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VOL. 20 NO. 8

AUGUST 2019

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ALTERNATE VIEWS

By Dave Yeager

There are two sides (at least) to every story, as the saying goes, and that's as true in medical imaging as in any other aspect of life. Depending on your view, you may think AI is on the verge of becoming ubiquitous or years away from making a significant contribution to radiology practice. The reality is probably somewhere in the middle, but it's useful to take a closer look at how AI is changing clinical practice.

Our cover feature by Kathy Hardy looks at AI platforms. AI has been generating massive buzz in radiology for a while now, but there are practical concerns that need to be addressed. Chiefly, how will multiple AI algorithms be incorporated into workflow? Most radiologists don't mind using AI as long as it doesn't disrupt workflow, but having to stop what they're doing to consult an app can quickly become burdensome. Clicks matter, and whoever figures out how to best harness AI without diverting radiologists' attention will likely be poised to fill a large niche in the radiology market.

When it comes to alternate views colliding, nowhere are differences of opinion more hotly debated than in matters of breast screening. In case you haven't heard, the American College of Physicians updated its breast screening recommendations this past April. The guidelines recommend that women 40 and older who are at average risk of breast cancer discuss screening and mammography with their doctors to weigh the potential benefits and risks. The guidelines go on to say that, in women aged 40 to 49, potential harms outweigh potential benefits. You can probably guess what happened next. Many in the breast screening community feel that the potential harms of breast screening are often exaggerated, and they point out that the studies the ACP based its recommendations on are older and may not have captured important data. Beth W. Orenstein provides an in-depth account of both sides' arguments on page 16.

While we're on the topic of decision making, you may have heard that the Centers for Medicare & Medicaid Services will require clinical decision support for advanced imaging, beginning in 2020. You probably also heard, at various times in the past, that it would be required beginning in 2018 and, before that, 2017. There's no indication that CMS has plans to push the date again, but Dan Harvey caught up with some experts who can explain why it's OK to stop worrying and learn to love CDS … as long as you don't ignore it.

Finally, Keith Loria has a round-up of imaging displays. A picture is only as good as the medium it's projected on, and several manufacturers are upping their game.

Enjoy the issue.
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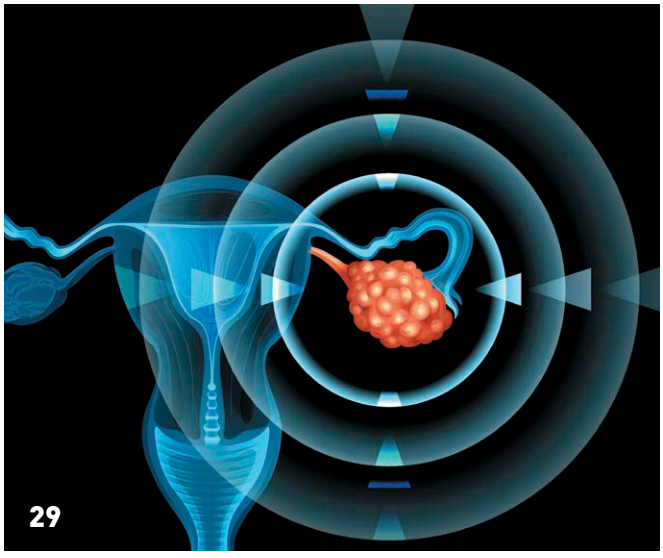

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Radiology Today (Print ISSN: 1539-0101, Online ISSN: 2169-9259) is published monthly by Great Valley Publishing Company, Inc., 3801 Schuylkill Road, Spring City, PA 19475. **Periodicals postage paid** at Spring City, PA, Post Office and other mailing offices. Permission to reprint may be obtained from the publisher. **Reprints:** Wright's Media: 877-652-5295 **Note:** For subscription changes of address, please write to ***Radiology Today***, 3801 Schuylkill Road, Spring City, PA 19475. Changes of address will not be accepted over the telephone. Allow six weeks for a change of address or new subscriptions. Please provide both new and old addresses as printed on last label. **Postmaster:** Send address changes to ***Radiology Today***, 3801 Schuylkill Road, Spring City, PA 19475. Subscription Rates — Domestic: free to all qualified recipients; Canada: $36 per year; International: $66 per year; Single issue: $5. ***Radiology Today*** Volume 20, Number 8.

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NONINVASIVE CANCER IMAGING

The Future of Targeted Cancer Treatments

By Robert Bard, MD, DABR, FASLM

New imaging technologies offer one-step image-guided cancer treatment. This is especially important since the size, depth, margins, and tumor aggression parameters are now quantifiably measured.

Identifying Skin Cancers

Skin cancers are the most common malignancy worldwide, and, while basal cell cancers are rarely fatal, aggressive squamous cell types have devastating health consequences. Malignant melanoma, the leading cause of death in the 25 to 45 age range, has a 98% diagnostic accuracy with 15- to 22-MHz ultrasound systems. More importantly, using quantitative Doppler technologies, we have specific criteria identifying which cancers are most aggressive and whether a tumor is likely to metastasize.

Digital Scanning vs Biopsy

The new optical dermatologic modalities of reflectance confocal microscopy and optical coherence tomography are highly accurate in ruling out malignant disorders and often alert us that a benign-looking lesion requires a biopsy, as is the case with amelanotic melanoma and pigmented basal cell cancers that mimic benign entities. 4D ultrasound imaging provides real-time evaluation of a 3D volume so we can immediately tell the patient the depth and the probability of recurrence.

Specific echoes generated by nests of keratin are strong indicators of aggression and are analyzed volumetrically. Highly suspect areas are then checked for spread in the area under the skin, and a search is performed for lymphadenopathy so we can show our patients that the disease is local and the need for further surgical intervention is unlikely at this stage. Patients are reassured because they simultaneously see the 3D image as the exam proceeds in systematic stages.

4D permits image-guided biopsy of the most virulent area of the dermal tumor and allows the pathologist to focus on the most suspicious region of the lymph node mass excised from the armpit, neck, or groin. In serious cases, patients are forewarned that the operation may be complex, involving skin grafts and advanced tissue construction, and can make plans in advance of any definitive treatment.

Reducing Complications

Fear of complications and life-altering posttreatment sequelae concerns deter patients from seeking medical opinions and possible surgical intervention, so many opt for noninvasive options. One out of 33,000 moles are malignant, meaning imaging reduces unnecessary biopsies. Cancer treatment depends on the depth of penetration, possibly involving facial nerves, muscles around the eye, and nasal bone or ear cartilage. Verified superficial tumors may be treated topically or by low-dose nonscarring radiation therapies.

Many cancers provoke a benign local immune response or coexistent inflammatory reaction that simulates a much larger area of malignancy. There is often cicatrix formation accompanying the body's healing response. 4D imaging highlights the true border of the tumor, sparing healthy tissue and resulting in smaller excisional margins and less scar formation.

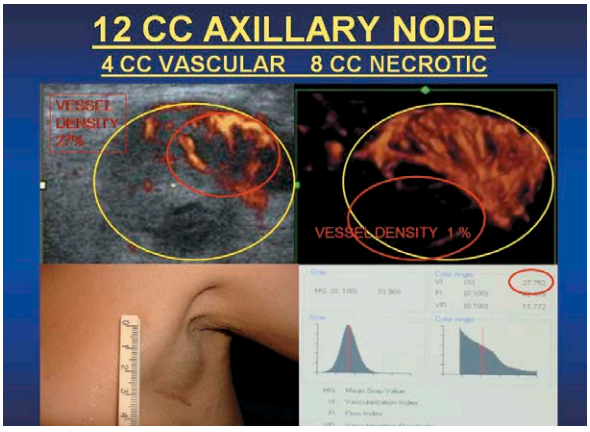
Doppler Applications

Blood vessel mapping using various Doppler modalities is routinely used in both cancer treatment and reconstructive preoperative planning. In cancer surgery, it is important to know whether there are any aberrant large veins or significant arteries in the operative site so that postoperative blood loss may be minimized.

Before initiating cosmetic procedures or aesthetic treatments, many plastic and reconstructive surgeons routinely perform a screening overview scan of the facial tissue including the eye, nose, jaw, and neck to check for forgotten fillers or postprocedure complications such as subdermal scar formation, calcific deposits from healing injured ligaments, or

retained silicone and other fillers that may have been injected in the past. Particular attention is focused on the nasal area between the eyes because instances of total, permanent blindness have been occurring for more than 10 years due to the inadvertent deposition of injectable filler material into the draining veins that supply the back of the eye.

Advance warning of this danger zone means injectables may be deposited in safer locations. Fat transplants around the eye's orbit occasionally put pressure on the ophthalmic arteries, cutting off blood supply to the face, resulting in tissue discoloration and, sometimes, death and sloughing of the affected skin. Advanced 3D Doppler systems allow for histogram vessel density measurement of neoplastic angiogenesis (Figure 1). This baseline of neovascularity is used as a treatment surrogate endpoint.



— IMAGE COURTESY OF ROBERT BARD, MD, DABR, FASLM

An example of Doppler imaging to map blood vessels.

Glandular Cancer Imaging Updates

Breast cancer invading the lower dermis and nipple, discovered with high-resolution probes, signifies that a tumor has spread farther than clinically judged. This finding is essential for detecting the newly discovered entity of breast implant–associated anaplastic lymphoma. This capability is vital for diagnosing the recent epidemic of male breast cancer occurring in first responders from 9/11. The cancer arises near the mammographically difficult nipple areolar complex.

Prostate cancer identified by 4D to be delimited by the capsule and of low vessel density is being followed serially in six-month intervals. Subsequent capsular invasion or increase in vessel density histogram analysis requires urologic measures. Bladder cancer is evaluated concomitantly with the prostate, and neovascularity and wall invasion are noted before surgical referral.

Testicular and thyroid tumors are similarly evaluated by 3D Doppler investigation protocols.

Contrast-Enhanced Ultrasound

In 1990, Rodolfo Campani, MD, director of the radiology department at the University of Pavia in Italy, developed contrast-enhanced ultrasound (CEUS) cancer imaging, which is currently used worldwide but not fully FDA approved. Microbubble media show tumor neovascularity with exquisite detail and are used to evaluate therapeutic response in solid organ disease. This is important, since the Response Evaluation Criteria in Solid Tumors, or RECIST, studies demonstrated that tumor enlargement during treatment may be related to apoptotic cell death with cystic degeneration or immune cell infiltration destroying malignant tissue.

Doppler ultrasound or CEUS reliably verifies decreased angiogenesis in these cases instead of using contrast CT or dynamic contrast-enhanced MRI for confirmation. Thermal treatments such as cryotherapy, high-intensity focused ultrasound, or laser ablation are designated complete when penetrating cancer arteries are no longer visible to the imager.

Margin Delineation

Advances in laser/optical devices allow near-microscopic tissue analysis of the cells by rapid, noninvasive testing. Real-time microscopy is performed during surgery to ensure, in cases of skin cancer, that a tumor border is clear. Future uses in breast and prostate cancer treatments are under clinical study.

Autoimmune Disease and Cancer

Abnormal immune responses that initially appear in the skin are associated with increased cancer incidence. Inflammatory vessels in psoriasis and infection are visibly catalogued, since successful treatment is quantified by a measured decrease in the number and types of abnormal vessels. High vascular immune vessel density is proportional to increased risk of future neoplastic tissue manifestations. Many arthritic conditions have coexistent dermal manifestations, alerting us to the probability of more extensive subclinical joint involvement.

— Robert Bard, MD, DABR, FASLM, has pioneered digital imaging technologies as alternatives to surgical biopsies for dermatologic and solid organ neoplastic disease since 1972. He is the author of *Image Guided Dermatologic Treatments*, *Image Guided Prostate Cancer Treatment*, and *DCE-MRI of Prostate Cancer* and is a member of leading international imaging societies.

A VIEW FROM HEALTH CARE'S LEADING EDGE

3D Printing, Elastography, and More

By Melody W. Mulaik, MSHS, CRA, FAHRA, RCC, CPC, CPC-H

Radiology is a dynamic specialty that arguably leads the health care industry in the advancement of new technologies. Think of imaging today as compared with 20 years ago. Very few specialties can boast the volume of new equipment and new procedures that have been introduced in such a short period of time.

One of the challenges often associated with offering new services and/or integrating new equipment and technologies is justifying the cost or offsetting the loss of revenue associated with a nonreimbursed procedure. Although a new procedure may be widely accepted in the medical community as safe and effective for the detection and/or treatment of a disease or illness, that is no guarantee that Medicare, or any other third-party payer, will provide payment for it. Thus, organizations that provide state-of-the-art procedures are often considered to be on the "bleeding edge" of health care; they are providing a valued clinical service with little or no standard reimbursement for their efforts. This article will highlight a few new leading-edge services to ensure that your organization is appropriately assigning procedure codes.

The types of procedures that fit into this category generally have one of three options for coding assignment and submission. For the first two options, there is either a Category 1 or 3 CPT procedure code that the payers choose not to reimburse. Category 1 codes are considered the "regular" five-digit procedure codes. Category 3 codes have four numerical digits plus the letter "T" at the end, eg, 0508T.

The third option applies when a procedure must be assigned an "unlisted" CPT code because there is not a code that accurately describes the service. Per ***CPT Manual***, "Do not select a CPT code that merely approximates the service provided. If no such procedure or service exists, then report the service using the appropriate unlisted procedure or service code." A great example of a procedure that started as an unlisted code but graduated to a regular code with reimbursement is breast tomosynthesis. This onetime leading-edge, bleeding-edge technology has become an industry standard, with Medicare leading the way to provide coverage. Examples of procedures that meet this exception today include 3D printing, computer-aided detection for breast ultrasound, ultrasound specimen imaging, and prostate ultrasound with MRI image fusion. Not all procedures that require the use of an unlisted code would be considered a leading-edge procedure, but most do fall into this category. Let's examine some scenarios that fit into each of these categories.

Ultrasound Elastography

Many times, procedure codes for new technologies start as Category 3 codes and then graduate into Category 1 codes, either through a code number change or a more extensive change involving the description(s). Elastography is a good example of this scenario.

Prior to 2019, ultrasound elastography was a Category 3 add-on code (+0346T) that was to be appended to a regular anatomical ultrasound code. Even though the coding has changed in 2019, this does not automatically mean that every payer will provide coverage for this exam.

Elastography is a technique for evaluating tissue elasticity (mechanical stiffness). It is used to identify malignant tumors, which are less elastic than nonmalignant tumors, as well as diagnose conditions (eg, fibrosis and cirrhosis) that cause an organ to increase in firmness.

CPT CODE	DEFINITION
76981(-26)	Ultrasound, elastography; parenchyma (eg, organ)
76982(-26)	Ultrasound, elastography; first target lesion
76983(-26)	Ultrasound, elastography; each additional target lesion (list separately in addition to code for primary procedure)
91200(-26)	Liver elastography, mechanically induced shear wave (eg, vibration), without imaging, with interpretation and report

Code 76981 can be assigned only once per session per evaluation of the same parenchymal organ. If both a parenchymal organ and lesion(s) in the same organ are evaluated in the same session, assign code 76981 only. Add-on code 76983 is only reported with code 76982 and cannot be reported more than two times per organ.

Code 91200 represents nonimaging liver elastography. This includes mechanical shear wave liver elastography—also known as transient elastography—as well as acoustic radiation force impulse liver elastography—see ***CPT Assistant***, October 2017. An example of 91200 is the FibroScan, which produces a numeric value, not an image. Note that code 91200 is restricted to exams of the liver.

Either imaging elastography (76981–76983) or nonimaging elastography (91200) can be performed in conjunction with diagnostic ultrasound of the liver (76700–76705). The National Correct Coding Initiative edits bundle the abdominal ultrasound into 91200, and it is appropriate to apply modifier 59 to

the ultrasound code to show that it represents a separate service—see the ***ACR Radiology Coding Source***, January/February 2015, and ***Clinical Examples in Radiology***, Spring 2015. However, it is inappropriate to report 91200 together with an ultrasound code when an imaging elastography exam was performed. In that case, the appropriate elastography code, rather than 91200, must be assigned. So you can see that, even though there are codes, great care must be taken to ensure that they are assigned appropriately and accurately to reflect the performed services.

Sacroplasty

Sacroplasty is a procedure that has been performed for many years but is still represented by Category 3 CPT codes (0200T–0201T). Sacroplasty is vertebral augmentation of the sacrum, performed to treat osteoporotic sacral fractures.

The most common type of fracture is a vertical crack that appears alongside the sacroiliac joint on one or both sides. The physician creates a cavity by inflating a balloon, inserting an implant, or using instruments to remove some of the bone, and then cement is injected into the cavity through a needle under fluoroscopy or CT guidance. Cement injection without cavity creation should be coded as sacral vertebroplasty (22511), not sacroplasty—the January 2015 issue of ***CPT Assistant*** incorrectly stated that cement injection without cavity creation could be coded as sacroplasty, but a correction was published in the April 2015 issue.

Bone biopsy is included when performed at the same level as the sacroplasty—see ***CPT Assistant***, December 2015. Biopsy of other vertebrae can be coded separately. The sacroplasty codes are contractor priced, so each Medicare contractor can determine whether to cover them and, if covered, how much to reimburse. Some payers do not cover sacroplasty because they consider it to be investigational.

3D Printing

A 3D printer can create a 3D object by depositing layers of material in response to a computer program. These devices are growing in popularity in the medical field, as they give health care professionals the ability to generate a model of an organ or other body structure for use in surgical planning or education.

Radiology groups and imaging centers that have 3D printers may be asked to create these models for treating physicians. If the provider performs 3D postprocessing of a CT or MR data set in order to create the model, the postprocessing can be reported with the 3D rendering codes (76376–76377). Keep in mind that 3D rendering cannot be reported for postprocessing of a CT angiograpy or MR angiography data set—see ***Clinical Examples in Radiology***, Winter 2017, Summer 2018.

Effective July 1, the American Medical Association has approved Category 3 CPT codes 0559T and 0560T, which are geared toward reimbursement for the production of individually prepared 3D-printed anatomical models that can be made up of one or more components with unique colors and materials, and 0561T and 0562T, which cover the production of personalized 3D-printed anatomic guides using patient imaging data. The new codes do not guarantee payment, however.

Whole-Body Scans

The performance of whole-body scans for cancer detection have resurfaced in the coding discussion for both CT and MRI. For example, the National Comprehensive Cancer Network has included a whole-body MRI scan as an option to detect multiple myeloma. According to ***Clinical Examples in Radiology***, Spring 2009, a "whole-body MRI should be reported with the unlisted MRI code 76498."

Similarly, there is not a specific CPT code to describe the whole-body CT scan for diagnosis or screening. According to ***Clinical Examples in Radiology***, Summer 2018, "When performed and medically necessary, code 76497, Unlisted computed tomography procedure (eg, diagnostic, interventional), is reported. If only certain anatomical areas are identified for CT evaluation, those anatomical regions should be coded accordingly."

Other Unlisted Procedures

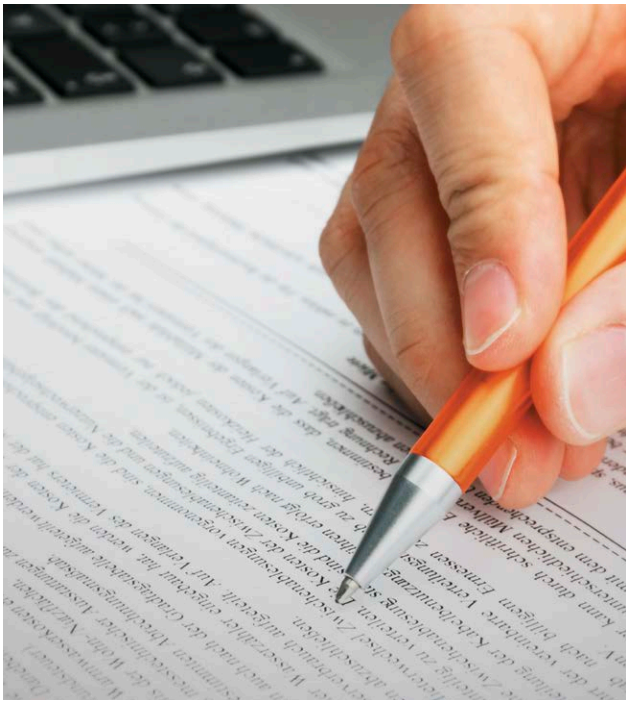
In the absence of policies that specifically address a procedure, unlisted codes require a detailed report from the physician including the complexity of the medical condition, any physical findings, and the extent of the procedure, including time, skill, and any specialized equipment necessary to provide the service. All insurance payers monitor and manually review claims filed with "unlisted" procedure codes. It is recommended that the elements of a detailed report include the following:

- a detailed description of the procedure performed;
- copies of articles in medical journals, etc, providing clinical trial information, medical indications, patient outcomes, and surgery or other procedure replaced by the new procedure;
- documentation of the medical necessity of the procedure;
- time, effort, and equipment required to perform the procedure;
- any cost savings experienced by utilizing this procedure;
- patient diagnosis, chief complaint, and presenting symptoms and signs;
- any concurrent problems requiring treatment or management;
- description of follow-up care and prognosis;
- relation of the "unlisted" procedure to an existing procedure in terms of the amount of physician work involved or facility resources expended; and
- financial quantification of cost savings to the payer when more extensive procedures are avoided, if applicable.

Including all of the recommended information may seem like a daunting task; however, it may be the worth the effort if your facility is frequently performing leading-edge procedures.

Radiology will continue to be at the forefront of medicine, but, unfortunately, reimbursement will generally lag behind. Make sure all of your financial analyses that incorporate reimbursement are realistic, accurate, and in accordance with correct coding guidelines. Also ensure that you are always up to date on the latest coding guidelines—remember, the only constant is change!

— Melody W. Mulaik, MSHS, CRA, FAHRA, RCC, CPC, CPC-H, is the president of Coding Strategies, Inc & Revenue Cycle, Inc.



A NEW LEASE ON TECHNOLOGY

How to Finance With a Payment Structure That Guards Against Obsolescence

By Kim Montgomery and Justin Tabone

Technology in the health care industry is rapidly evolving. This accelerated pace of change has no doubt improved patient outcomes, but it has also put additional pressure on providers to stay up to date and refresh their technology more frequently. To deliver the best patient outcomes and remain competitive in this environment, hospitals and imaging facilities need to keep abreast of new developments.

Being stuck with obsolete equipment can cost facilities in a couple of critical ways. First, obsolete equipment may not provide the best standard of care. Speak with any radiologist or technologist, and they will tell you that using outdated imaging equipment makes their work more difficult and less efficient. Second, the cost of maintenance can increase and revenues can decline as equipment becomes older.

Upgrading equipment will always be on the to-do list, and it's not simply a one-time consideration for facility leaders. They must be aware of the best time to upgrade equipment and the best financing structure to meet the facility's business goals and budget. The ever-changing technology and competitive environment create pressure to add innovative technology, but it's up to the leaders themselves to be strategic when it comes to technology acquisition plans. By considering the right financing structure, business leaders can use foresight and knowledge to plan for these changes before they're actually needed.

Financing Structures

Financing can help relieve stress by providing structures that offer the flexibility needed to protect against obsolescence or facilitate ownership for equipment with low obsolescence risk. Two main categories of finance structures are fair market value (FMV) leases and $1 leases.

FMV Leases

An FMV lease offers the lowest payment option and the most flexibility. At the end of the lease term, the customer has the option to upgrade, purchase, or return the equipment or renew the lease on a month-to-month basis. This gives the customer the opportunity to evaluate available technology enhancements at the end of the lease, rather than making that decision at the start of the lease. Due to its flexibility, this is typically the best structure to guard against technology obsolescence.

$1 Purchase Option Lease

Customers typically choose a $1 purchase option lease when ownership is the top priority and the life of the technology will extend well beyond the term of the lease. This structure has a higher payment because the full cost of the financing is captured over the chosen lease term.

Many Options

If you're interested in new equipment but have an existing lease, there may be options available. It may be possible to arrange a trade-in of the old equipment, carry over the remaining balance into a new lease, and extend the term to maintain, or even lower, your prior payment and potentially receive a more attractive interest rate. Often, a new lender can buy you out of an existing lease; however, it's generally more efficient to establish a long-term relationship with a lender to seamlessly negotiate upgrades.

Above all, it's critical to seek out a financing program that provides you with the flexibility to seamlessly and cost-effectively implement the latest technology so you can deliver the best standard of care. In addition to speaking with your supplier, you may want to consult a financial advisor, tax attorney, accountant, or other trusted professional to help you make the best choice for your situation.

— Kim Montgomery is the vice president, health care originations leader for TIAA Commercial Finance, Inc. She has worked in the health care equipment finance space for more than 20 years, developing finance solutions to facilitate implementation of health care technology.

— Justin Tabone is the senior vice president, originations group leader for TIAA Commercial Finance, Inc. He has more than 20 years of experience in the equipment finance industry.

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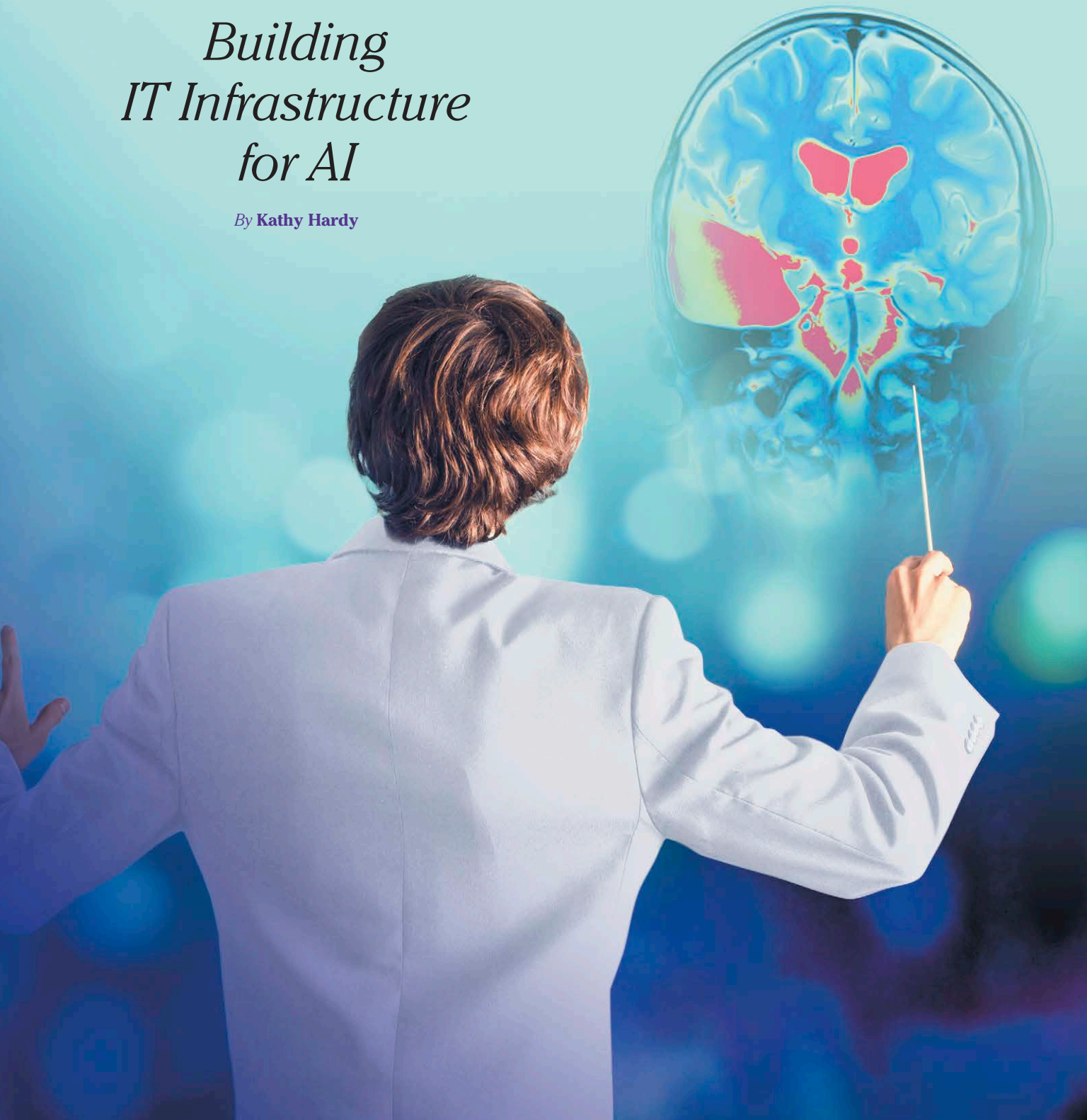
ENSEMBLE

Building IT Infrastructure for AI

By **Kathy Hardy**



APPROACH

The current spotlight on AI tools for radiology is bringing an emphasis on the development and validation of individual applications. Consumers are looking at which applications would be most useful in their practices, often looking for solutions to the "lowest-hanging fruit" of their imaging needs or selecting the few options they can easily incorporate into their workflow. A result of this process of picking and choosing various AI applications is a disjointed network of tools in need of a unifying mechanism. The intelligence that deep learning brings to diagnostics and treatment needs a platform on which to build an IT infrastructure to support this powerful resource.

Eliot Siegel, MD, FACR, FSIIM, a professor and vice chair of the department of diagnostic radiology at the University of Maryland School of Medicine, compares the situation to that of music lovers shopping for songs. They want to download only select songs from a music streaming service, rather than purchase the entire CD and end up with playlists full of songs they don't want.

"Like in music, radiology departments don't want to buy an entire package," Siegel says. "They want to pick and choose best-of-breed solutions. We need a way to do this in radiology. We have PACS, but we don't have the ability to easily or quickly add one-off contracts with each application vendor. We need a mechanism to consolidate the applications that work best for our individual needs."

All Together Now ...

Experts in AI note a growing number of vendors getting into the space, creating new applications for deep learning. Siegel says that, while the increased input brings new perspectives to the technology, it can also lead to disruptions to the status quo of the imaging community.

"In the past, new technology developments in radiology came from the major modality vendors, such as GE, Siemens, or Philips," he says. "The introduction of the large number of new AI vendors is disruptive. It adds to the excitement and hype about AI in radiology circles, but also leads to questions about what choices to make."

Variability among vendors is just one of the changes begat by AI's growing place in radiology. Another change is in development time. Siegel mentions computer-aided detection, which utilizes a variety of technologies that typically require a high level of expertise and a lengthy development timetable, but still results in quality applications. Now, with deep learning applications, Siegel says the ability to generate useful algorithms directly from imaging databases helps speed up the application development process.

"By shortening the development time, deep learning will result in a democratization of AI and an increased number of applications," he says. "This makes it easier for more new vendors to get involved. You can still access apps from the major modality vendors and advanced visualization providers but, with deep learning, there is an increased number of opportunities for what the smaller and potentially more nimble AI developers can do. Instead of a small number of large radiology companies with multiple applications, we now have more vendors producing fewer but often more unique and specialized applications."

For now, many radiologists are using multiple traditional imaging suites to utilize the applications that best serve their needs. This can cause problems with consistency and requires users to learn different interfaces. There are some options in the industry for single support of multiple, varied applications, but Siegel says movement in that direction is slow to come. One-stop mechanisms need to enable applications to work in concert, he says, so users can view images and have the analysis in one place.

"We need an ensemble approach," Siegel says. "We need a platform that allows us to pick and

choose applications and then enables them to work together cooperatively in series or parallel."

Getting to this point may be challenging. Siegel says next steps pertain to workflow: As radiologists look to adopt new applications, especially for "boutique" use, scalability becomes more difficult.

"We need to look at whether these new platforms will become part of our existing workflow of interpreting studies, or will we need to reinvent our workflow and platforms?" he says. "Interoperability will be a big issue, as will integration into workflow and the ability to scale up. It's fascinating to see one AI application at a time do well independently. Now, we need to get to the next phase, where we can create a practice around this new workflow."

Proprietary vs Open Source

Creating platforms that enable AI applications to work together is a goal in building the right IT infrastructure. With that, however, come concerns about whether these platforms comprise proprietary components. Bradley Erickson, MD, PhD, a radiologist with the Mayo Clinic in Rochester, Minnesota, sees the exclusivity of proprietary systems as a concern with regard to adoption. When radiologists become locked into using the same vendor for all components of a system, it limits the potential for changing components as needed. He recounts similar concerns when PACS was introduced.

"When PACS started, it was proprietary," Erickson says. "When you needed to make a change, you had to completely change the entire system. You couldn't just change one component. That's why you want to use a vender-neutral system. You want to be able to bring in the best of all the AI tools. It's not a one-size-fits-all."

Despite the desire to keep the platform open to a variety of AI applications, Siegel notes that, at least in its infancy, the development of proprietary systems could lead to the development of standards for interoperability.

"If you create a sophisticated interface to integrate various AI applications today, it would most likely have to be proprietary," Siegel says. "One of those proprietary systems might achieve a critical mass similar to the case with video equipment such as VCRs and television broadcast resolution. So, even though it starts out as a proprietary system, a highly successful one could become or at least inspire the de facto standard for AI interfaces."

Erickson's approach is a vendor-neutral system that brings together as much data about the patient as possible. In the course of researching aspects of computer-aided diagnosis and the use of computer technologies to extract information from medical images, he began developing a system to promote team science. This system, which brings together previous images and other clinical support data, was first introduced and used at the Mayo Clinic before being introduced commercially as FlowSIGMA.

"Like a team approach in medical care, FlowSIGMA pulls together multiple series and prior exams," he says. "There can be gaps in diagnosis if you're not looking at all the relevant patient data. As more AI tools are being built, we see a need to incorporate everything together."

FlowSIGMA, for which Erickson serves as CMO, started as a system to enable an algorithm for identifying changes in brain tumor patients using MRIs. This process is more complex than simple routing or forwarding, given that it requires recognition that several specific series be present to constitute the specific exam and querying the archive to determine that a prior exam of this special type is available. The technology also "time boxes," meaning that if the analytic process takes longer than its prespecified amount of time, an error-handling workflow can be executed.

"If one of the AI tools is down, you wouldn't know it," Erickson says. "You have PACS, RIS, and EMR that communicate together. AI is the fourth leg of the communication process and provides the infrastructure that helps them communicate together. The capacity to detect errors is needed, but it's not understood how to address that need. That's a problem that can be addressed with the right IT infrastructure."

Since its introduction, the FlowSIGMA technology has been used for several other workflows, including high-throughput tools such as CT denoising. Erickson says the system is flexible and its modular design allows for integration with other industry-standard tools.

Workflow

When considering AI integration into workflow, Erickson says there are considerations such as graphics processing

"Having the ability to access imaging and nonimaging applications, working in concert, is a more sophisticated way of using data in the course of diagnostics or triage. It's a best-in-practice approach, and what's best in practice is what's best for patients. Making the decision to use a platform that consolidates all the relevant data is what's best for workflow, best for efficiency, and best for patient care."

— Eliot Siegel, MD, FACR, FSIIM, a professor and vice chair of the department of diagnostic radiology at the University of Maryland School of Medicine

units (GPUs) to accelerate the creation of images for output to a display device and central processing units (CPUs) to carry out the instructions for performing arithmetic and other aspects of algorithm building. CPUs require less infrastructure than GPUs.

"When people think about what's needed to integrate AI into workflow, they think about the process of training the system to recognize the data needed to complete the analysis," Erickson says. "They're thinking of the power it takes to train the network. The computing required for the inference aspect of integrating AI is low."

He sees workflow as the biggest challenge, yet this aspect of the process is often underestimated.

"Most AI tools currently work with single images," Erickson says. "But AI is better with more data. With advancements in imaging technology, we have more data we can include. When I was going through my radiology training, we were told that a patient's previous exams were your best friend. The same can be said for AI."

In addition to images, Erickson says the infrastructure to support a successful AI system should also be able to incorporate nonimaging data, such as patient history and current medications. However, "systems today don't adequately combine all this previous information to optimize tools," he says.

Siegel agrees, noting that AI has limitations when it comes to certain areas of radiology, such as its use in oncology. The current AI paradigm is to address a single task when reviewing a medical imaging study. While this works for diagnostic purposes, it doesn't address a major radiologist responsibility in oncology: determining whether there has been a significant change over time with or without a therapeutic intervention. In that case, the process isn't to diagnose but to track changes in tumors, to see whether the patient is improving with treatment. Radiologists need to look at prior exams and current exams to quantify improvement.

"Having the ability to access imaging and nonimaging applications, working in concert, is a more sophisticated way of using data in the course of diagnostics or triage," Siegel says. "It's a best-in-practice approach, and what's best in practice is what's best for patients. Making the decision to use a platform that consolidates all the relevant data is what's best for workflow, best for efficiency, and best for patient care."

Siegel would also like to see various AI systems work together cooperatively, just as a panel of experts would collaborate.

"You need more than one AI system," he says. "With that, you also need a platform on which radiologists can build the AI tools that best fit their needs. With more tools that will need more data, there will be more recognition and greater adoption of a more sophisticated system in the near future."

— Kathy Hardy is a freelance writer based in Phoenixville, Pennsylvania. She is a frequent contributor to *Radiology Today*.

PERSPECTIVE MATTERS

New ACP guidelines reignite the debate about optimal breast cancer screening protocols.

By **Beth W. Orenstein**

Every year, more than 40,000 women die from breast cancer in the United States, according to the American Society of Clinical Oncology. Experts agree that, when detected early, breast cancer is more treatable and women are more likely to survive long term. Screening mammography is widely considered the best way to detect early breast cancers. But that's where agreement ends—and controversy arises.

Recommendations on when most women should start screening mammography and how often they should have mammograms—yearly or every other year—have changed over the years. In 2003, the American Cancer Society (ACS) recommended women begin annual mammograms at age 40 and continue annually as long as they are at average risk for breast cancer, in reasonably good health, and candidates for treatment. The recommendation stood and was supported by others, including the ACR and the Society for Breast Imaging, for a number of years.

Contrasting Views

In November 2009, the US Preventive Services Task Force (USPSTF) recommended that all women start routine biennial mammography screenings at the age of 50. The USPSTF also said that women may choose to start routine mammography screenings between ages 40 and 49, after talking with their doctors about their personal values and preferences. In 2015, the ACS updated its recommendation to say women should begin screening at 45 and undergo annual screening until 55. The group also recommended that women 55 and older could continue annual screening with mammography or transition to every other year, if they wish. Both groups' recommendations stirred controversy when they were issued.

Now, the American College of Physicians (ACP) has raised the question of when and how often an average-risk woman should have mammograms, once again sending concern rippling through the communities of radiologists and oncologists who specialize in breast cancer. In April, the ACP published a guidance statement in the ***Annals of Internal Medicine*** stating that its goal is to help clinicians care for women at average risk for breast cancer in making decisions regarding breast cancer screening. The ACP reviewed selected guidelines and evidence from around the world to develop a set of guidance statements of its own.

The ACP guidance statements recommend that, starting at age 40, women of average risk for breast cancer talk with their doctors regarding breast cancer screening and

mammography to determine what's best for them. The statement also says: "Discussion should include the potential benefits and harms and a woman's preferences. The potential harms outweigh the benefits in most women aged 40 to 49 years." Based on the evidence, the ACP guidance statement notes that, for average-risk women aged 50 to 74, screening for breast cancer would best be every other year. After age 75, an average-risk woman can discontinue screening, as she would be more likely to die of other causes, the ACP says.

Ana Maria Lopez, MD, MPH, MCAP, a medical oncologist and the immediate past president of the ACP, affirms that "early detection is important," but notes that, in reviewing the literature, the ACP did not see a significant benefit in screening average-risk women starting at age 40 or in screening those over 50 annually rather than biennially. "When you look at observational studies, there was not a difference in mortality for women age 50 or older being screened annually or biennially," she says. "There are not as much data for women over 70, and we need more trials that include older women. ACP's recommendations about who should be screened and when are grounded in the data."

The ACP and the USPSTF say they recommend fewer screenings because of an increase in false-positives that lead to unnecessary biopsies and overtreatment of some breast cancers. Alex H. Krist, MD, MPH, a member of the USPSTF, says that out of every 1,000 women who are screened starting at age 40, an additional 200 or so will be called back for additional views because of a potentially suspicious finding on their mammograms. Of those women, about 50 will go on to get biopsies that turn out to be negative, he says. "It's more than just anxiety," he says. "It's the further testing, and it can lead to a woman and her doctor being worried or concerned that there's something wrong for some time."

Krist says screening can also result in some cancers being overdiagnosed, ie, if left alone, they would never affect the woman's health. "You can't tell whether it's an overdiagnosed cancer or not, but we often treat it, once we know it's there," he says.

The ACR vehemently disagrees. "We believe that the guidelines that don't have women starting until age 50, and then only every other year, could result in up to 10,000 unnecessary and additional breast cancer deaths in the United States each year," says Dana H. Smetherman, MD, FACR, chair of the ACR's Breast Imaging Commission.

Smetherman believes most women would prefer to be screened and, if necessary, called back—or even undergo biopsies—only to be reassured that everything is all right, rather than have a cancer missed in its early stages because

"If you have a tumor that is one-third of an inch, why would you wait for the tumor to be over an inch to address it? Tumor cells can travel through the lymphatic channels and end up in the bloodstream via the lymph nodes, and that can affect the staging of that tumor and the type of treatment required."

— Stamatia Destounis, MD, FACR, FSBI, FAIUM, of Elizabeth Wende Breast Care in Rochester, New York

it wasn't caught on mammography. Smetherman agrees with the USPSTF and ACP that every medical procedure requires weighing risks and benefits but disagrees with them that the harms of screening mammography outweigh the benefits. Indeed, she says, the opposite is true.

Risk vs Benefit

The ACP says its guidance statement only applies to women at average risk of breast cancer. For screening purposes, a woman is considered to be at average risk if she doesn't have a personal history of breast cancer, a strong family history of breast cancer, a genetic mutation known to increase the risk of breast cancer (eg, a BRCA gene), and has not had chest radiation therapy before the age of 30. "While our guidelines are for women at average risk, we are saying that it depends on the woman and her individual preferences," Krist says. "As a physician, I have found that when discussing this with women, there are some who say, 'I am worried about breast cancer, and I want to start screening earlier.' And there are plenty of others who say, 'It sounds like there are a lot of false-positives, and I don't want to start earlier.' Women deserve the right to make that decision for themselves."

The USPSTF, having scrutinized the data, associated a negligible mortality benefit with screening women earlier. "If you start screening at 40, out of 1,000 women, you save eight from dying of breast cancer. If you start screening at 50, out of 1,000 women, you save seven," Krist says. "This benefit needs to be balanced against the harms of false-positives and overtreatment."

Smetherman believes the ACP and the USPSTF are looking at the issue the wrong way. She agrees that false-positives can be "anxiety provoking" but says that most women aren't traumatized by being called back for additional screenings if a potential abnormality is identified.

"There's anxiety with getting that phone call that says you need to come back for some additional images," Smetherman says. "And as a breast imager, I would never want to minimize that. But that anxiety is usually short lived and resolves quickly. Most of the time, when women find out from additional images that everything is all right, they are relieved and go out and have a good rest of their day."

Even if a woman is told she must have a biopsy, Smetherman says, "I don't think that kind of anxiety should outweigh the potential life-saving of having had a mammogram." Research on the anxiety associated with callbacks is limited, Smetherman says, "but what there is shows anxiety to be of short duration and usually doesn't have any lasting effect."

While researchers are learning more and more about breast cancer, they're not at the point where they are able to identify those that will be fatal and those that may be survivable without treatment, Smetherman says. As with all cancers, "there is a range; some are relatively indolent and some are more aggressive. In breast cancer, it's a very important question." No provider wants to give a woman a treatment she does not need, Smetherman says. "But because, at this time, no one can tell a patient how aggressive their cancer will be, we have to treat them all as if they would have consequences," she says.

Smetherman also takes issue with the ACP's claim that biennial mammography screening results in no significant difference to breast cancer mortality. "This is incorrect," she says. "There have been no randomized controlled trials to test this claim." To the contrary, the National Cancer Institute/Cancer Intervention and Surveillance Modeling Network models that the USPSTF and the ACS used show a major decline in deaths among women screened annually vs every other year, Smetherman says. Using the Swedish Cancer Registry, a study published in ***Cancer*** in February 2019 showed that women screened regularly for breast cancer have a 47% lower risk of dying from the disease within 20 years of diagnosis than those not regularly screened. Other large studies—eg, Otto and colleagues in ***Cancer Epidemiology Biomarkers and Prevention*** in 2011 and Coldman and colleagues in the ***Journal of the National Cancer Institute*** in 2014—show that undergoing regular mammography cuts the risk of dying from breast cancer nearly in half.

Not Worth the Wait

Stamatia Destounis, MD, FACR, FSBI, FAIUM, of Elizabeth Wende Breast Care in Rochester, New York, also says that following the ACP and USPSTF screening guidelines would greatly reduce the mortality benefit. Destounis, who is a member of ***Radiology Today***'s Editorial Advisory Board, says screening every other year could lower the chance of survival should a cancer develop.

"The data show that if you start with annual screening at age 40, you will reduce breast cancer–specific mortality by 40%," she says. "If you wait until 50 and then screen every other year, you will reduce mortality overall by 23%. So, if you follow the ACP and USPSTF guidelines, you're reducing the mortality benefit by approximately 50%."

If an aggressive cancer goes undiagnosed because of a longer interval between screenings or starting screening at

an older age, it delays treatment. Like most cancers, breast cancer is most treatable in its early stages, Destounis says. When a cancer is found in its early stages, a woman has more treatment options available as well, she says.

"If you have a tumor that is one-third of an inch, why would you wait for the tumor to be over an inch to address it? Tumor cells can travel through the lymphatic channels and end up in the bloodstream via the lymph nodes, and that can affect the staging of that tumor and the type of treatment required," Destounis says. "Most women, when told they have breast cancer, don't want to follow the tumor to see if it grows. They want to take care of it." It's true that some breast cancers are slower-growing tumors, "but you don't know that until you biopsy them," she adds. "There is no characteristic on a mammogram or an ultrasound that you can hang your hat on and say, 'This is slow growing, and you can probably afford to wait on it.' We don't know that. So, we biopsy them."

The ACP and USPSTF recommendations are for women who are at average risk, Destounis says. Approximately 70% of breast cancers are found in women who have no family history of the disease. "We need to screen average-risk women because we know the biggest risk factors for breast cancer are being female and aging." Also, she adds, starting at 40 gives your radiologist a baseline. "Then, if you come back every year, we can look for subtle changes that may develop year to year. It makes it more difficult to identify subtle cancers if you don't have a prior mammogram for comparison."

Emily Conant, MD, a professor and the chief of the division of breast imaging in the department of radiology at the Hospital of the University of Pennsylvania in Philadelphia, says the recommendations to begin at 50 are based mostly on older data from randomized controlled trials that used older equipment, often longer screening intervals, and different detection thresholds. Those methods "lead to underestimations of the benefit of routine screening," she says.

Also, Conant says, while it is true that the incidence of breast cancer increases with age, it is also known that women who develop breast cancer at a younger age, ie, premenopausal women, tend to have more rapidly growing cancers. "By screening women later in life and less frequently, as recommended by the ACP guidelines, the number of breast cancers diagnosed at later stages will increase. A later stage at diagnosis means more extensive surgeries, more aggressive treatment, including chemotherapy, and less chance for cure," she says.

A Better Outlook

Some are concerned that insurance companies will use the latest salvo in this debate to reduce coverage for screening mammography, further reducing the number of women who are screened. In 2015, according to the Centers for Disease Control and Prevention, slightly more than 65% of women older than age 40 had a screening mammogram within the last two years. That means about 35% did not.

The various guidelines from different medical societies must be confusing for women and their physicians, Destounis says. And the ACP's revisitation of the issue—not based on new research—does a disservice to women, she says. Destounis isn't worried that insurance companies will reconsider and stop paying for screenings, however. "I'm more concerned that the different recommendations from the different medical societies will confuse women and they won't know what's the best for them," she says. "That's detrimental to our patients' health."

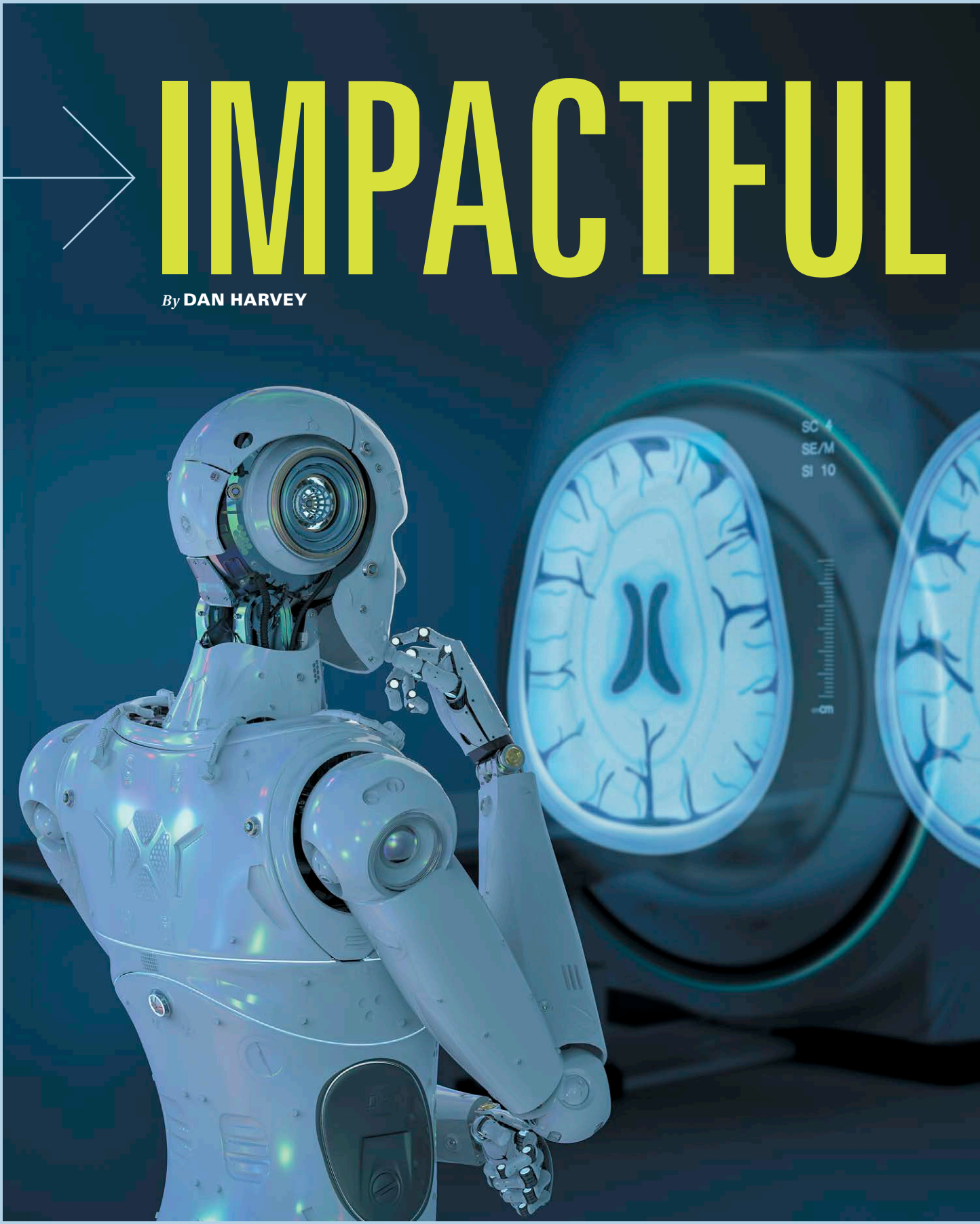
Joseph P. Russo, MD, a breast imaging radiology specialist at St. Luke's University Health Network in Bethlehem, Pennsylvania, says he's surprised that groups continue to debate what the best mammography cancer screening routines are. "The detail of when to get mammograms is less important than determining the best way to implement newer technologies," he says. "The fact of the matter is that mortality has gone down 35% since the advent of screening mammography. It's such a great modern medicine success story that it boggles my mind why it's still being tinkered with. It works and, in combination with new technology, continues to get significantly better. We should never dissuade women from taking advantage of these incredible breast imaging tools that are now available to them."

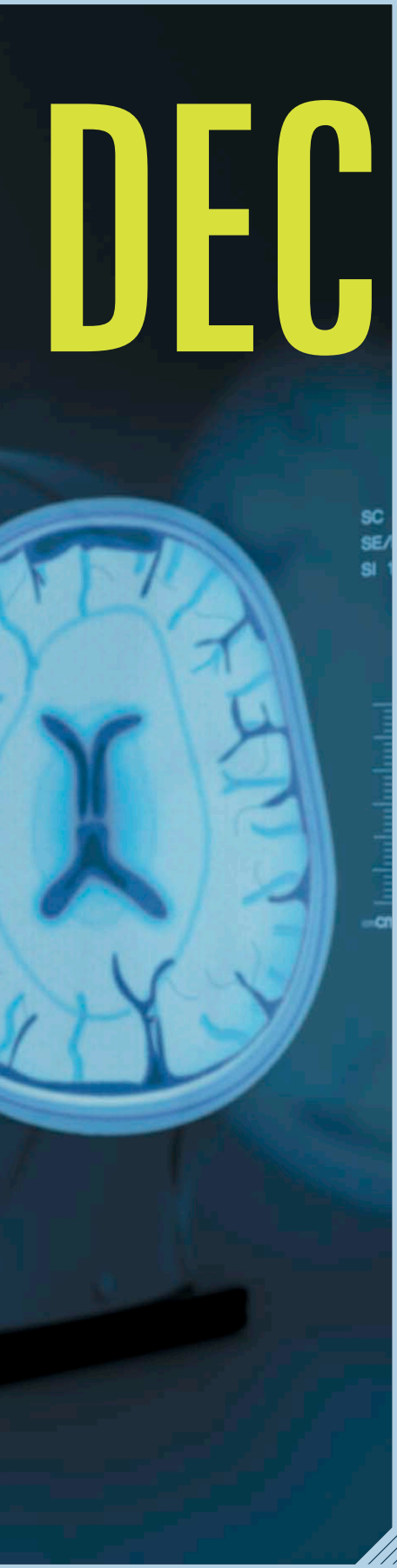
Conant agrees that newer tools should have changed the debate: "Recent tomosynthesis screening studies, including our multisite study published in ***JAMA Oncology*** in February, have shown that with this new modality, the outcomes for 40- to 49-year-olds in terms of improved cancer detection and decreased false-positives becomes very similar to what has been accepted for women aged 50 to 59 years who were screened with conventional 2D mammography. If we accept the 2D outcomes for women aged 50 to 59 years as beneficial, and we can obtain similar outcomes with 3D in women aged 40 to 49 years, why not screen these younger women and give them this proven benefit—reduction in breast cancer mortality?"

— Beth W. Orenstein of Northampton, Pennsylvania, is a freelance medical writer and regular contributor to *Radiology Today*.

IMPACTFUL

By **DAN HARVEY**





DECISION

How will the CDS/AUC requirement affect radiology?

The clinical decision support (CDS)/authorized use criteria (AUC) requirement initiated by the Protecting Access to Medicare Act (PAMA) will soon take effect. Its impact will be felt in many health care areas, but radiology will be on the front lines. The legislation requires that external referring providers adhere to AUC before ordering the most advanced diagnostic imaging services such as MRI, PET, and CT to receive Medicare reimbursement. Specific regulations delineated by the Centers for Medicare & Medicaid Services (CMS) become effective on January 1, 2020. The rule is intended to reduce inappropriate or unnecessary imaging studies that have led to increased health care costs.

Overutilization Concerns

In large part, the requirement has to do with technology. Recent decades brought remarkable innovation and increased utilization of imaging technology. With it came increased health care costs, and overutilization became a major concern. The Medicare Payment Advisory Committee sounded an alarm.

"CMS and Congress were put in a hard place," says Keith D. Hentel, MD, MS, executive vice chairman and an associate professor of radiology at Weill Cornell Medical Center and NewYork-Presbyterian Hospital. He explains that private payers used preauthorization as cost control. When the issue was raised, then-president Barack Obama considered implementing preauthorization for Medicare services. This caused some people "to go nuts," Hentel recalls.

Looking for a potentially workable alternative, members of Congress learned of a project in which different CMS convener groups implemented CDS and determined the impact on appropriateness and subsequent imaging utilization. Light bulbs switched on over many heads. "CMS did a great job in revealing what it learned from the project," Hentel says.

It comes down to point-of-care feedback, delivered at order entry, says Cree Gaskin, MD, vice chair of informatics and director of musculoskeletal imaging and intervention at the University of Virginia. "It's intended to assist providers determining which imaging test—or perhaps no test at all—is right for a particular patient in a specific scenario. It can even help with decisions to use contrast or not," he says.

Available feedback can be tailored to patient age, gender, clinical setting, or ordering provider specialty, among other possibilities. "It helps providers get the right test the first time," Gaskin says. Additional benefits include increased efficiency, cost reduction, and—perhaps most importantly—avoidance of unnecessary radiation, he adds.

Deploying New Technology

Because new technology comes into play, EHR systems won't make direct decisions related to exam purpose, says Kevin McEnery, MD, a professor of radiology and the director of innovation in imaging informatics at The University of Texas MD Anderson Cancer Center in Houston.

"That's implicit," McEnery says. "Organizations have to contract with a separate company, as CDS technology for radiology is separate from EMR."

Hentel agrees: "Integration as part of EMR or computerized health record entry involves new implementation." He adds, however, web-based portals exist that allow users to type in information about a patient and imaging order, and the site will return decision support and even provide information about possible outcome. But he adds this caveat: "This easy way is not so easy at it appears. You'll still have to type in the patient information every time."

"A computer-based system enables guidance for the ordering providers," McEnery says. As applied to radiology, CDS/AUC provides rules that promote guidance about examination appropriateness. "As a 'for instance,' a patient presents with back pain that has lasted for more than six months. Spine MRI is advisable," he says. "The same can apply to other areas, such as pulmonary embolism. 'Patient presents with the symptoms, such as shortness of breath, tachycardia, and laboratory values that indicate high levels of positive examination results.' This contrasts with a patient who doesn't present with symptoms. Yet a physician, for whatever reason, schedules a study. The CDS/AUC system would indicate that an examination is not appropriate."

The overall purpose, McEnery says, is reduction of inappropriate studies to increase the value of services.

Apocalypse When?

January 1, 2020, looms large and appears fearsome. Adam Prater, MD, MPH, an assistant professor of radiology, imaging sciences, and emergency medicine and the director of stroke imaging and imaging informatics at Grady Memorial Hospital in Atlanta, describes the scramble: "Everyone knows it's coming. How facilities choose to implement can have a large impact on daily workflow of ordering providers."

This makes people sensitive to elements such as new workflow steps and extra clicks. Concerns involve possible increased burden; no one wants an implementation that will bring an additional set of overwhelming obligations for ordering providers, Prater says. But both Prater and McEnery point out that the aforementioned date is not a drop-dead, ***Apocalypse Now*** moment.

"It looks complicated, but it's meant to help guide ordering providers," Prater says. This means entities such as family doctors and treating physicians who can be considered, at some point in time, as referring physicians. "Automated support will help them," Prater points out.

McEnery, too, is adamant that this is not a date to mark on the calendar with a grim reaper image. Consider 2020 as a test year. "Organizations must take full advantage of the education and testing year to avoid any unpleasant surprises in 2021," he emphasizes.

Still, a year's worth of breathing room shouldn't foster complacency, he warns. The test-and-education year will entail full involvement and strong commitment. "By December 2020, organizations should be at the point where their systems work as planned," McEnery says. "Year 2020 only means that we're seeing if everything up and running is working as designed. The date means that information entered should be accurately interpreted by CDS mechanisms."

> *"Facilities need to implement a CMS-approved IT solution accessible to ordering providers. Beyond technical solutions, communicate changes to ordering providers."*
>
> *— Cree Gaskin, MD, vice chair of informatics and director of musculoskeletal imaging and intervention at the University of Virginia*

If enterprises haven't reached this level, then they need to watch out: Penalties will start in 2021. How severe? CMS indicates no reimbursement.

People Get Ready

PAMA was signed into law in 2014 and scheduled to begin in January 2017 ... then 2018 ... then 2020. Why the delays? The complex elements involved make the delay understandable. It was determined that existing systems—billing and image ordering—weren't sufficiently robust to compensate for such a significant change. "The systems were 'not ready for prime time,'" McEnery says. "The delay gave organizations time to determine how best to implement decisions and systems instead of rushing something out. CMS would rather delay than enact a rule that was half baked."

"You don't place something new into your practice and just turn it on," Hentel adds. "We're looking at a substantial culture change, one that will involve many decisions."

Gaskin makes another important observation involving nuts-and-bolts issues. "More time was needed to deploy the developing technology across the United States," he says. "In 2017, it was simply too soon to expect everyone to have a useful solution in place."

As problems with moving forward have been addressed, what are the next steps? What do enterprises need to do to get ready for 2021? "Whoever orders a study must be aware of AUC for whichever targeted clinical areas, and there are eight of them," Hentel says. These include coronary artery disease (suspected or diagnosed), suspected pulmonary embolism, headache (traumatic and nontraumatic), hip pain, low back pain, shoulder pain, lung cancer (primary or metastatic, suspected or diagnosed), and cervical or neck pain.

Furthermore, Hentel says, any advanced imaging decision needs CDS exposure. "Decisions must comply with CDS

criteria," he says. This involves two "flavors," so to speak. One involves total integration. By having an integrated health record system, organizations can integrate appropriate physician decision support into an extant ordering process. The other is nonintegration, wherein users must type information into the existing platform.

Prater takes user readiness even further. "Closely consider legal mandates," he says. "Then you need to work with stakeholders to establish what individual needs entail."

This is an important point because each organization's needs are different. Prater concedes this can be a lengthy process, as it involves comprehensive evaluation of implemented EHRs, available vendors, and how a vendor product will interface and interact with the current EHR. But that's just the beginning; the technical piece involves the resources providers have at their disposal. "After decisions are made, you need to determine how much help your IT team can allocate," Prater says.

How Ready Is Radiology?

That sounds reasonable, but it becomes more difficult when the next step is considered. "Modifications need to be tailored to the tastes of stakeholders," Prater says. "Engage them from the front end. Getting them involved isn't easy."

"Facilities need to implement a CMS-approved IT solution accessible to ordering providers. Beyond technical solutions, communicate changes to ordering providers," Gaskin advises. But expect pushback. "Some will be confused or frustrated by the changes," he says.

Meanwhile, organizations need to take full advantage of the educational and testing year of 2020 to ensure that their systems are working and clinicians are entering orders that foster decision support, McEnery says. "Organizations can document that such support took place, which will ensure that the decision submitted with that information is approved for payment," he adds.

Some facilities can provide a comprehensive report about where they are, Hentel notes. Others haven't even started to develop a strategy to deal with this looming issue, so there may be an apocalypse in some enterprises' futures. "Some practices might be in for a rude awakening when 2021 hits," he warns.

But the outlook isn't as dire as it may sound, Hentel says. Many facilities, thanks to years of publicity, lead time, and delay, will be ready. Those that aren't quite ready will likely get up to speed during 2020—a year without penalties. No penalty doesn't translate into a free pass, however—organizations still must address existing challenges.

"One of those is overcoming the typical inertia that often accompanies change," Hentel says. "Some facilities confronted with this specific change don't even know what they're supposed to do." One reason is that many radiology practices get orders from multiple sources—and sometimes on paper—so making sure that providers' orders result in the most appropriate consultation can be difficult. Some best practices and benchmarks have been identified, however. Hentel says that, in moving forward, enterprises must choose between an integrated or nonintegrated solution, or possibly a combination of the two.

"I think that's what most of the largest enterprises will try to do," he says. "Facilities must identify which AUC and which vendor can deliver what's best suited to their strategy. CMS provides a list of vendors that can provide decision support. But, then, depending upon which provider you choose, they can have different criteria support. So, results can be impacted by vendor chosen."

Thoughts on Change

Hentel says important considerations include the most appropriate CDS strategy (eg, integrated or nonintegrated, the best vendor to implement the chosen strategy, the difference among vendors, the workflow impact), what to do when an order comes in without appropriate CDS, and what steps to take if it has been decided that you won't be reimbursed based on your treatment decision. He adds that the ACR provides helpful toolkits and information.

"ACR has been a big driver behind this," McEnery says. "Radiologists want to interpret appropriately ordered studies. The biggest impact may be on the order providers. Potentially, their daily workflow could be interrupted."

Prater says it's hard to tell whether everyone is on board with CDS, as there a lot of opinions. "You'll find that many facilities and stakeholders are satisfied, but that's because they have the available resources and time," he says.

Prater recalls his own experience. "Many factors in the current health care system come into play when you start tweaking imaging choices and how the choices are made," he observes. "In my case at Grady, I didn't have enough people available to help me. Three people are not enough to implement something like this. Questions remained about how it would function in a clinical environment. I witnessed a mismatch between expectations and what CDS implementation would provide and what would happen. The problem was that our EMR limited some of the demo features that we saw from the vendor."

He adds that such issues can be overcome by adjustment and modification—trial and error—and networking with other facilities.

Some fear that implementation of CDS software will dictate how clinicians practice medicine. Indeed, there has been substantial discussion on this point. Hentel feels that this won't be the case.

"Clinicians will still practice what they consider to be best medicine," Hentel says. "At the end of the day, it's still up to them to do what they feel is best for the patient in their care."

— Dan Harvey is a freelance writer based in Wilmington, Delaware.

PICTURE THIS

BY KEITH LORIA

Recent technological advances have increased the number, size, and variety of medical image types, heightening the requirement for displays with functions that help to improve reading efficiency, says Jennifer Beaumont, vice president of IT for Radiology Partners. She adds that some of the newest features include software, servers, and integrated calibration sensors for simple and easy quality control of medical displays and space-saving, compact designs with thinner bezels.

Today's displays also have the ability to read all medical modalities on a single model. Large-format options in a variety of resolutions are now available for those users wanting one display vs two.

"We are looking at the use of multimodality color displays, which can view multiple medical images on one screen," Beaumont says.

Recent software advances allow more in-depth testing, reporting, and configurable alerting functions. On the hardware side, LED-backlit displays are providing higher contrast and brightness levels with longer life and higher resolution.

"Photosensors built into the displays for autocalibration are more accurate and used in conjunction with sophisticated calibration software. Monitor gray levels and colors are calibrated more accurately to much tighter tolerances and enable enterprise management," says Tara Neill, director of sales and marketing for Double Black Imaging. "With the rise of color use in [graphic user interfaces] as well as with multimodality imaging, the market has seen a shift from monochrome to color displays."

Following are some of the latest medical display upgrades.

EIZO

Thomas Waletzki, president of EIZO, notes that the latest buzz in medical displays is the use of built-in functionality. "With added functionalities such as a [keyboard, video, and mouse] switch, picture-in-picture capabilities, and 'point and focus,' EIZO helps save desktop space, eliminates the need for an extra monitor or other hardware devices, and creates functions that help the reader focus and read faster and accurately," he says.

Medical display advances bring a sharper focus to radiology.

The company's latest displays are the 3-megapixel color display, RadiForce RX360, and 5-megapixel monochrome display, RadiForce GX560. EIZO was the first in the industry to introduce low-temperature poly silicon (LTPS) LCD panels with both of its newer medical monitors. LTPS panels are mainly used in mobile devices such as cellphones, and the benefits include higher panel reliability, higher resolutions, narrow bezels, and lower power consumption.

"The newer LTPS panels allow the GX560 to have the highest contrast ratio in the industry," Waletzki says. "Our greatest display is the 8-megapixel color display RadiForce RX850, which rounds out our monitors for multimodality on single display."

Waletzki notes that today's newer displays have added functionality to maintain optimal workflow. For example, the Hybrid Gamma PXL function allows both monochrome and color images to be displayed on the screen at the same time, in the appropriate grayscale and gamma curve. Previously, the color mode had to be changed depending on the image being read; color and monochrome images could not be compared simultaneously.

"With the Switch-and-Go function, USB switching is done within the monitor. This enables users to use a single keyboard and mouse across two PCs," he says. "Users can work on either PC by moving the mouse cursor across the screens."

Additionally, the Hide-and-Seek function enables users to hide the picture-in-picture window that is not being used and reopen it as needed by moving the mouse cursor to the edge of the screen. This eliminates the need for an extra monitor, while still allowing simultaneous viewing of reports, patient charts, and other information.

Barco

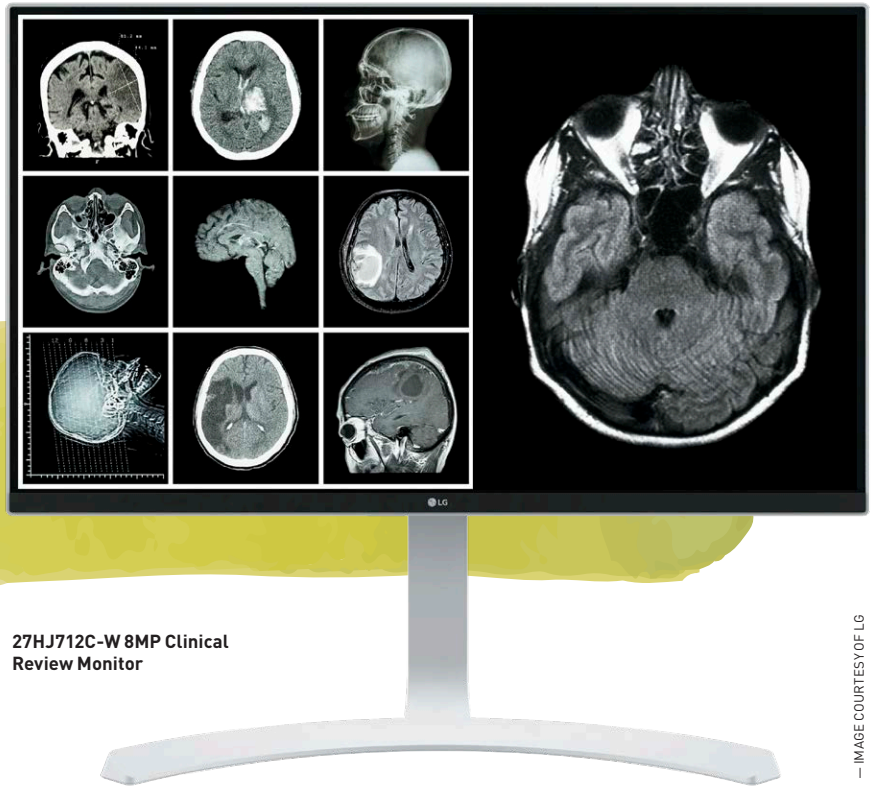
Lynda Domogalla, Barco's vice president of product marketing, health care division, says today's medical displays need to support more efficient workflow and healthy ergonomics to address ever-increasing workloads, challenges with ergonomic stresses, and radiologist burnout.

"Barco's color fusion-format displays allow radiologists to bring together images from all modalities onto one workstation," she says. "All our display systems come with clinical workflow tools that allow radiologists to see more details in an image, boost brightness, and optimize contrast in a region of interest."

Barco's Coronis Uniti display system supports multimodality breast imaging as well, bringing together 2D mammography, breast tomosynthesis, breast MR, and breast ultrasound on one display. The Coronis Uniti also incorporates features to improve reading ergonomics, bringing the full screen into the natural field of vision to reduce neck strain and adding ambient light to reduce eye strain.

"Today's displays are brighter, allowing radiologists to see more details with less windowing and leveling adjustment and reduced eye strain," Domogalla says. "With a brighter display, details can be identified more quickly, reducing read times and also ergonomic strains. Barco's displays also have technology to run [quality control] checks and calibration without intervention."

The company conducts site assessments with health care organizations to help them see a clear overview of their medical display systems. "Some displays may no longer calibrate to a luminance which meets ACR guidelines; some may be close to the end of their useful lifetime, and some may still be using grayscale display systems," Domogalla says. "We also find that some institutions still invest a lot of effort in quality management of their workstations, which is especially challenging when managing more remote locations. If they aren't using a [quality assurance] software to manage the quality and compliance of their workstations, it is time to start taking advantage of this capability."



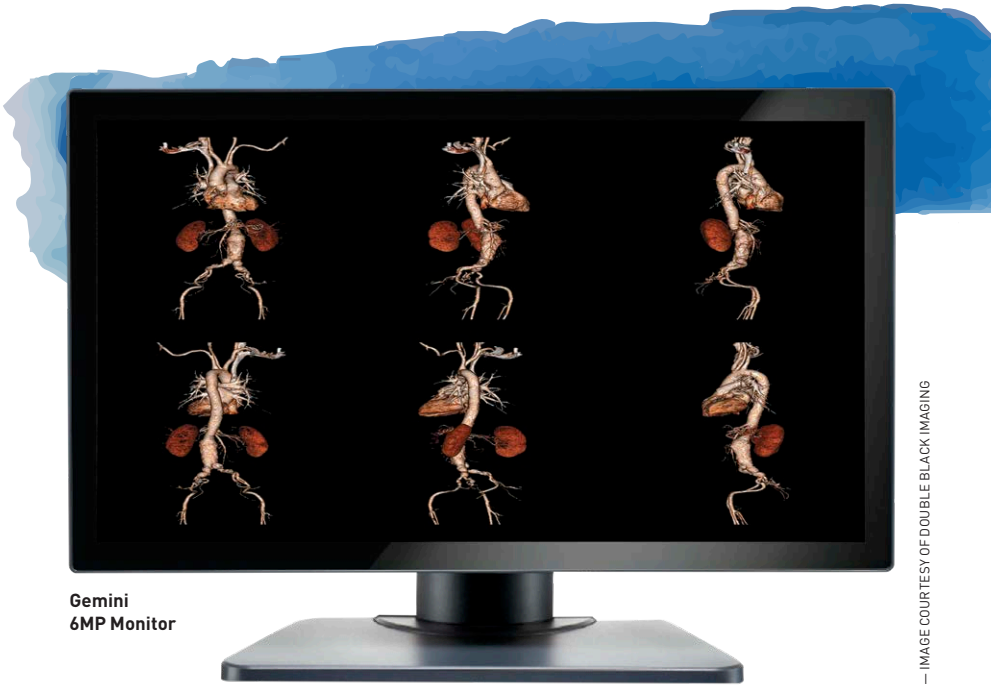
27HJ712C-W 8MP Clinical Review Monitor

— IMAGE COURTESY OF LG

LG

Stephen Hu, director of sales, IT, and the national solutions provider sales team for LG Electronics USA, says the company's advances include larger screen size, multimodality displays with LCD technologies that offer enhanced brightness levels, and an increased contrast ratio.

"The LG 8MP Clinical Review Monitor is a 27-inch [in-plane switching] monitor driving 3840 X 2160 pixels," he says. "The monitor is DICOM compliant [and] is equipped with backlight stabilization technology to guarantee stable luminance levels." Hu adds that these features are critically important to ensure color accuracy.



Gemini 6MP Monitor

— IMAGE COURTESY OF DOUBLE BLACK IMAGING

Double Black Imaging

Double Black Imaging offers a range of diagnostic, mammo/tomo, clinical, and surgical displays, according to Neill.

"We work to ensure the solution we provide fits the specific site need [because] large enterprises differ greatly from doctors doing home reads for smaller enterprises," Neill says.

All of the company's diagnostic displays are autocalibrating, and its enterprise management tools include automatic testing, reporting, and alerting. Today's models have higher resolutions, are LED backlit, and have higher brightness and contrast.

"[These] features allow for better quality control when it comes to the image the radiologist is reading, extend the life of the display, and enable the radiologist to read everything from CT to mammo at the same station with our multimodality displays approved for mammo and tomo," Neill says.

Neill adds that the software incorporates shortcuts to view areas of interest, reduces ambient lighting from worklist displays, and streamlines cursor behavior. The company also incorporates its display solutions into ergonomic workstations.

New Views

Displays used in primary interpretation have a usable lifetime. This lifetime is primarily based on the displays' ability to output adequate brightness. The easiest way for a hospital or imaging center to know when it's time to update its medical displays, Hu says, is when they're no longer capable of achieving DICOM-calibrated review/diagnostic brightness guidelines.

Waletzki says EIZO has a reporting tool that helps users predict when monitors will no longer support the recommended brightness. "These reports are based on the monitors' actual performance and ability to display sufficient brightness, not a prediction based on end of warranty or support," he says.

Double Black Imaging's CFS software suite automatically calibrates and tests for conformance to ACR and DICOM compliance. "Users are proactively informed of display issues that cannot be 'autohealed' by our automated system," Neill says. "Typically, displays are upgraded when the display no longer meets ACR recommendations or DICOM compliance."

Technology in the commercial display and TV market is constantly changing and evolving, and many of those advances will be seen in the medical display market in the years ahead. As we enter the age of precision medicine, the number and variety of medical image types will become massive, leading to an ever-growing demand for faster and more accurate processing of image data, Waletzki says.

Beaumont also expects the number and variety of medical image types to grow. "It is not impossible to meet this growing demand with hardware," she says. "It must be met through a total solution encompassing not just hardware but also software and networks."

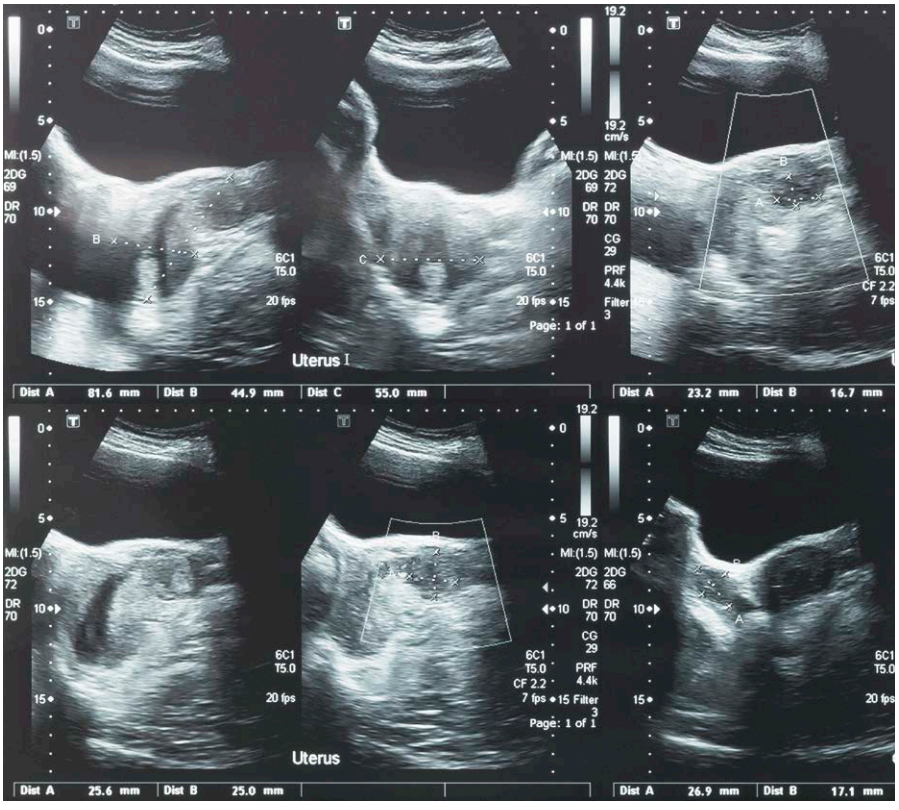
Neill anticipates the incorporation of organic and quantum dot LED technology into medical displays, which will raise brightness while enhancing black and white levels, without compromising the color values.

"Displays will also follow their commercial counterparts, providing higher resolutions, thinner and sleeker footprints, with even longer lifespans," she says. "Software tools will further advance productivity. Service, support, and understanding the unique nature of each medical imaging environment will increase in importance, continuing advancements in medical imaging."

Hu says, in the next five to 10 years, medical technology will continue to become more portable, lightweight, and durable with embedded AI tools to aid in diagnosis.

"AI is an important new technology that has far-reaching benefits," Hu says. "[We are] excited to see AI adoption growing so rapidly in home appliances and consumer electronics."

— Keith Loria is a freelance writer based in Oakton, Virginia.



UFE SAFER, EQUALLY EFFECTIVE AS SURGERY FOR UTERINE FIBROIDS

Uterine fibroid embolization (UFE) effectively treats uterine fibroids with fewer postprocedure complications compared with myomectomy, according to research recently presented at the Society of Interventional Radiology's 2019 Annual Scientific Meeting. Women who received this minimally invasive treatment also had a slightly lower need for additional treatment than those who underwent surgery.

A uterine fibroid—leiomyoma—is a noncancerous tumor that occurs in the muscle cells of the uterus. These growths do not spread to other regions of the body and are typically not dangerous. While some women do not experience symptoms, others have very heavy and prolonged bleeding that can be debilitating, as well as pelvic pain and abdominal enlargement.

Treatments for uterine fibroids can range from monitoring the fibroids or administering medications to relieve the symptoms, to more invasive approaches, such as myomectomy and hysterectomy. UFE falls in the middle of the spectrum of treatment options and is performed through a tiny incision. Using real-time imaging, an interventional radiologist guides a catheter into the uterine arteries and releases tiny particles to block the blood flow to the fibroid tumors.

Compared with surgical options, UFE for uterine fibroids is less painful, preserves the uterus, and allows women to get back to their lives sooner. However, past research suggests US women, a majority of whom will experience uterine fibroids by age 50, are largely unaware of UFE, despite more than 30 years as an evidence-based treatment.

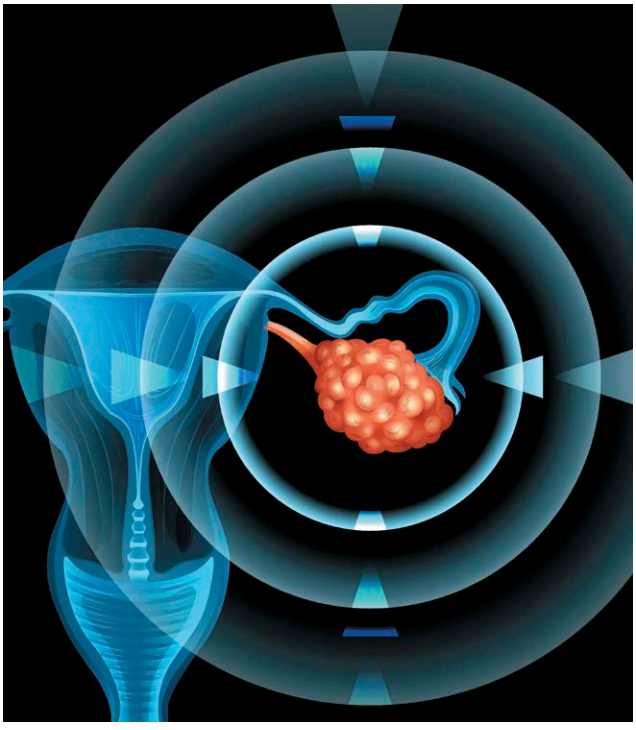
"Women have options for treating their uterine fibroids. UFE and myomectomy are procedures with similar efficacy and durability for treating fibroids, but UFE has fewer complications and shorter hospital stays," according to Jemianne Bautista-Jia, MD, a radiology resident at Kaiser Permanente and lead author of the study. "There are important factors women should consider when choosing between the procedures. These factors include risk of bleeding, possibility of infections, and recovery time."

In the retrospective cohort study, researchers analyzed treatment outcomes of 950 uterine fibroid patients from January 1, 2008, through December 31, 2014. One-half of the patients underwent UFE, a nonsurgical treatment that eliminates the blood supply to fibroids, causing them to shrink or disappear. The other half were treated surgically through myomectomy, a procedure that removes existing fibroids.

After an average seven-year follow up, the study found that women who underwent myomectomy had a higher rate of postprocedural complications, including a 2.9% rate of blood transfusion, which was significantly higher than the 1.1% rate for those who were treated using UFE. Patients in both treatment groups demonstrated a significant increase in hemoglobin one year after the initial procedure, due to reduced bleeding. The two methods were comparably effective based on the rate at which secondary interventions—including UFE, myomectomy, and hysterectomy—were needed. Secondary interventions were completed in 8.6% of women who received an initial UFE compared with 9.9% for women who initially underwent a myomectomy.

The study also showed similar rates of miscarriage for women who underwent either UFE or myomectomy. Future research exploring the impact of all uterine-sparing fibroid procedures on pregnancy, which remains still poorly understood, is necessary. More information about UFE and fibroids is available at sirweb.org/fibroidfix.

— SOURCE: SOCIETY OF INTERVENTIONAL RADIOLOGY



AI STREAMLINES OVARIAN CANCER PROGNOSIS

AI software created by researchers at the United Kingdom's Imperial College London and Australia's University of Melbourne has been able to predict the prognosis of patients with ovarian cancer more accurately than current methods. It can also predict what treatment would be most effective for patients following diagnosis.

The trial, recently published in ***Nature Communications***, took place at Hammersmith Hospital, part of Imperial College Healthcare National Health Service (NHS) Trust.

Researchers say that this new technology could help clinicians administer the best treatments to patients more quickly and paves the way for more personalized medicine. They hope that the technology can be used to stratify ovarian cancer patients into groups based on subtle differences in the texture of their cancer on CT scans rather than classification based on what type of cancer they have or how advanced it is.

Eric Aboagye, PhD, lead author and a professor of cancer pharmacology and molecular imaging at Imperial College London, says, "The long-term survival rates for patients with advanced ovarian cancer are poor despite the advancements made in cancer treatments. There is an urgent need to find new ways to treat the disease. Our technology is able to give clinicians more detailed and accurate information on how patients are likely to respond to different treatments, which could enable them to make better and more targeted treatment decisions."

Professor Andrea Rockall, PhD, coauthor and honorary consultant radiologist at Imperial College Healthcare NHS Trust, adds, "Artificial intelligence has the potential to transform the way health care is delivered and improve patient outcomes. Our software is an example of this and we hope that it can be used as a tool to help clinicians with how to best manage and treat patients with ovarian cancer."

Ovarian cancer is the sixth most common cancer in women and usually affects postmenopausal women or those with a family history of the disease. There are 6,000 new cases of ovarian cancer per year in the United Kingdom, but the long-term survival rate is just 35% to 40% among these patients, as the disease is often diagnosed at a much later stage once symptoms such as bloating are noticeable. Early detection of the disease is, of course, integral to improving survival rates.

Doctors diagnose ovarian cancer in a number of ways, including a blood test to look for a substance called CA 125—an indication of cancer—followed by a CT scan that uses X-rays and a computer to create detailed pictures of the ovarian tumor.

However, while the scans help clinicians assess how far the disease has spread and determine the type of treatment patients receive, they can't give clinicians detailed insight into patients' likely overall outcomes or on the likely effect of a therapeutic intervention.

Researchers used a mathematical software tool called TEXLab to identify the aggressiveness of tumors in CT scans and tissue samples from 364 women with ovarian cancer between 2004 and 2015.

In order to assess the patients' prognosis, the software examined four biological characteristics of the tumors—structure, shape, size, and genetic makeup—that significantly influence overall survival. The patients were then given a Radiomic Prognostic Vector (RPV) score, ranging from mild to severe, to assess the disease.

The researchers compared the results with blood tests and current prognostic scores used by doctors to estimate survival. They found that the software was up to four times more accurate than standard methods for predicting deaths from ovarian cancer.

The team also found that 5% of patients with high RPV scores had a survival rate of less than two years. High RPV was also associated with chemotherapy resistance and poor surgical outcomes, suggesting that RPV can be used as a potential biomarker to predict how patients would respond to treatments.

Aboagye suggests that this technology can be used to identify patients who are unlikely to respond to standard treatments and offer them alternative options.

The researchers have stated that they will carry out a larger study to assess how accurately the software can predict the outcomes of surgery and/or drug therapies for individual patients.

— SOURCE: IMPERIAL COLLEGE LONDON

ON THE CASE

By Alex Merkulov, MD

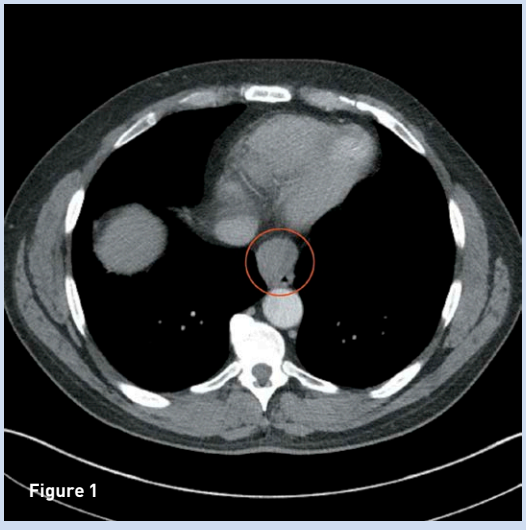


Figure 1

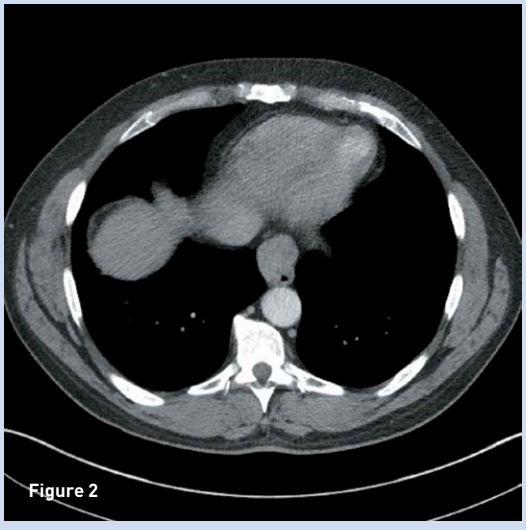


Figure 2

History

A 58-year-old man presented to the gastrointestinal clinic for a consultation of his dysphasia. The patient reported solid food dysphagia for the past 12 months, and his symptoms were getting progressively worse. He had previously undergone a modified barium swallow and a speech evaluation, which were both normal. The patient was found to have elevated integrated relaxation pressure on a high-resolution esophageal motility study with intact peristalsis, which excluded achalasia, and was consistent with esophagogastric junction outflow obstruction. Chest CT with IV contrast was ordered to evaluate the gastroesophageal junction and to exclude malignancy. The patient was also scheduled for an endoscopy and placed on a soft diet.

Findings

Axial, coronal, and sagittal IV contrast-enhanced (60 mL of Omnipaque-350) CT images of the chest demonstrated a 3.5-cm smoothly marginated, homogeneous, soft tissue distal esophageal mass located just above the gastroesophageal junction (Figures 1, 2, 3, and 4). The mass lacked cystic or calcified components. There was no mediastinal or hilar lymphadenopathy. The patient underwent an endoscopic ultrasound (EUS) with a fine needle aspiration for a tissue diagnosis of the distal esophageal mass.

Diagnosis

Esophageal leiomyoma.

Discussion

Benign esophageal tumors represent 20% of esophageal neoplasms. Imaging findings of benign tumors include a smooth intramural or intraluminal mass without ulceration or nodularity and absence of peritumoral invasion, lymphadenopathy, or distant metastases.

Leiomyomas are neoplasms of mature smooth muscle cells and are the most common benign esophageal neoplasm, although they are about 50 times less common than esophageal carcinoma. Leiomyomas are usually less than 3 cm in size and are found predominantly in the middle and lower thirds of the esophagus, the portion of the esophagus lined by smooth muscle.

Leiomyomas appear smooth or slightly lobulated and may contain course calcification, but cystic degeneration, necrosis, and ulceration almost never occur. Approximately 97% of leiomyomas are intramural, with 10% of these masses having a circumferential growth pattern.

On barium examination, leiomyomas exhibit the typical findings of an intramural mass, appearing as smooth-surfaced crescent-shaped filling defects that form right angles or slightly obtuse angles with the adjacent esophageal wall. They can occasionally encircle the esophagus, producing a short stricture.

On CT, esophageal leiomyomas are smoothly marginated homogeneous masses in the mid to lower esophagus, occasionally containing areas of calcification. These tumors are isoattenuating or hypoattenuating to muscle on nonenhanced CT and slightly hyperintense on T2-weighted MR imaging. They demonstrate homogeneous enhancement after contrast administration.

EUS can facilitate diagnosis and guide the treatment approach by demonstrating which layer of the esophageal wall is involved. EUS findings of a homogeneous hypoechoic mass in the muscularis mucosae, submucosa, or muscularis propria with an intact overlying mucosa have a diagnostic

Section Editor: Alex Merkulov, MD
Associate Professor of Radiology, Section Head
of Women's Imaging
UCONN Health

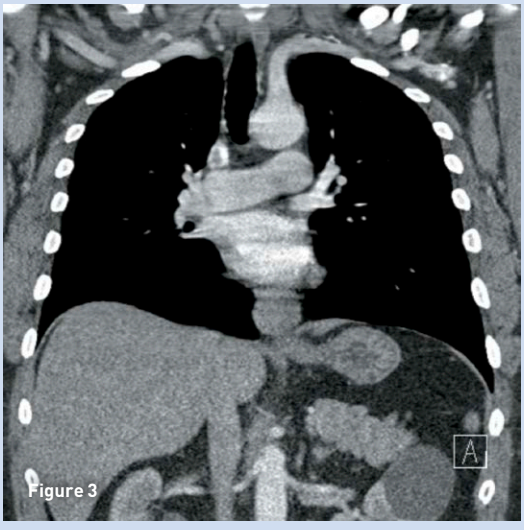


Figure 3

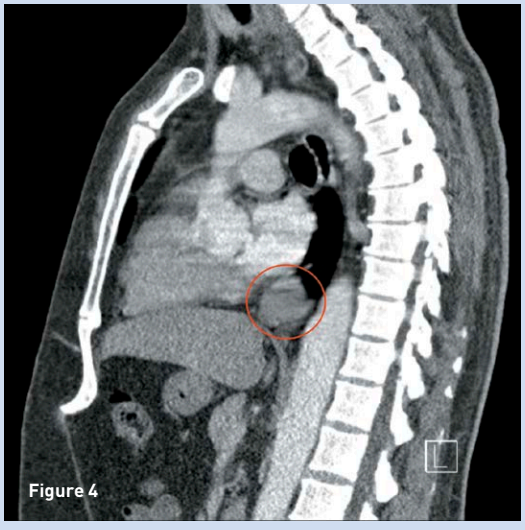


Figure 4

accuracy of 89% for esophageal leiomyoma. FDG PET exams are usually negative in patients with leiomyomas, as these tumors have a low mitotic rate, although FDG uptake has occasionally been reported.

The differential diagnosis for intramural masses in the esophagus includes duplication cysts, granular cell tumors, gastrointestinal stromal tumors (GISTs), lymphoma, and hematogenous metastases. Duplication cysts are the second most common benign esophageal lesions after leiomyomas but usually manifest in childhood and have typical findings of cysts with all imaging modalities. Granular cell tumors of the esophagus may be indistinguishable from leiomyomas but are much less common and tend to be multiple.

Calcification has been reported to be a specific finding of leiomyomas but can also occur in esophageal GISTs. Large GISTs may be differentiated by central low attenuation secondary to necrosis or cyst formation. Small GISTs may be homogeneous intramural masses indistinguishable from leiomyomas. Immunohistochemical analysis helps distinguish esophageal leiomyomas from GISTs, as the former are negative for CD117 and CD34.

Most patients with an esophageal leiomyoma are asymptomatic, but dysphagia and pain may develop, depending on the size of the lesion and amount of encroachment on the esophageal lumen. Unlike patients with malignant esophageal tumors, affected individuals usually have longstanding symptoms, with a duration of more than two years in most cases.

Treatment options include endoscopic resection, surgical enucleation, and observation. Esophageal leiomyomas have a benign clinical course and typically do not recur after surgery.

— Alex Merkulov, MD, is an associate professor of radiology at UCONN Health.

ON THE CASE SUBMISSION REQUIREMENTS

1. Cases should have clinical relevance and clear radiological findings.
2. Sections should include a title, history and course of illness, findings, diagnosis, and discussion.
3. Maximum word limit should not exceed 800. At least three references are recommended.
4. Cases may be submitted from any radiological subspecialty and imaging modality.
5. Figures must be high-quality JPEG or TIFF images and labeled for ease of reference. Please keep images in their native format, without the addition of arrows or other means of highlighting the key findings.

Submit cases via e-mail to Alex Merkulov, MD, at alex.merkulov@gmail.com or to ***Radiology Today*** at RTeditor@gvpub.com.

For resources, view this article on our website at www.RadiologyToday.net.

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DECEMBER 1-6, 2019
RSNA 105TH SCIENTIFIC ASSEMBLY AND ANNUAL MEETING
Chicago, Illinois
www.rsna.org

MARCH 21-25, 2020
AMERICAN INSTITUTE OF ULTRASOUND IN MEDICINE ANNUAL CONVENTION
New York, New York
www.aium.org

MARCH 28 – APRIL 2, 2020
SOCIETY OF INTERVENTIONAL RADIOLOGY 45TH ANNUAL SCIENTIFIC MEETING
Seattle, Washington
www.sirmeeting.org

APRIL 16-19, 2020
2020 SOCIETY OF BREAST IMAGING/ACR BREAST IMAGING SYMPOSIUM
Denver, Colorado
www.sbi-online.org

MAY 3-8, 2020
AMERICAN ROENTGEN RAY SOCIETY ANNUAL MEETING
Chicago, Illinois
www.arrs.org

MAY 16-20, 2020
ACR ANNUAL MEETING
Washington, D.C.
www.acr.org

JUNE 13-16, 2020
SNMMI ANNUAL MEETING
New Orleans, Louisiana
www.snmmi.org

SEPTEMBER 11-14, 2019
AMERICAN SOCIETY OF EMERGENCY RADIOLOGY ANNUAL SCIENTIFIC MEETING AND POSTGRADUATE COURSE IN EMERGENCY AND TRAUMA RADIOLOGY
Scottsdale, Arizona
www.erad.org

SEPTEMBER 12-15, 2019
AMERICAN SOCIETY OF NUCLEAR CARDIOLOGY ANNUAL MEETING
Chicago, Illinois
www.asnc.org

SEPTEMBER 26-29, 2019
SOCIETY OF DIAGNOSTIC MEDICAL SONOGRAPHY ANNUAL CONFERENCE
National Harbor, Maryland
www.sdms.org

OCTOBER 3-5, 2019
ACADEMY FOR RADIOLOGY PHYSICIAN EXTENDERS ANNUAL SYMPOSIUM
Grapevine, Texas
www.rpeacademy.org

OCTOBER 4, 2019
RADIOLOGY EVENTS AND LEARNING FROM DISCREPANCIES ORGANISED BY THE BRITISH INSTITUTE OF RADIOLOGY SCOTTISH BRANCH
Glasgow, Scotland
www.mybir.org.uk

OCTOBER 4-6, 2019
SOCIETY OF RADIOLOGISTS IN ULTRASOUND ANNUAL MEETING
Denver, Colorado
www.sru.org

OCTOBER 17-19, 2019
SOCIETY OF INTERVENTIONAL RADIOLOGY LEARN: LOWER EXTREMITY ARTERIAL REVASCULARIZATION COURSE IN PERIPHERAL ARTERY DISEASE
Nashville, Tennessee
www.sirweb.org

OCTOBER 24-26, 2019
SOCIETY OF INTERVENTIONAL RADIOLOGY ACTIVE: ADVANCED THERAPIES IN VENOUS INTERVENTIONS FOR THE MANAGEMENT OF VENOUS THROMBOEMBOLIC DISEASE
Scottsdale, Arizona
www.sirweb.org

NOVEMBER 1-2, 2019
SOCIETY OF INTERVENTIONAL RADIOLOGY STROKE IMAGING BOOT CAMP
Reston, Virginia
www.sirweb.org

NOVEMBER 3-9, 2019
RADIOLOGY IN CAPE TOWN
Cape Town, South Africa
www.radiologyintl.com

NOVEMBER 7-8, 2019
BRITISH INSTITUTE OF RADIOLOGY ANNUAL CONGRESS
London, England
www.mybir.org.uk

NOVEMBER 20-22, 2019
SECOND INTERNATIONAL CONFERENCE ON MEDICAL IMAGING AND CASE REPORTS
Boston, Massachusetts
www.unitedscientificgroup.com

DECEMBER 8-12, 2019
NATIONAL DIAGNOSTIC IMAGING SYMPOSIUM
Orlando, Florida
www.worldclasscme.com

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"Not only can we study where drugs are localized in the body, which is something that's important for drug development work, but we could also develop imaging agents to track cancer progression or inflammation in the body, aiding in cancer research and Alzheimer's research. Having more than one method for tumor detection may give you cross-verification to make sure what you're seeing is real. If you have two methods to validate a scan, two is better than one."

— David Nicewicz, PhD, of the University of North Carolina, regarding the development of individualized PET imaging agents that work in tandem with a patient's medications, as described in *Science*

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We're happy to be featured in **@RadiologyToday** this month! The article, "Imaging Informatics: Bold Investments in AI — The Groundwork for Radiology's Future," is on page 6 of the June 2019 issue: viewer.zmags.com/publication/dd ... #radiology #future #AI

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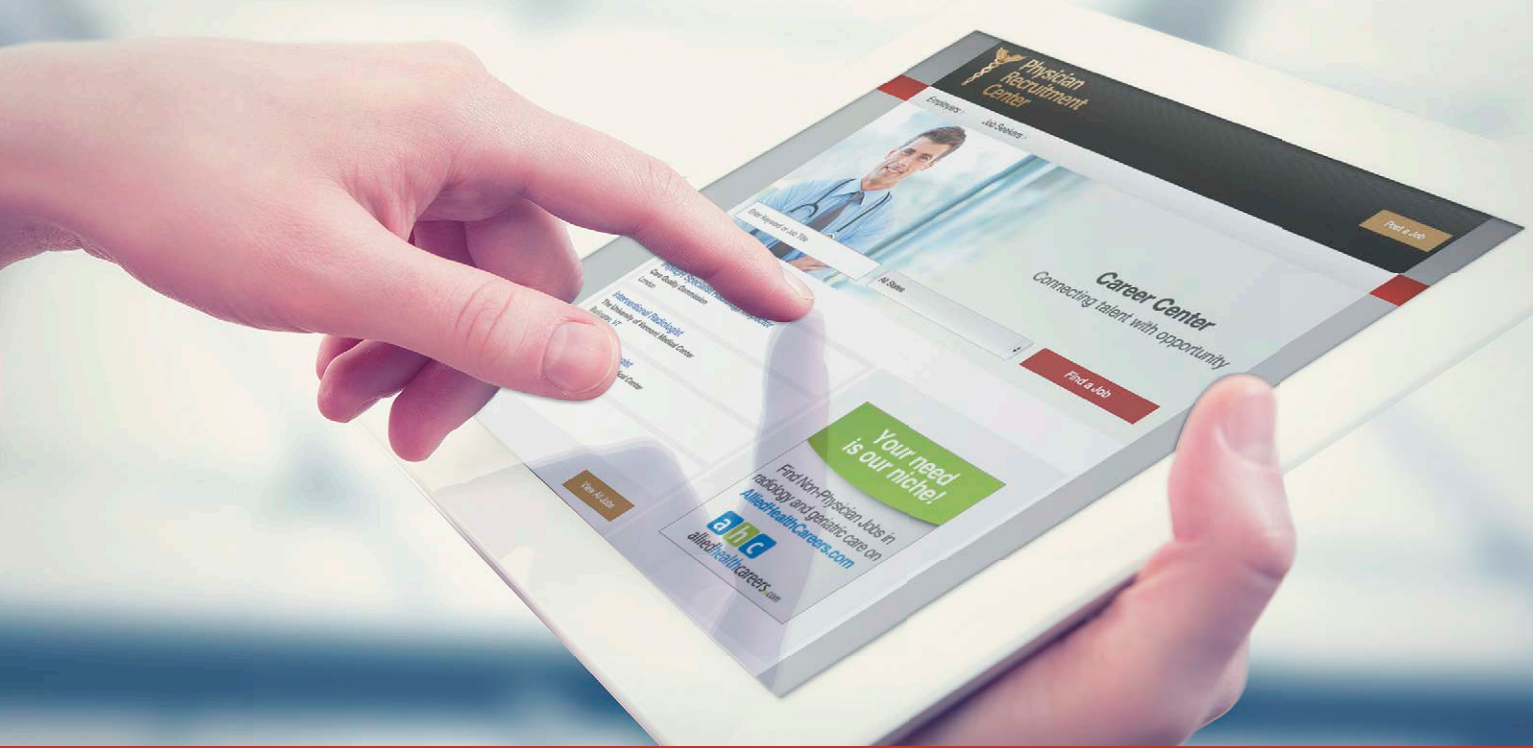

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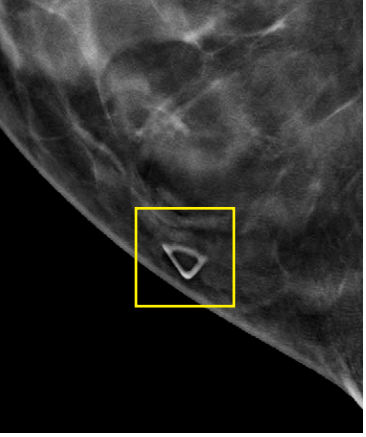

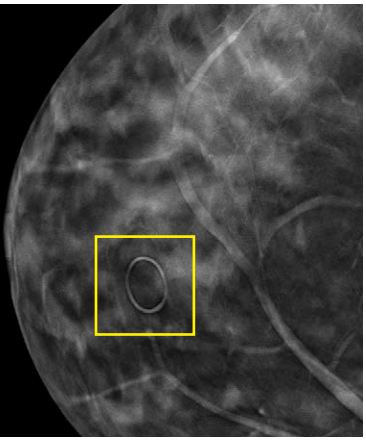

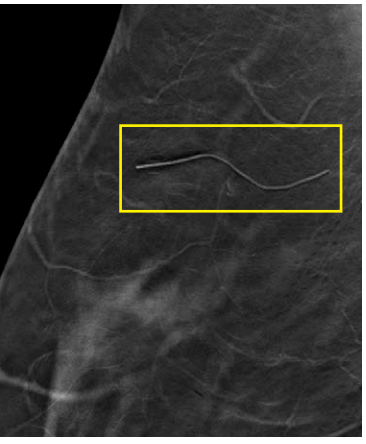

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[1] ACR PRACTICE PARAMETER FOR THE PERFORMANCE OF SCREENING AND DIAGNOSTIC MAMMOGRAPHY Revised 2018 (Resolution 35) section E, labeled Markers, part 2, page 5

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