest” technology&lt;br&gt;(3) Create justification for updating software in next budget cycle</td>
</tr>
<tr>
<td>Outdated IT software</td>
<td>Poor communication among IT team members</td>
<td>Establish regular team meeting to discuss operations</td>
</tr>
<tr>
<td>Conflicting information from various IT staff</td>
<td>Poor communication among IT team members</td>
<td>Establish regular team meeting to discuss operations</td>
</tr>
<tr>
<td>Long turnaround time when dealing with active issues</td>
<td>Poor communication among IT team members&lt;br&gt;(1) Poor issue tracking&lt;br&gt;(2) Understaffed IT team&lt;br&gt;(3) Lack of project management skills</td>
<td>Establish regular team meeting to discuss operations</td>
</tr>
</tbody>
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Note: CIIP = certification of imaging informatics professionals.
the position of the physician informaticist be structured appropriately. This foundational work includes assignments such as job title, reporting, budget, direct reports, and other resources. Before creating this position, an organization should consider each of these elements.

**Title.** Various titles have been used depending on the expertise and seniority of the informatics leader, including director of imaging informatics, chief of imaging informatics, or vice chair of imaging informatics. Organizations less familiar with informatics may choose to start at the director level but should plan to grow the position to a vice-chair level once a successful program is established. This higher-level position leverages leadership across departments and reflects the individual’s experience. This pattern of growth has occurred at several leading academic centers with apparent success.

**Reporting structures and channels.** Various reporting structures can be used by a physician informaticist champion. In a small group private practice, the physician informaticist reports directly to the group leadership. In academic departments, multiple approaches may be used; the most straightforward model is for the physician informaticist to report to the radiology department chair. In more mature informatics environments in which enterprise imaging plays a large role, the informaticist may additionally report directly to the chief information officer or the chief medical information officer.

Because this position may be new for many organizations, reporting channels must be clearly established and the position must have the support of executive-level leadership. Without careful planning and buy-in from key positions, the informatics leader may be marginalized in the organization. Avoid creating a position that gives responsibility without real authority. An organization that identifies informaticists as leaders but does not give them actual decision-making authority may reveal an ideological problem among its leaders regarding the role of informatics expertise. For example, such a problem occurs when an informaticist is perceived as an internal consultant. In this scenario, the informaticist develops plans and strategies but does not have a direct path to execute them.

Informaticists should be wary about organizations that believe informatics physicians do not need, or should not have, a direct reporting structure. This attitude may reveal the true beliefs of the organization’s leaders regarding informatics. Without direct control of resources (ie, hiring/firing and budgets), this role becomes an internal consultant, not truly a leader, despite any titles or representations to the contrary. This situation reduces the effectiveness of translation of informatics expertise into reality and certainly reduces job satisfaction [5]. If the physician informaticist leader has no direct control of IT resources, the job becomes much more difficult, as the person must work much harder to obtain indirect influence. In this setting, building strong relationships with the IT and financial directors who control resources will be crucial if this person is to have any measurable success.

**Expected Time Requirements**

Time commitments vary with organizational complexity. In some large academic centers, the physician informaticist may be employed full time in informatics and paid by the enterprise IT department. In small- to medium-sized operations, the informaticist may have 1-2 days per week of informatics time, with the remaining time spent in clinical radiology. The ideal time commitment approach may be one that balances clinical and informatics duties. This balance allows the informaticist to maintain and develop clinical skills and gives the added advantage of first-hand, up-to-date knowledge of what clinicians face. Balancing the 2 disciplines is a challenge that comes with the territory.

**Qualifications**

Given that this area of informatics leadership in radiology is in the early stages of development, no set qualifications have been established for physician informaticist candidates. In most cases, successful candidates for this position would be board certified in radiology with proven managerial and imaging technology experience. The specific managerial and technology experience will likely vary widely among candidates. The most likely candidates are those individuals who are naturally interested in technology, quality improvement, and process efficiency and have demonstrated active improvement of work systems. Some candidates will have shown early leadership potential while serving as chief residents. Younger radiologists have been immersed in technology throughout their lives, and to this group, effective use of technology has more likely become second nature. For many groups, finding a radiologist who is interested in this role will be the first step. Then, the informatics education may be gained on the job and through training options outlined in the next section. Perhaps more important than formal education is a strong drive to learn, an inclination to solve tough problems, and a “let’s get it done” attitude.

**Education and Training**

Until recently, there was no formal defined pathway for informatics education for those with an MD/DO. Thus, the physician informaticist who wants to build knowledge and skills in this area faces a challenge. Despite the ambiguity regarding a required or reasonable level of domain training, various avenues are available to pursue informatics education, including fellowships, formal education options, and resources from associations and organizations dedicated to informatics.

**Accredited training fellowships.** The American Board of Medical Specialties (ABMS) approved a new accredited subspecialty in clinical informatics. This new certification is jointly sponsored by the American Board of Preventive
Medicine and the American Board of Pathology and is managed by the American Medical Informatics Association. The curriculum and examination encompass all areas of clinical informatics and do not have a specific focus on imaging informatics. The first certification exam was given in fall 2013. Practicing informatics professionals who demonstrate experience in the field will be grandfathered into the subspecialty after passing the certifying exam. After 5 years, new applicants will need to complete a 24-month fellowship at an ACGME-accredited program and pass the certifying exam. More information is available at www.theabpm.org.

Nonaccredited training fellowships. According to the Society for Imaging Informatics in Medicine (SIIM), several institutions sponsor specific fellowships in imaging informatics, which are usually combined with clinical fellowships at the end of residency training:
- Brigham and Women’s Hospital;
- Massachusetts General Hospital;
- Mayo Clinic;
- Medical College of Wisconsin;
- University of Maryland and VA Maryland Healthcare System;
- University of Pennsylvania;
- University of Pittsburgh; and
- University of Utah.

Postgraduate degrees. For those interested in a formal informatics education, many universities have graduate programs in biomedical informatics. Some of these may even offer degrees based on distance learning (usually nonthesis tracts). For a list of programs funded by the National Library of Medicine, visit www.nlm.nih.gov/ep/GrantTrainInstitute.html.

Certified IIPs. SIIM has established a program for the certification of imaging informatics professionals (CIIP; www.siimannualmeeting.org/ciip/). Certification is sponsored by the American Board of Imaging Informatics. Although CIIP is targeted mainly at PACS administrators and other department IT support staff, radiologists are welcome to participate and will gain valuable knowledge about the tools of the trade.

Professional association educational resources. Several professional societies connected to informatics hold annual conferences that provide education for attendees. SIIM is the organization most focused on informatics topics specific to imaging, generally offering 7 or 8 learning tracks centered on current challenges in imaging informatics. Conference material ranges from introductory to advanced, and conferences offer great networking opportunities for emerging leaders. Another good source of training can be found at the annual RSNA meeting. RSNA provides 4 specific informatics learning tracks with refresher courses, as well as scientific sessions addressing current topics. For a broader informatics view, the American Medical Informatics Association goes beyond imaging informatics and covers informatics topics relating to all of medicine. The Healthcare Information and Management Systems Society hosts one of the largest conferences focused on general IT in health care; it is perhaps the most vendor focused and often receives the most press.

BUILDING AN IIP TEAM
Starting with an effective radiology IT leadership team is paramount to enhancing the role of IT in a radiology department. Recruiting a physician champion to work in concert with the IT team is one model for success, but not the only one. In the absence of a physician IT leader, the role of IT champion and liaison may fall upon the nonphysician IT lead in the department. Selecting the appropriate IT manager becomes more challenging because of the multiple roles this individual must serve: interfacing with physicians, administration, and ancillary staff as well as leading the IT team. Ostensibly, the nonphysician IT manager must be aware and empathetic to the needs of all expert personnel in a department who interact with IT systems and be motivated to constantly explore ways to improve user interaction with these systems. The IT manager can have the most influence as a change agent by building or transforming a new or existing radiology IT team.

Organizations sometimes rely on nonphysician leaders to guide their clinical IT needs. This situation can be successful only when a nonphysician leader partners closely with clinical stakeholders. The role of a clinical informaticist is to bridge cultural communication gaps and translate specific needs between the clinical and technology worlds. If an organization relies on nonphysician informaticists or other personnel without a clinical background, an extremely important characteristic for candidates for such positions is strong service and communication skills and an understanding that their mission goes beyond keeping the department’s computers running.

Selecting the right candidate to lead IT efforts in general requires thoughtful introspection into the particular needs and culture of the organization. Successful IT leaders should not focus their energies solely on technology. Often the success of any technology initiative (and ultimately the measure of the IT leadership team) relies on additional factors, such as organizational readiness, communication, and a leader’s ability to execute a vision. IT should be considered a strategic asset to an organization, and successful IT leaders will have a broad view of the critical role they play in the organization’s success.

Picking an Operational IT Leader
Although too narrow a focus on technology can be a problem, a strong foundation in IT fundamentals is essential for successful informatics leadership. IT leaders need to understand technology and the health IT
ecosystem, including how data flow through various information systems and how any potential disruption (such as upgrades or downtimes) may affect operations. Ideally, candidates should have an interest in technology that is not merely professional. This background is not only important to understand and expediently adjust to current trends but also essential to establishing credibility in the larger hospital IT community, where the ability to justify a project’s technical impact on the organization’s infrastructure or workflow is key.

**Qualifications of an Informatics Leader**

As mentioned earlier, the most important characteristics of informatics leadership are the creation and perceived value of a culture of close partnership between IT and clinical teams. Informatics leaders should ideally see their role as a bridge between the worlds of technology and clinical care. As such, they should be able to easily interact with each of the groups in the clinical environment, including physicians, technologists, finance, administration, and IT. Informatics leaders should work to understand each group’s needs, act as an advocate, and appropriately translate organizational needs among groups.

To attract the right physician informaticist candidate, it is essential to focus on IT as a strategic advantage to a practice. Such a focus is also critical in setting the tone of the person’s efforts once she/he is in the organization. Although many organizations initially focus on system stability or even expansion as a primary responsibility, the next step is often forgotten. Stable infrastructure should be only part of an informatics leader’s responsibilities. Radiology, a technology-heavy endeavor, should value a candidate’s ability to create a culture of responsive customer service, to understand the impact of information systems on clinical workflow, and to translate current trends in technology into strategic opportunities. Achieving this level of valuation may require a change in how the organization views IT.

**Roles and Jobs**

Organizations increasingly understand that recruiting the right team of IT professionals is a key to success. One model published by Goodhue of the Gartner Group [6] suggested that successful IT teams should be made up of individuals with a focus and background in 3 areas: technology, behavioral science, and business. Although every individual is a unique blend of interests and backgrounds, adapting this model to clinical informatics is useful in understanding the desired makeup of an informatics team.

**Technology focus.** Technology-focused team members have a strong background in infrastructure expertise, methodologies, and systems architecture. They often provide personal computer support or act as system administrator. They may have a background solely in traditional IT and may have gained experience with information systems outside of a clinical environment. They run the information systems, perform the backups and upgrades, and generally provide the day-to-day technical support and administration for the IT infrastructure. They can also implement new technology and keep it running. They are a strategic resource for vendor technology assessment and for designing architectures, and are a must-have for both system stability and strategic informatics infrastructure.

**Behavioral focus.** Behaviorally focused team members may have a clinical background and often have high emotional intelligence and act in roles such as PACS administrator, application specialist, or trainer. They may understand the clinical need for technology better than the technical specifics of the systems architecture. Their background in clinical workflow makes them essential to quality and process improvement initiatives. An empathetic focus helps them understand clinicians and their need for robust technology that improves their ability to have a positive impact on patient care. They should have a working knowledge of the technical abilities of their clinical associates, as this will help guide workflow implementations with the appropriate level of technical complexity. They are a strategic resource for gauging the impact of new technologies on clinical workflow and a must-have to improve departmental processes and overall quality.

**Business focus.** Business-focused team members often act in roles such as RIS administrator, project manager, or director of IT. They may at one time have had a predominantly clinical or technology-focused position but then shifted toward a more managerial role. Their background in either discipline has sparked an interest in financials, billing, or managing projects or people. Their business focus helps them understand the financial needs of the organization to assist with technology initiative metrics such as return on investment or total cost of ownership. Understanding and balancing the various roles and skills needed is important for building a high-performance team of knowledge personnel (Table 1).

**Roles and Skills Matrix**

Understanding and balancing the various roles and skills needed is important for building a high-performance team of knowledge personnel. Not everyone on an informatics team will have a background and skillset in all aspects of imaging informatics. Understanding the types of roles, related backgrounds, and what to expect from each is essential.

**Desktop support.** This role is often responsible for personal computer support activities, including adding new desktop software for users, deploying new computers, and troubleshooting computer performance issues. This position is usually entry level, and candidates often vary in level of IT experience.

**System administrator.** This role is responsible for back-end system maintenance and stability. Common
activities include server backups, adding new storage, monitoring performance issues, and maintaining stability in the servers or systems. This position is usually at a senior level. Most candidates have a pure IT background.

**PACS administrator.** This role is often responsible for the day-to-day operations of the PACS. Common activities include ensuring proper image flow and repair, adding new modalities, and training end-users. This role is usually more advanced, and candidates often have either a general IT (eg, desktop support) or clinical (eg, technologist) background.

**RIS administrator.** This role is responsible for the day-to-day operations of the RIS. Common activities include ensuring proper reporting flow, debugging interfaces, setting up RIS resources and templates, and training end-users. This role is usually more advanced, and candidates often have a clinical background or other strong experience in clinical workflow. RIS administrators can be crucial players in quality improvement projects.

**Application specialist.** This role is responsible for training end-users in advanced imaging systems such as a PACS, an RIS, or subspecialty advanced visualization systems. Strong behavioral skills and an understanding of learning patterns are required for success in this role. Application specialists should have a clinical/behavioral background and are critical to end-users’ successful use of clinical information systems.

**Digital imaging manager.** This role is responsible for importing and exporting imaging from and to external media and for reconciling/matching orders and images between a PACS and an RIS. This role reflects the expected transformation of the duties of the traditional radiology file room manager from shipping/receiving film (in a traditional film library setting) to moving digital images between physical media and devices.

**Informatics leader/director.** Ideally, the manager, team leader, or IT director should have experience in all of the above roles, having progressed through the ranks to seeing their current role as more than resolving individual issues or problems. The informatics leader should hold a strategic position in the organization and be able to work with the service line chair, CEO, or physician informaticist to help set and operationalize organizational goals. Successful candidates have varied backgrounds, which often include demonstrated career experience characterized by incremental progression in responsibilities.

**Qualifications**

When building an informatics team, organizations often find it challenging to identify IT personnel who have the needed skills to become effective resources. Although the number of CIIPs is increasing, the demand for skilled knowledge personnel remains high and may exceed the availability of CIIPs in many geographic areas. Organizations should consider the following when building a team or even when adding a specialist.

**Basic skills.** Many entry-level technology professionals offset a lack of real-world experience by completing IT certification programs such as CompTIA A+, a vendor-neutral computer technician certification, programs offered by Microsoft such as the Microsoft Certified IT Professional, or other product-based certifications. Although these certifications do not guarantee technical knowledge per se, they demonstrate an interest in professional recognition and may indicate interest in formal recognition and professional development.

**Advanced skills.** For intermediate or advanced informatics team members, some imaging domain knowledge or advanced skills are necessary. Specific technical knowledge may be relevant on a site-by-site basis (eg, knowledge of firewalls may be more relevant for practice sites that maintain their own networks, which is unlikely in university settings). Specific experience or knowledge related to imaging is desirable but may not be easily obtained in some job markets. The candidate interview is critical to gauge professionals’ prior roles and their expected fit in the organization. If the candidate has no health care experience (but has strong technical skills), look for questions that probe the person’s perspective toward customers. Sample interview questions include the following:

- Tell me about a time when your system was down and service had to be restored at all costs. What was that like? What did you do to provide great recovery and communication? What was your customer’s experience like?
- How do you view service disruptions in your systems?
- How important is technical support team customer service?
- Tell me about a time when you worked closely with your customers to jointly solve a problem.

These and similar questions may be useful to understand the perspective and commitment level of potential candidates, especially when they have no strong health IT background or experience to discuss. Regardless of a candidate’s background, setting expectations during the interview as to what type of role is being created and what is anticipated from the candidate is essential. If the team member is expected to carry a pager and be on call to provide support 24 hours a day, 7 days a week (all while smiling and delivering great customer service), discussing those expectations from day 1 is a good idea.

**BUILDING AN IMAGING INFORMATICS AND IT TEAM**

The task of fostering a well-developed informatics and IT team comes with many of the organizational, budgetary, and interpersonal challenges faced by those
operating at the interface of management, human resources, and technology. The goal of such an effort should be to maximize the effectiveness of a practice’s efforts in fulfilling its mission, which may include clinical, research, advocacy, and educational components. Ultimately, a well-balanced, efficient team will do the following:

- cover the core competencies required to fulfill that mission;
- minimize the risk of failure of mission-critical technologies;
- anticipate the needs of a practice before they arise; and
- help maintain a practice’s competitive advantage.

A new upstart imaging practice has the advantage of developing an informatics and IT strategy from the ground up, anticipating the need to hire individuals with various strengths to fulfill that strategy. However, more often, an informatics leader or champion is tasked with starting or developing such a team in an existing practice or department with established budgetary constraints, political structures, and organizational limitations.

How does one deal with a situation in which an informatics and IT team is not easily identifiable? With no team to handle an existing department’s needs, the situation can be alarming. If a department has been functioning without incident, a team may in fact be tending to its needs. The distributed nature of the individuals contributing to IT and informatics needs may obscure the exact composition of the team. This situation sometimes occurs in large organizations. In such a case, identifying the various individuals maintaining operations is a worthwhile undertaking. Such individuals may be among the staff in hospital IT or administration, or employed as radiology technologists, vendors, or contractors.

What if the search for a team turns up only one person? It is common practice to have one individual identified as the “radiology IT” resource. In rare cases, this individual is a true superstar with advanced IT, clinical workflow, business operations, and strategic skills. Practices able to retain such rare talent are fortunate indeed. It is more common, especially in practices with more-limited resources, that a single individual has some basic IT and imaging IT skills and the judgment and communication skills to know when to seek help from other organizational resources or vendors. An imaging practice can likely maintain clinical operations indefinitely with such an arrangement. One resourceful individual with appropriate access to other IT professionals and vendors may be able to cover the core competencies required to fulfill an imaging practice’s basic clinical mission.

However, such an arrangement leaves much to be desired. When a practice is dependent on one individual, that individual becomes a single point of failure. A practice that relies on a single individual for IT tasks cannot effectively mitigate the failure risk of mission-critical technologies, especially if that individual becomes unavailable for an extended period. Furthermore, unless the individual has extraordinary time-management capabilities, the task of constantly anticipating the exact needs of a practice or helping maintain a practice’s competitive advantage while also tending to daily operations is nearly impossible for one person.

What if several individuals fulfill the needs of a practice but do so without coordination or leadership? In many practices, it is common to find the core IT competencies required for maintaining a mission shared among a few individuals. For example, one person’s primary role may be to provide desktop and user support; another may serve as a PACS administrator, and another as an RIS administrator. This circumstance is an improvement from the one in which a single individual is responsible for all these duties, because with some basic cross-training, the department could likely survive the temporary absence or departure of any one of those team members without mission-critical technologies failing. However, effective cross-training requires coordination among these individuals and a common awareness of what it takes to make the department run.

In other words, it requires these individuals to operate as a team, not just as a group of individuals.

In some cases, a group of individuals can coordinate its efforts and strategize for the future while maintaining a relatively flat organizational structure, ie, without defined leadership, but in most cases, active leadership is required. If a practice suffers from the absence of a designated IT leader other than a physician champion, the first necessary step is to evaluate the underlying cause. Has the practice staff grown organically over time, and the absence of a designated IT leader was simply an oversight? Is there a concern that someone promoted to a leadership role will require budgeting for a higher salary? Perhaps there is concern that identifying a single leader will alienate other members of the team? Identifying the underlying cause of the leadership absence will help prescribe the appropriate course of action. A physician champion may need to make sufficient effort to convince other members of the practice or organizational leadership that the need for an IT leader outweighs their concerns.

Such a leader can be recruited from outside the organization or groomed from within. With good leadership, a practice can move beyond simply covering core competencies and minimizing operational risk to anticipating needs and growing a competitive advantage. As discussed earlier, such a leader has a grasp of the technical landscape, excellent people skills, and the strategic skills necessary to keep up with a quickly changing landscape.

**REMEDIATING A DYSFUNCTIONAL IT GROUP**

The phrase “learned helplessness” has been used to describe many physicians’ attitudes toward IT systems...
and processes in health care settings. The fact that a fair number of dysfunctional IT teams are working in health care, and imaging IT in particular, should be no surprise. How does one recognize a dysfunctional IT group? This can be a challenge in itself. One avenue is to consider the relationships of the IT group with others in the imaging department and ask the following questions: Do IT personnel feel comfortable going into reading rooms and discussing issues with radiologists? Do radiologists see IT professionals as obstructionists who put obstacles in the way of getting their jobs done? Or do they see the IT group as being on their team, working toward solutions? What about vendors? Does the IT team have a purely transactional relationship with vendors in which anything is possible if the practice pays for it, or do members of the IT team have an idea of products’ inner workings, future developments, and even a friendly relationship with their more important vendors? Does the imaging IT team have a good relationship with other IT groups (in particular the hospital IT team if it is separate)? Finally, a dysfunctional IT group may be so because of its interpersonal relationships. Are members of the team wasting valuable time and effort because of petty internal disputes, bickering, or turf battles?

Besides poor relationships and interpersonal skills, an IT team can be dysfunctional for several reasons. Exhaustion, a poor knowledge base, difficult personalities, lack of proper structure/organization, or poor leadership are among some of the many underlying issues that could lead to a dysfunctional IT team. Remediating such a team requires establishing at least a working theory of the underlying root causes of the dysfunction. No one-size-fits-all formula can remediate such a team; every case may require analysis, corrective action, and re-evaluation. Providing the needed objectivity can be challenging when the stakeholders are also the change agents. An investment in an unbiased outside consultation service can prove beneficial in providing and adopting an objective modification plan. Besides poor relationships and interpersonal skills, an IT team can be dysfunctional for several reasons (Table 2).

CONCLUSIONS
Regardless of the practice size or setting (private versus academic), a radiologist’s relationship with IT staff and appreciation of how IT adds value to the practice mission is critical to the success of any IT strategy. Even practices that have a perceived mature IT infrastructure and staff should devote time and effort to performing regular IT needs assessments to ensure enough resources to support current and future clinical activities. Under the current climate of cost restraints, government regulations, and declining reimbursements, strategic investment in IT may initially be perceived as an unnecessary luxury. However, as practices find it challenging to participate in utilization control and population management, some of the critical management and business intelligence needed to prevail in such an environment can be derived only from robust, interoperable IT systems. Growth through mergers and acquisitions and increasing demand for high-volume, high-quality, low-cost care drive differentiation between successful and failing practices, and success may hinge, in good part, on a practice’s capability to effectively leverage IT.

TAKE-HOME POINTS
- The role of physician informaticist is an important one to have within the radiology executive leadership. Qualifications for this position vary depending on the complexity of the organization, but many educational opportunities are available for the interested physician.
- Understanding and balancing the various roles and skills needed is important for a high-performance team of knowledge workers. Key roles include: desktop support, system administration (PACS and RIS), application specialist, digital imaging manager, and informatics director.
- CIII’s have the skillset to perform the necessary functions of current and future radiology departments.
- Regardless of the size of a radiology practice or the setting (private versus academic), the relationship with IT personnel and resources and appreciation of the value IT can add to the practice mission is critical to its success.

REFERENCES