DO COMMUNITY HOSPITALS NEED DUAL-ENERGY CT?

BY
GREG FREIHERR

WHITE PAPER

WHITE PAPER

Do community hospitals need dual-energy CT?

By Greg Freiherr

Executive Summary

American medicine is changing from volume to value, as is the type of medical equipment being used. Providers are no longer dancing to the tune of new bells and whistles. Features are chosen on the impact they can have on efficiency, effectiveness, and patient well-being.

And yet, technology has continued to progress with large medical centers and teaching hospitals experimenting with dual-energy CT (DECT). Over the past decade, they have identified specific DECT applications. During this time, however, capabilities found on advanced conventional CTs have migrated to mid-tier products, boosting efficiency and dramatically lowering patient radiation.

Today 64- and 128-slice CTs, available at mid-tier prices, support every routine radiological and cardiological applications, while performing scans at lower doses, some under a milliSievert.

Meanwhile, on the leading edge of medical practice, DECT leverages the x-ray spectrum. It can identify, with a high degree of certainty, the presence of gout; distinguish the 20% of patients whose non-calcified kidney stones can be medically dissolved; and substantially reduce artifacts, such as those that can confound challenging neurovascular diagnoses. This advanced modality promises other clinical advantages in oncology and pulmonology.

Despite its potential, and the commercial availability of DECT since 2006, "the excitement generated by (DECT) has _not_ been followed by widespread implementation into routine clinical practice, particularly outside academic institutions," note the authors of a 2014 paper in Radiology. (1)

Possibly one reason is that DECT has been commercialized at a time of substantially declining reimbursement. Imaging has been hit hard, beginning with cuts from the Deficit Reduction Act (DRA) of 2005. Signed into law in 2006, the DRA cut Medicare reimbursement for imaging services $2.8 billion over five years. Healthcare reform has since raised questions about how medical care will be paid in the future.

One thing is certain – reimbursement for CT scans is not likely to go up. Decades of reimbursement cuts amid vastly improving CT performance argue against the addition of fees

About the Author

Greg Freiherr has reported on developments in medical imaging since 1983. He has served as business and technology editor for Diagnostic Imaging magazine, editor--in--chief of the business newsletter DI SCAN; contributing editor for Medscape, and features editor for Oncology News International. Mr. Freiherr has consulted for corporations, including JP Morgan; academia including the Harvard Medical School; and public agencies, including components of the National Institutes of Health. He has been quoted as an imaging industry expert by publications, including the Wall Street Journal and New York Times.

for the use of DECT, despite the added costs of acquiring and operating this equipment.
In this climate of increasing concern about efficiency and cost-effectiveness and a future of uncertain reimbursement, community hospitals – pressured by declining reimbursement and increasing competition – are being asked to weigh the real and potential benefits versus the costs of DECT.

American medicine evolves

The transition from volume to value began years ago when the U.S. Congress passed the 2005 DRA. It accelerated with the Affordable Care Act, which became law in 2010.

In early 2015 the U.S. Department of Health and Human Services (DHHS) announced that Medicare would shift half of its traditional payments to alternative models within four years. Among these are Accountable Care Organizations, consisting of doctors, hospitals, and other providers who voluntarily coordinate services.

By the end of 2018, Medicare plans to tie 90% of its remaining fee-for-service payments to quality or value through programs such as Hospital Value-based Purchasing and Hospital Readmissions Reduction Programs.

DHHS also plans to work with private payers, employers, consumers, providers and states to expand their use of alternative models.

These models do not reimburse for individual procedures. Instead they seek to keep patients healthy, while emphasizing efficient and cost-effective management of patients who need healthcare. Quality of care weighs heavily on these models.

CT technologies diverge

Dual-energy CT has been shown to improve diagnoses in particularly challenging circumstances. But DECT costs more to acquire, service and maintain, just as technologists and radiologists require special training in its use. Running DECT protocols, post processing the data, and interpreting images also take extra time. The opposite is true of conventional CTs.

Once considered super-premium CTs, 16-slice scanners are now entry-level products. Even more advanced scanners – 64- and 128-slice CTs whose predecessors propelled radiology ten years ago to the fringes of cardiological practice – are now mid-tier. The operation of these systems has been

Methodology

The author examined and integrated information from several sources as part of original research funded by Hitachi Medical Systems America. Peer reviewed publications were examined for clinical data and analyses about the use and adoption of spectral and dual--energy CT (DECT). Websites were searched regarding the utilization of DECT and conventional CT. Experts with first--hand knowledge about the adoption, operation, clinical application and issues regarding conventional and DECT were interviewed. Expert opinions and experiences were correlated with information obtained from publications and websites. Citations referencing information drawn from peer--reviewed documents are numbered in parentheses in the paper and noted at the end of the paper. Website information is referenced using inserted hotlinks, indicated by blue type and underscoring.

automated and their dose to patients reduced, as their prices have fallen dramatically.

Sixteen-slice scanners today average $402,000, according to industry data, compared with more than a million dollars when multi-slice scanners were introduced in 1998. Today the more powerful 64- and 80-slice scanners average $549,000. By comparison, premium scanners capable of dual-energy CT cost on average more than twice that – $1.29 million.

Equipment service contract charges vary, depending on whether service applies to a single scanner or is part of a national contract. "It is fair to say, however, that the more hardware and software, the higher the service contract price for a given new system," said Michael Silver, senior fellow at the consulting firm Sg2/MedAssets, which provides analytics, intelligence and educational services to hospitals and health systems.

"While DECT won't be for everyone, large institutions that already operate premium CT scanners are particularly well primed to introduce the technology."

- *The Advisory Board Company*

DECT offers unique capabilities

Ten years after its practical, clinical, routine, high-value diagnostic sweet spot," Silver said. "I think it remains best suited for academic healthcare, clinical problem-solving, clinical research and for larger volume, subspecialty care services."

In more routine clinical practice, he said, "it is probably for subspecialty level care."

Of the more than 8400 sites performing CT in the U.S., fewer than 5% – just 400 sites – have any kind of premium CT, according to The Advisory Board Company, a healthcare consulting firm, which defines a premium scanner as providing dual-source CT, 256 or more slices per rotation, or high-definition imaging.

"While DECT won't be for everyone, large institutions that already operate premium CT scanners are particularly well primed to introduce the technology," according to the Board.

A primary distinction between conventional and DECT is the imaging chain. In dual-energy CT, two sets of data are obtained of the same slice, one at lower energy, such as 80 or 100 kV, the other at higher energy, such as 140 kV. (This dual capability is unique to DECT, although the latest generation of 64- and 128-slice CTs can be set to scan at low energy, typically 80 kV.)

X rays of different energies typically come from two sources. These may be angled 90 degrees from each other. X rays may also come from a single source that switches between two different energies. Alternatively a detector may register data specific to different energies coming from a multi-energy x-ray beam. These data can then be post processed into a dual-energy scan.

Because the scan data are taken from different energy spectra, DECT can distinguish between materials of different atomic number.

Although the limited adoption and availability of dual-energy CT have restricted clinical experience, peer-reviewed publications indicate increased confidence in specific, particularly challenging cases.

Gout. DECT is both sensitive and specific in the diagnosis of gouty arthritis. It has also shown promise as a means for monitoring the response of patients with this disease to therapy. (2) (Other means, less costly than DECT, are commonly applied in diagnosing and following up patients. These include taking a patient's medical history, examining the affected joint, and doing a blood test, according to the Arthritis Foundation.

Kidney stones. Because DECT can determine the chemical composition of kidney stones, ones that might be dissolved can be differentiated from those requiring shockwave lithotripsy or surgical extraction. (3)

Lung pathology. In patients suspected of acute pulmonary embolism, DECT improves the detection of peripheral intrapulmonary clots. Further development of DECT may open new opportunities in lung imaging, for example, selective xenon detection for imaging lung ventilation. (5)

Cancer. In comparison to standard CT, data collected at 60 keV using DECT significantly improves lesion enhancement, contrast-to-noise ratio, subjective overall image quality and tumor delineation of lung cancer, according to a study reported at the European Congress of Radiology (ECR) meeting in 2015. (6)

DECT may help in the assessment of head and neck cancers. This application may require the optimization of keV settings. Because optimal signal-to-noise ratio is achieved at 65 keV and tumor conspicuity is greatest at 40 keV, the use of DECT may involve expert balancing. (7)

Vascular anomalies. Because DECT distinguishes between calcium and iodine, it can be used to identify calcified vascular plaques. Its use improves the detection of aneurysms, vascular malformations, and iodine enhancement, which may be particularly useful in neuroradiology. (8)

Post processing DECT data can "remove" from the image bone that can complicate the evaluation of intracranial vessels. In this setting, however, DECT may lead to an overestimation of stenosis in the presence of calcifications, particularly ones close to the skull base. (9)

Other interpretive issues may arise in DECT images. The appearance of parenchymal calcium may be confounding. And high iodine concentrations (equal or greater than 37 mg/ml) can degrade image quality, causing reliability issues in the interpretation of virtual noncontrast and overlay images. (10)

Cardiac imaging. DECT may be advantageous, when evaluating heart patients. At ECR 2015, presenters reported that iodine quantification, achieved by post processing DECT data, can be used to distinguish between normal and ischemic myocardial tissue. (11)

Artifact reduction. Because DECT is not susceptible to beam hardening, it "might have improved diagnostic performance compared to SECT (single-energy CT) imaging for the assessment of myocardial CT perfusion. (12) It might make the interpretation of myocardial CT perfusion studies easier, because beam hardening artifacts occasionally resemble perfusion defects.

DECT data can also be post-processed to reduce or eliminate artifacts caused by metal implants. (13)

Lowering patient radiation dose. Data sets acquired at two energies allow the iodine in a contrast-enhanced CT angiogram to be "subtracted." This creates a "virtual" unenhanced image. Consequently, DECT can reduce overall radiation dose by eliminating the need for a separate non-contrast scan. Such virtual scanning has been shown to be "a reliable tool for diagnosing subarachnoid hemorrhage." (14)

Validity across platforms

Although DECT has shown significant clinical potential, questions have arisen about the comparability of data gathered using different platforms. Given that there are several ways to acquire DECT data, Silver asked whether the clinical results obtained on one platform can be directly compared with the results from another. "It goes to sensitivity, specificity, the reliability and reproducibility," he said. "It needs robust clinical validation with large numbers of routine patients."

Performance issues also address dose reduction claims. If the digital subtraction of iodinated contrast eliminates the need for a noncontrast scan, as at least some advocates of DECT contend, patient exposure to radiation is effectively cut in half. Silver would parse the clinical data that have been acquired to support such a claim by degree, clinical circumstance exam protocols and platform, asking, "When is the (DECT virtual) noncontrast image good enough versus as good as the true noncontrast?"

In short, which claims apply to dual-source; which to single-source; and which to spectral detectors that gather data over a range of x-ray energies?

Other questions relate to how the various DECT platforms would be used in routine clinical practice. Because two simultaneous exposures must be performed at two different energies, both dual- and single-source platforms require providers to make a decision about whether to assess a patient with dual energy *before* the scan. The alternative approach to DECT, using the detector to record data at the different energies present in a single, multi-energy x-ray beam, puts that decision off until the post processing phase.

"Different flavors of the technology are clearly allied with certain vendors," Silver said. He suggests that prospective buyers consider if their staff are up to the task presented by the complexities of each and how much training would be needed to get them to that point.

"From a technical perspective, how good do you have to be to make a clinically significant difference?" Silver asked. "The technical skills of both the RT (radiologic technologist) and radiologist have to be up to the challenge."

Right-sizing your CT

Despite the proven clinical utility of DECT, few sites outside of academia have adopted it. In a 2014 Radiology paper, the authors state the cause is "likely multifactorial, including some discordant opinions about the way in which dual-energy CT should be implemented, misconceptions about the exact radiation dose using two simultaneous x-ray energies, and the lack of robust validation." (15)

DECT requires that technologists be specially trained to perform DECT protocols and diagnosticians to interpret the images, according to Dr. Dushyant Sahani of MGH and Harvard Medical School. Sahani further notes that DECT scans take longer to post-process and interpret than conventional ones. Additionally, DECT data sets are large and dual-energy software is not routinely integrated in picture archiving and communication systems.

Also possibly contributing to the limited adoption of DECT is the ability of today's mid-tier CTs to exceed the needs of most mainstream radiology departments. According to the American Association of Physicists in Medicine (AAPM), protocols for routine applications of the head, chest, abdomen and pelvis can be accomplished with scanners generating as few as 16 slices per rotation.

Even brain perfusion and lung cancer screening can be accomplished on 16-slice scanners, according to AAPM.

In its guidelines for Radiation Protection of Patients, the International Atomic Energy Agency in Vienna, Austria, states that 16-slice scanners represent the minimum level of technology for many current CT angiographic applications, but that 64 slice scanners provide good visualization of lesions.

"Expected workload is definitely the key in selecting the right CT scanner."

- *Nitin P. Ghonge, associate editor for the RSNA*

In regard to cardiac scans, "current studies indicate that 64-slice CT angiography is highly accurate for exclusion of significant coronary artery stenosis (> 50% luminal narrowing) with negative predictive values in excess of 95%, unless there is heavy arterial calcification," according to the AAPM.
When choosing a CT, several factors should be considered. Current and future needs figure prominently, said Nitin P. Ghonge, a consultant radiologist and associate editor for the RSNA. "Expected workload is definitely the key in selecting the right CT scanner," he opined in 2013. (16)

It may be difficult, however, to get a handle on workload. Community hospitals are increasingly being called on to handle more and more challenging cases. Since St. Elizabeth Lafayette East opened in February 2010, the 150-bed community hospital has met increasingly sophisticated clinical and imaging needs, today offering trauma care, open heart surgery, and neonatal intensive care.

"We are not a typical community hospital," said Carlos Vasquez, administrative director of radiology services and facilities management at St. Elizabeth Lafayette East. "We are at the high end of the clinical acuity spectrum."

To meet challenges, the hospital installed in March 2013 a 128-slice scanner. "We meet all clinical demands of advanced imaging with a 128," he said.

Three years ago, the hospital considered purchasing dual-energy CT. Doing so, however, would have exposed the hospital to increased costs through additional training, longer patient set up and reduced workflow, according to Vasquez, in addition to higher capital costs upfront and continuing service charges.

"When you are in a research institution, you want to be at the bleeding edge of technology," said Vasquez, who previously served at research and tertiary care facilities in Indianapolis, Pittsfield, Massachusetts, and Lebanon, New Hampshire. "But when I came to a community hospital, I recognized that I don't need that, meaning I must acquire technology according to (the) clinical demand of (the) population (we) serve."

Buying beyond the needs of clinicians and population served by the hospital, he said, "in my opinion, would have been fiscally irresponsible."

A dominant issue for community hospitals is efficiency, said Roland McGraner, system director of diagnostic imaging services at Heritage Valley Health System in Pennsylvania. "Efficiency, access, turnaround time for interpretation – we have to excel in all those areas," he said.

"We have to be sure to keep our costs as low as possible, so we can compete in the market."

- *Roland McGraner, Heritage Valley radiology administrator*

Since March 2014, Heritage Valley Hospital in Beaver, PA, has been operating a 128-slice scanner primarily to support emergency cases. The 300-plus bed hospital serves the needs of residents in western Pennsylvania, eastern Ohio and the panhandle of West Virginia.

Accurately matching the CT to clinical tasks is necessary in the ever more cost-constrained marketplace, according to McGraner. He is now planning to replace a 16-slice system that does not comply with the new XR-29 Smart Dose requirements that Medicare has established for lower-dose scanning. DECT is not on his radar.

"We really don't need a high-end scanner because we just need it for bread-and-butter stuff," he said.

DECT scanners can reduce throughput due to more complex protocols and added post-processing steps. Their value is achieved primarily through increased diagnostic specificity in challenging cases. This increased specificity, however, comes with added costs in capital equipment, service, staff training, and workflow.

When calculating the expected return on investment from a new CT, large medical centers and teaching hospitals have different considerations than community hospitals.

Research funding for projects conducted by subspecialized staff often demand acquisition of the most advanced imaging systems. As tertiary centers of care, they receive referrals from physicians regionally or even nationally and, consequently, must be able to handle the most challenging cases. Community hospitals, on the other hand, look to satisfy local needs efficiently and cost effectively, while ensuring patient safety.

An important issue to consider is whether dual-energy CT can make a difference in patient outcome for a substantial number of routine patients, Silver said. "At this time, can a hospital say this will make a significant clinical difference in a large enough percentage of its patients?" he asked. That question grows in difficulty when it pertains to a community hospital that is not staffed for routine subspecialty care.

"In a community hospital, you have to look at what is going to cover the needs of 95% of your patients," Silver said. "What are the strategic objectives and clinical requirements of your clinical service lines? Do you want the lowest dose in your market? What do you need for cancer, for neuro, for orthopedics and for cardiac diagnostics? These may give you different answers than asking what is nice to have."

Some proponents argue that buying DECT now will be a hedge against obsolescence in a future when dual-energy is routine. But that assumes the current platforms will remain state-of-the-art.

"You may buy a platform with two sets of detectors, and maybe that platform is supported for an appropriate length of time, but in the future it may not be the optimal method for doing DECT," Silver said. "Not all upgrades are created equally. The devil is in the details.

"And DECT is clearly still evolving," he added.

Even if the overall approach or design of the scanner is conserved, fundamental changes in electronics can radically alter the capacity of a platform. Recent examples of this include the introduction of analog-to-digital converters, advanced CPUs and chipsets, "all of which have made a difference when running new clinical applications," Silver said. "An upgraded detector may require a complete upgrade of all related data acquisition and processing hardware and software, including CPUs and workstations."

Proponents may argue that DECT is needed to differentiate the provider from its competition. But providers today are being pressured more to compete economically than technologically.

"Less technology is going to be purchased for the sake of technology – for the pure sake of differentiation – as opposed to clinical performance and cost-effectiveness," Silver said.

Care must be taken to remain cost-competitive, warns McGraner. This is particularly so in CT, which "is a commodity to the insurance companies," he said. "We have to be sure to keep our costs as low as possible, so we can compete in the market."

Scanners reflect user goals

The users of DECT are typically very different from those who rely only on conventional CT. UCLA Radiology, which notes its use of DECT in angiography to facilitate bone and plaque removal, combines "excellence in clinical imaging, research and educational programs with state-of-the-art technology," according to its website.

Through its seven New York City hospitals and network of surgical, ambulatory, primary and specialty care facilities, the Mount Sinai Health System provides the newest technologies as it "blazes new trails in our global community". DECT leads the list of advanced technologies followed by dedicated extremity MRI, metal-suppression MRI, and PET/MRI.

On a slightly different, although still elevated plane, is Radiology Associates of Ridgewood (RAR). This DECT user, located just off the Franklin Turnpike in Waldwick, NJ, distinguishes itself from other outpatient imaging services through "significant formal subspecialization within the field of diagnostic radiology (providing) the expertise needed to fully take advantage of ongoing innovations in modern diagnostic imaging."

On its website, RAR highlights DECT for its:

- Characterization of chemical composition of urinary stones;
- Improved imaging of patients with orthopedic hardware (by reducing metal artifact); and
- Assistance in diagnosing gout.

On the other hand, community and mid-size hospitals in Colorado and New Jersey have gravitated toward 64- and 128-slice CTs. San Luis Valley Health in Alamosa, CO, described its acquisition of a 128-slice CT as part of its 2014-15 Strategy Map and its commitment to becoming "Providers of Choice for Healthcare."

Nestled in suburbs a 20-minute drive from the Jersey shore, yet close to New York City and Philadelphia, 284-bed CentraState Medical Center uses its low-dose, 128-slice CT to do "whole-body imaging in only 12 seconds"…and to "capture images of the heart between beats," according to a March 13, 2015, press release.

The Center announced plans this year to install a 64-slice CT to serve its emergency department.

Case studies

Several years ago, ***Heritage Valley Health System***, developed a strategic plan for managing its diagnostic imaging equipment. As part of that plan, in 2014, Valley Health installed a mid-tier CT at its hospital in Beaver, PA. The 128-slice scanner was intended primarily to support the emergency department, which has 60,000 visits per year.

In the first fiscal year of its operation, the 128-slice scanner performed 22,000 CTs, according to Roland McGraner, system director of diagnostic imaging services at Heritage Valley Health System.

The 128-slice system complements a premium system, which supports dual-energy scanning. DECT is reserved for high-end stroke and brain perfusion studies. Its acquisition of the mid-tier system is in line with the health system's strategic plan, which focuses on matching equipment to clinical needs. Among the high priority items in this plan is minimizing patient radiation exposure.

In 2014 Heritage Valley Health System launched its Imaging Efficiency and Dose Reduction Program. The goal was to increase awareness by the general public, physicians and other staff of the need to reduce patient radiation dose; gain a better understanding of patient exposure; and develop means to reduce patient dose. Software on the 128-slice scanner cuts dose between 30% and 40%, depending on the body part, McGraner said.

St. Elizabeth Lafayette East treats on average 146 emergency cases daily – a remarkable number for a 140-bed community hospital. This, the newest of a two-campus hospital system in Lafayette, IN, was initially designed to handle a daily load between 60 and 80 emergencies.

"They (emergency cases) present quite a challenge, especially during the prime hours from 7am to 5pm," said Carlos Vasquez, administrative director of radiology services and facilities management.

The hospital's two CTs, neither of which supports DECT, play critical roles in meeting emergency and other clinical demands. About 45% of the CTs performed are emergency cases. The remainder comes from orthopedics, oncology and family practice, although the hospital also does "a lot of CT-guided biopsies and drainages," Vasquez noted.

In deciding against DECT, administrators at St. Elizabeth Lafayette East "looked at the needs of our patients and of the referring physician practices," said Vasquez, who two years ago served as AHRA president. "We are not a research center, so we don't need all the high-end stuff. We want value and throughput without cutting or diminishing the quality of the outcome to the patient."

Low-dose scanning was and remains a priority at St. Elizabeth Lafayette East. Advanced procedures – interventional procedures, coronary artery calcium scoring and, most recently, lung cancer screening – underscore the need to optimize patient exposure to radiation.

The hospital is, however, a "state-of-the-art" facility, accommodating advanced technology and services. It supports 24/7 emergency care, open heart surgery, and serves as a Level III Neonatal Intensive Care unit. Since opening in February 2010, it has sought to be the preferred choice for comprehensive care in Lafayette, despite fierce competition from neighboring hospitals, including Indiana University Health Arnett Hospital and physician-operated imaging centers.

"We are trying to cut our costs to be competitive so obviously I am not going to get a piece of equipment that is not clinically compatible with the imaging needs of referring physicians and in synch with our operations strategy," Vasquez said.

Serving patients on Florida's West Coast, ***Sarasota Interventional Radiology*** specializes in minimally invasive surgery. About three quarters of the outpatient clinic's procedures are interventional, typically biopsies and ablations. The remainder are noninvasive and mostly related to upcoming interventions, for example, scans to evaluate arterial flow to a lesion. Coronary CT angiograms are also performed, on average once daily, as a non- invasive alternative to hospital-based cardiac catheterization.

Patients typically are geriatric. "Remember we are in Florida," said Lead Tech Chris Howes. "If you're 70, you're young. If you are 90, you're midlife."

All CT procedures are conducted using a 128-slice scanner, installed at the outpatient clinic in January 2014 as a replacement for an outdated 16-slice CT. Repeated exposures track the route of the needle or cannula. Because CT-guided interventions typically require multiple exposures, low-dose scanning was deemed essential – but not at the sacrifice of image quality.

"We are looking at little, minute areas," Howes said. "You don't want to dose the heck out of a patient, but you need the detail."

Some special procedures may involve stent placement to solve problems found on CT peripheral arteriography or, as happened recently, placement of a catheter connecting the kidney and bladder to circumvent a tumor that was blocking drainage.

"We do everything that can be done in an outpatient setting," Howes said.

The center also has begun offering low-dose lung screening, a procedure for which it recently received ACR accreditation.

Valley Imaging in West Covina, CA, brought the first CT scanner to the San Gabriel Valley 40 years ago. Today the outpatient center operates a 128-slice CT as one in a range of imaging modalities that include digital radiography, mammography, ultrasound, MRI and PET/CT. The mid-tier CT, installed in February 2014, performs primarily basic studies, although the center also offers screening for heart and lung disease.

Most of the center's practice is bread-and-butter scanning, said Steve Mathis, the center's chief operating officer: head and musculoskeletal scans; spine work; oncology scans of the abdomen, pelvis and chest. "We advertise cardiac and lung screening, but we don't do a booming business in those," he said.

The low-dose, efficient 128-slice system addresses a primary need of Valley Imaging – survival, according to Mathis, who noted that reimbursement today is very low. Years ago the center used to charge between $800 and $1000 per CT scan, he said. It now charges $200 or less.

Whereas some providers must face high-profile competitors, Valley Imaging has the opposite problem – competitors that operate CTs offering as few as four-slices per rotation. "They get the same reimbursement for their scans as we do on our 128," Mathis said.

The center chose the high-performance mid-tier system because "we wanted a system to be proud of," he said. "We were looking for one that would deliver high quality at a reasonable cost."

Center staff considered dual-energy CT, but "there was nothing (DECT) could do that would justify us spending the extra dollars," he said. "(Insurance companies) don't pay anything extra for it."

Summary

The choice of a new CT should be considered in the context of healthcare in the U.S., which is transitioning to value medicine, and the widely recognized ability of mid-tier 64- and 128-slice CTs to efficiently and cost effectively manage routine radiological procedures, as well as some advanced cardiological and neuroradiological ones.

While DECT can help in diagnostically challenging cases, many of those applications have limited relevance to community hospitals. Its use may appeal to radiologists, cardiologists and interventionalists especially those in subspecialties.

DECT requires special training in the interpretation of its images, however, just as technologists must be trained in the performance of DECT protocols. PACS may have to be tuned to store and retrieve the results of DECT studies. Finally there is the added cost of acquiring and servicing a premium CT scanner. No added reimbursement is provided for the use of DECT, nor is any likely in the foreseeable future, given the growing emphasis on reining in healthcare costs.

Citations

1. Marin D, Boll DT, Mileto A, et al. State of the art: dual-energy CT of the abdomen. Radiology. 2014 May; 271(2):327-42. doi: 10.1148/radiol.14131480

2. Hu HJ, Liao MY, Xu LY. Clinical utility of dual-energy CT for gout diagnosis. Clin Imaging. 2015 Feb 11. pii: S0899-7071 (14) 00321-0. doi: 10.1016/j.clinimag.2014.12.015

3. Liu Y, Qu M, Carter RE, et al. Differentiating Calcium Oxalate and Hydroxyapatite Stones In Vivo Using Dual-Energy CT and Urine Supersaturation and pH Values. Academic Radiology. 2013; 20(12):1521-1525. doi:10.1016/j.acra.2013.08.018

4. Okada M, Kunihiro Y, Nakashima Y, et al. Added value of lung perfused blood volume images using dual-energy CT for assessment of acute pulmonary embolism. Eur J Radiol. 2015 Jan; 84(1):172-7. doi: 10.1016/j.ejrad.2014.09.009

5. Lu G, Zhao Y, Zhang L, et al. Dual-Energy CT of the Lung. AJR 2012; 199: S40-S53

6. Kaup M, Scholtz JE, Engler A, Bauer RW, et al, Virtual monoenergetic dual-energy CT: optimisation of keV-settings in lung cancer (presented at the European Congress of Radiology 2015)

7. Lam S, Gupta R, Levental M, et al. Optimal Virtual Monochromatic Images for Evaluation of Normal Tissues and Head and Neck Cancer Using Dual-Energy CT. AJNR Am J Neuroradiol. 2015 May 28

8. Postma AA, Das M, Stadler AR, et al. Dual-Energy CT: What the Neuroradiologist Should Know, Curr Radiol Rep (2015) 3:16 DOI 10.1007/s40134-015-0097-9

9. Postma A, Das M, Stadler A, et al. Dual-Energy CT: What the Neuroradiologist Should Know. Current Radiology Reports. 2015; 3:16 DOI: 10.1007/s40134-015-0097-9

10. Dinkel J, Khalilzadeh O, Phan CM, et al. Technical limitations of dual-energy CT in neuroradiology: 30-month institutional experience and review of literature. J Neurointerv Surg. 2015 Aug; 7 (8): 596-602. doi: 10.1136/neurintsurg-2014-011241. Epub 2014 Jun 20

11. Oca Pernas R, Delgado C, Trinidad C, Mera D, Bustos A, et al. Quantitative myocardial perfusion with dual-energy CT: iodine concentration differences between normal and ischemic myocardium (presented at the European Congress of Radiology 2015)

12. Carrascosa PM, Cury RC, Deviggiano A, et al. Comparison of myocardial perfusion evaluation with single versus dual-energy CT and effect of beam-hardening artifacts. Acad

Radiol. 2015 May; 22 (5): 591-9. doi: 10.1016/j.acra.2014.12.019

13. Yu L, Leng S, McCollough CH. Dual-energy CT-based monochromatic imaging. Am J Roentgenol. 2012 Nov; 199 (5 Suppl): S9-S15. doi: 10.2214/AJR.12.9121

14. Jiang XY, Zhang SH, Xie QZ, et al. Evaluation of Virtual Noncontrast Images Obtained from Dual-Energy CTA for Diagnosing Subarachnoid Hemorrhage. Am J Neuroradiol. 2015 May; 36 (5):855-60. doi: 10.3174/ajnr.A4223

15. Marin D, Boll DT, Mileto A, et al. State of the art: dual-energy CT of the abdomen. Radiology. 2014 May; 271 (2):327-42. doi: 10.1148/radiol.14131480

16. Ghonge NP. Computed tomography in the 21st century-current status and future prospects. J Int Med Sci Acad 2013 (Jan–Mar); 26:35–42