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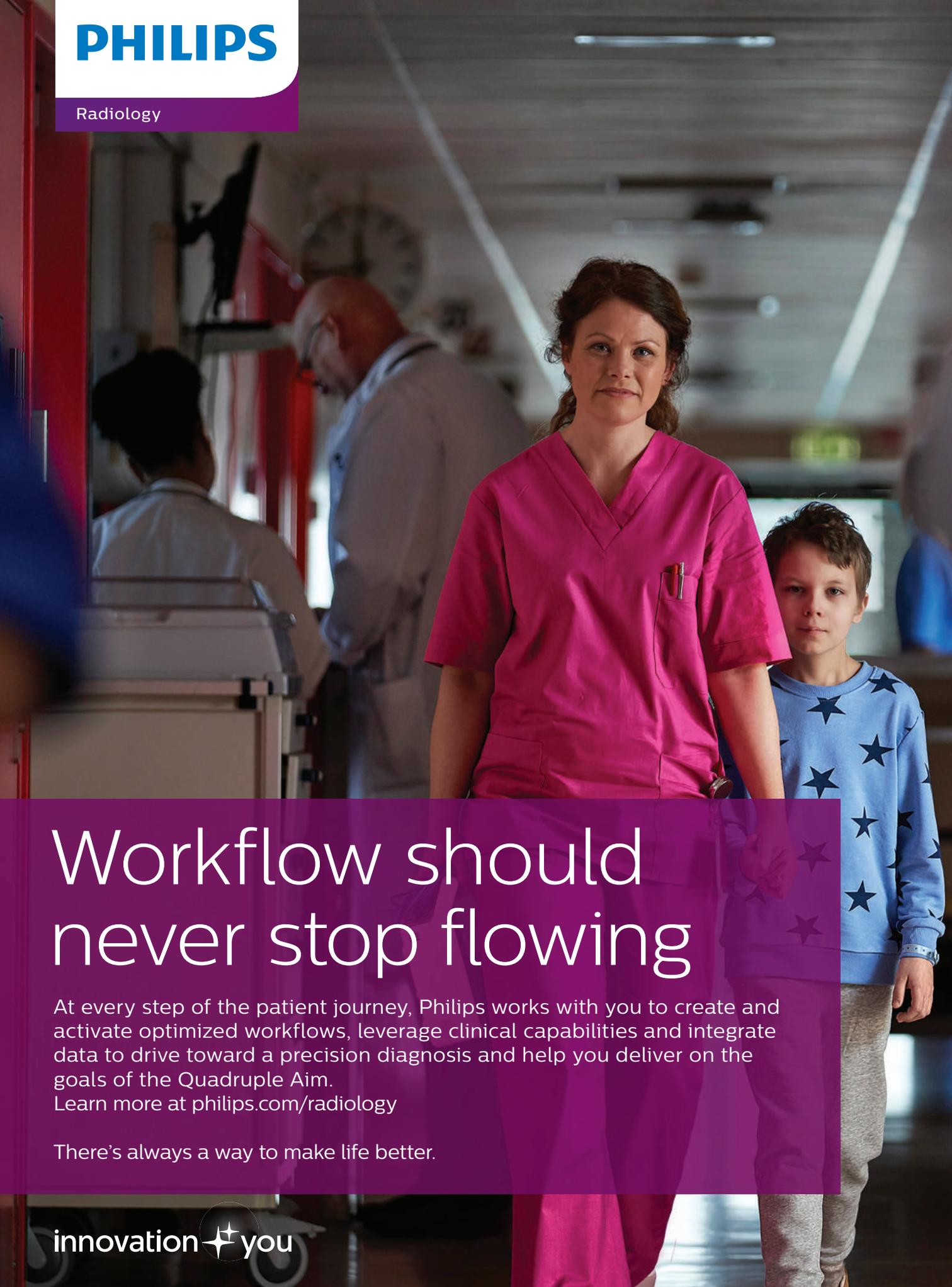
THE JOURNAL OF PRACTICAL MEDICAL IMAGING AND MANAGEMENT



Empowering You To Realize Precision Diagnosis

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A photograph of a hospital hallway. In the foreground, a woman in pink scrubs stands with a young boy in a blue star-patterned sweater. In the background, other medical staff are visible, including a man in white scrubs and another person near a medical cart. The lighting is soft and clinical.

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APPLIED RADIOLOGY

THE JOURNAL OF PRACTICAL MEDICAL IMAGING AND MANAGEMENT

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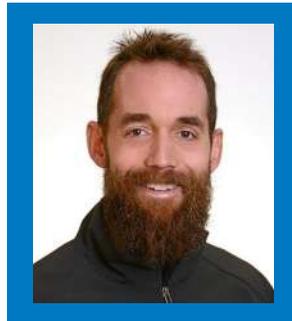
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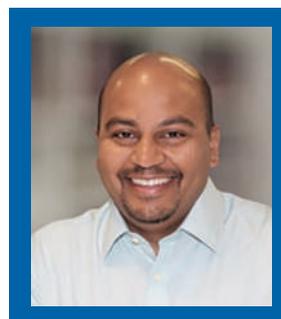
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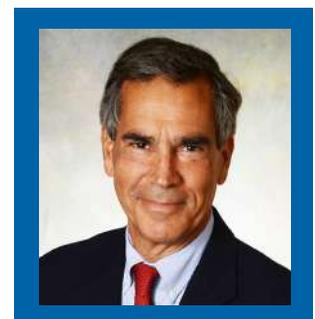
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Empowering You To Realize Precision Diagnosis



At Philips, we work collaboratively with customers to tightly align our innovations with their objectives to deliver meaningful and tangible value.

Chip Truwit, MD, FACR
Chief Medical Officer,
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Healthcare systems globally are under intense pressure – and nowhere is this more evident than in the management of the operational and clinical complexities. Care providers are striving to deliver on clinical outcomes that improve quality despite being burdened with obstacles that constrain workflow optimization. Complex technology and IT integration, increasingly being brought to bear on such workflow limitations, though well-intended, often actually complicate and disrupt such workflow, threatening the continuity of care.

Improving clinical workflows requires ongoing attention to consistently optimize efficiency and interoperability. And, despite some broad, algorithmic approaches to care in oncology, cardiology, neurology, and urology, oftentimes care can be so complex and individualized that what is right for one patient is not right for others. This is at the heart of Philips' commitment to personalizing patient care throughout its end-to-end solutions.

It is only when assessing the patient journey from both a clinical and operational standpoint that precision diagnosis and the path it provides toward precision medicine can be realized for patients, clinicians and health systems alike. With a systems view and a patient-centered approach to diagnosis and treatment, Philips applies strong clinical capabilities, simplifies workflows, and integrates artificial intelligence to help healthcare providers deliver precision diagnosis — leading to precise therapies with predictable outcomes for patients.

At Philips, we work collaboratively with customers to tightly align our innovations with their objectives to deliver meaningful and tangible value. Our partnership begins with innovations that connect clinical capabilities and optimize workflows around patient needs. Artificial intelligence embedded within each step in the journey helps to enable both a timely precision diagnosis and specific treatment outcomes. This precise diagnosis informs a patient's care journey: treatment, follow-up, assessment, monitoring and even a transition toward home care. In doing so, we enable our health system partners to achieve the goals of the Quadruple Aim: better outcomes at lower cost, as well as improving patient and staff experience.

In the pages of this special supplement, Philips is proud to highlight some of the achievements of our customer collaborations — achievements that demonstrate very clearly and concretely just how Philips is working to advance imaging with a portfolio of solutions that provide greater value to healthcare organizations, and greater benefit to their patients' lives.

Chip Truwit, MD, FACR
Chief Medical Officer, Diagnostic Imaging, Philips Healthcare

Artificial Intelligence: Augmenting Radiology for Precision Diagnosis

by Claudette Lew

As one of the most popular buzzwords making the rounds in today's healthcare circles, "precision medicine" refers to a time and place where conditions and diseases can be precisely diagnosed and precisely treated with therapies that are predictively effective.

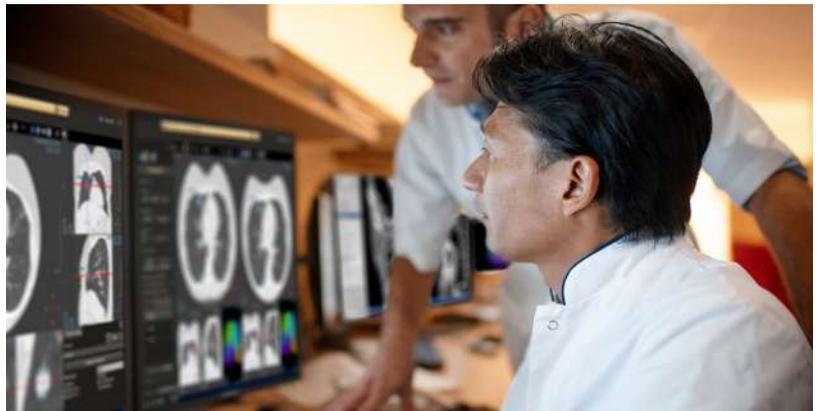
We're not quite there yet, says Sham Sokka, PhD, but we are headed in the right direction.

Dr. Sokka, Global Marketing and Ventures Leader in Precision Diagnosis for Philips Healthcare, describes precision diagnosis as one of the most fundamental components of precision medicine. Philip's strategy of augmenting the role of the radiologist, he says, will help achieve important patient care milestones along their pathway.

Making a plan

Though often the slowest to adopt significant change, the healthcare industry seems increasingly willing to leverage artificial intelligence (AI) to improve data analysis, help streamline clinical and administrative workflows, and provide insights through clinical decision support. This is especially apparent in radiology where, with the support of Philips' development of its own AI embedded within tools, workflows, operations, and clinical decisions, clinical care can be redesigned and/or enhanced, ultimately promoting progress toward realizing the promise of precision medicine. AI leverages Philips' deep clinical and operational knowledge within Radiology to apply various technologies to assist physicians with contextual insights embedded within their workflows.

Precision diagnosis combines diagnostic tools, procedures, and processes, and optimally



Philips delivers AI-enabled solutions with contextually-aware toolsets for the radiologist.

integrates the data generated by them so physicians have the right information at the right place and at the right time, Dr. Sokka says.

"Philips is going to help define and shape precision diagnosis, because we're uniquely positioned to bring the necessary technologies together for precision medicine," he explains.

The first and most important step toward achieving precision diagnosis and precision medicine, Dr. Sokka says, is getting the diagnostics right in the most cost-effective way possible. The second step is integrating all the data, while the last step is to use the data to propose and select the most appropriate therapy based on the context.

"The path of precision medicine guides patients from making sure they come prepared for the initial study, all the way through to suggesting the optimal therapy for them based on their diagnostic profiles," Dr. Sokka says.

One step at a time

At each step, AI can be implemented in ways that support the role of the radiologist.

AI, says Dr. Sokka, is fundamentally about making someone's life easier. "It's about making patients' lives easier because they get a text message that tells how to prepare for their specific exams. For the technologists, it's about using technology to predict no-shows, and to automate their schedules to minimize risk so they can have a better working experience that day. It's also for radiologists so they can get the data aggregated and presented optimally so that a more informed and faster diagnosis can be achieved. At Philips, our philosophy is to create an ecosystem of AI innovation at each step in this connected chain."

Standardizing the data

Dr. Sokka believes that, as an industry, healthcare is still using AI to build solutions for the "first phase" of care, such as using AI to help devise better schedules, recommend the right tests, or suggest potential findings from the imaging record.

"If I have three MRI scanners, what's the best way to schedule so that I can maximize the efficiency on each scanner? When I'm reading an imaging study or a pathology study, can I use AI to better aggregate the most relevant patient information?" he says by way of providing examples.

One reason the healthcare industry hasn't moved beyond this phase, Dr. Sokka says, is because of widespread challenges to data integration. He stressed that achieving data standardization is a prerequisite to moving forward.

"Most of the data that we use in the healthcare enterprise is not clean; and standards can only address part of the issue," he explains. "One institution may record everything around the patient episode, including any missed appointments, details about scheduling, their complete health record, and all their prior imaging studies. Another site may not have any of those data points recorded and the record around the patient can be much more ambiguous."

This lack of data standardization, resulting in the potential for an abundance of partial and inaccurate information in the medical record, is

a major stumbling block to data integration, Dr. Sokka says, noting that, "the inability to reconcile data from multiple institutions with a standard algorithm makes it extremely challenging to incorporate intelligent solutions that rely on this underlying data."

Addressing the challenges

Philips is working with hospital providers and professional societies such as the American College of Radiology (ACR) to find ways to move the industry to open standards for recording and easily moving these types of data from one organization to another.

A second initiative is to create a standard way of reporting similar data from one hospital to the other. A good example is the variation in imaging study acquisitions from one institution to another. "In one place," Dr. Sokka says, "an imaging study might take five minutes and in another, it takes 30 minutes. In actuality, the study that took five minutes might be more accurate and have better diagnostic value than the one that took 30 minutes. Why is that?"

He explains that metadata, which in this case consists of all the data points recorded around an event such as an imaging study, is not recorded in a standard way. Recording information such as which protocols were used, who selected the study, how long the elements of each study took, and the study outcomes, will make a big difference.

"Going forward, if our goal is to get the right imaging procedure that first time, I need all of that data to figure out why patient information, in one place, was captured correctly and why, in another, it was not, in order for AI to learn from that and then offer predictive information."

Industry groups are working to help bring data standards into place; on the clinical side, meanwhile, groups are trying to set up standard workflows.

"This work is a prerequisite for AI to get to the next level," Dr. Sokka says. "What we're seeing today in most cases is anecdotal evidence of AI being helpful, but one of the reasons we're not able to apply its principles more



At Philips, our philosophy is to create an ecosystem of AI innovation at each step in this connected chain.

Sham Sokka, PhD
Global Marketing and
Ventures Leader in
Precision Diagnosis
Philips Healthcare

broadly is because we're not yet at the level of standardization and cleanliness on the data side to be effective.

"Right now, if I have 1,000 patients, 900 patients will lack key data elements in their record. One patient might have ten data points and another might have all 25 though they share the same ailment. If I have this sparse amount of data on which to build a model of an AI predictor for the right study, I can't do it effectively," Dr. Sokka says.

AI right now

Dr. Sokka says AI has a better chance of success in places where the data is already standardized. Ironically, many examples of data standardization on the imaging side are already in place because of the industry's use of the DICOM standard. Many AI projects are being pursued in image analysis but have not yet been implemented into clinical workflows. There is risk associated with using predictive data analytics with patients' health. Bottom line: There are consequences if the AI is wrong.

As a result, AI adoption is more likely to be seen on the practice and administrative side of healthcare in the near future. Great opportunities exist for advancement. Even if clinical AI is at the level of providing more insights based on the data, administrative AI may take the next step toward more predictive modelling. But it all starts with having the right tools built into an ecosystem available to the hospital.

"One of our big philosophies at Philips is to create an ecosystem of AI innovation, and put people at the center of it," Dr. Sokka explains. "That can be an AI innovation that Philips developed, or an integrated AI from outside of Philips. We're integrating external AI developments across our solutions to create a better experience for the patient and the provider."

Philips recently announced its acquisition of Medumo, a Boston-based start-up that has developed a platform to help healthcare providers deliver patient-engagement and education services related to diagnostic, interventional, or therapeutic procedures.

"Medumo is a great example of a company that delivers AI and information to patients as they're preparing for their imaging studies," Dr. Sokka says. "Medumo's business model was initially based on preparing patients for colonoscopy because typically 10 to 15 percent of patients would come to the colonoscopy without their bowels optimally prepared. It's really about the same concept, getting the patient informed so that you can have a confident diagnosis."

Philips plans to work within the Medumo platform to engage patients for other types of procedures, such as diagnostic imaging, biopsy preparation, cardiology cath-lab preparation, and other situations that can directly engage patients in their diagnostic journey.

Collaborative AI

In addition to incorporating AI from external sources, Philips is working continuously to develop AI solutions with its own customers. Some of Philips' innovations are built so that users can create their own AI algorithms to integrate into their workflow.

"Philips IntelliSpace Discovery¹ is a solution that allows customers to discover different AI techniques from their own images and build them into their own clinical production environment," explains Dr. Sokka. "We're working with customers on how to standardize the data, get it properly prepared and conditioned, and then we can change the workflows where we need to collect additional data and develop new AI algorithms together."

Artificial Intelligence, he says, is not meant to replace the radiologist; in fact, radiologists' expertise is at the heart of what is needed to develop AI and to enhance the value of imaging.

"As a company that is really taking AI forward," Dr. Sokka concludes. "Philips knows it's not just about providing the new technology, [but] about providing the full service; taking it all the way through to the workflow, and always keeping the people at the center of our innovations."

¹IntelliSpace Discovery is for research use only and cannot be used for patient diagnosis or treatment selection.

IQon Spectral CT: Improving Patient Management in Neurology

by Claudette Lew



We've found that, using IQon Spectral CT, we can more definitively differentiate between contrast staining and blood in these images.

Ryan Lee, MD
Section Chief of
Neuroradiology
Einstein Medical Center
Philadelphia, PA

The radiology team at Einstein Medical Center in Philadelphia, PA, is changing the way it helps fight stroke. A key weapon in their arsenal: Philips' IQon Spectral CT.

Stroke is a leading cause of death and disability worldwide; imaging plays a critical role in evaluating suspected cases of the condition in patients who present to the emergency department, as well as in assessing the results of treatment.

As part of their comprehensive imaging protocol, radiologists at the flagship hospital of the namesake Einstein Health Network (Einstein) are leveraging IQon Spectral CT technology to image ischemic stroke patients before and after recanalization therapies. And along with recent changes they have made to their clinical workflow, they're reducing costs and improving care and patient experience.

Optimal imaging

Given the complexity of stroke and its effects, optimizing imaging protocols is critical, especially with respect to selecting the right modality and the ideal acquisition technique from among many available such techniques, needed to generate the best possible patient outcome.

Einstein's radiology department uses Philips' IQon Spectral CT as its technology of choice in stroke imaging. Ryan Lee, MD, Einstein Radiology's Vice Chair of Quality and Safety and Section Chief of Neuroradiology, says spectral CT has made a significant impact

on stroke management at the medical center. In fact, longstanding protocols were recently changed to require that all post-interventional scans be acquired on the IQon Spectral CT.

It's common, Dr. Lee says, to see density in the infarct bed on the brain CT scans immediately obtained after intervention.

"Typically, this is contrast staining, but it could be hemorrhage," he says, explaining that a hemorrhage finding warrants more intense follow-up.

"We've found that, using IQon Spectral CT, we can more definitively differentiate between contrast staining and blood in these images," Dr. Lee says. "Because I have spectral data, I can manipulate the images to get specific reconstructions to separate blood from contrast. It didn't take very long for me to see the potential to eliminate the follow-up CT for confirmation."

Change for good

Indeed, Dr. Lee proposed permanently eliminating confirmation CT scans of post-stroke treatment patients based on the results provided by the IQon Spectral CT, and both the neurology and interventional radiology teams agreed. This simple change to the workflow has improved staff and patient experience and reduced costs by doing away with unnecessary exams. The neurology and interventional radiology physicians are pleased with the change, he says.

"The main benefit is the increased confidence we have that it is contrast staining and

not hemorrhage, allowing us to not obtain another follow-up head CT. As a result, we are improving our overall quality of care with this protocol change," says Dr. Lee, adding that by eliminating these additional scans, "We're relieving some of the anxiety that comes from waiting for the 'all clear' after the interventional procedure."

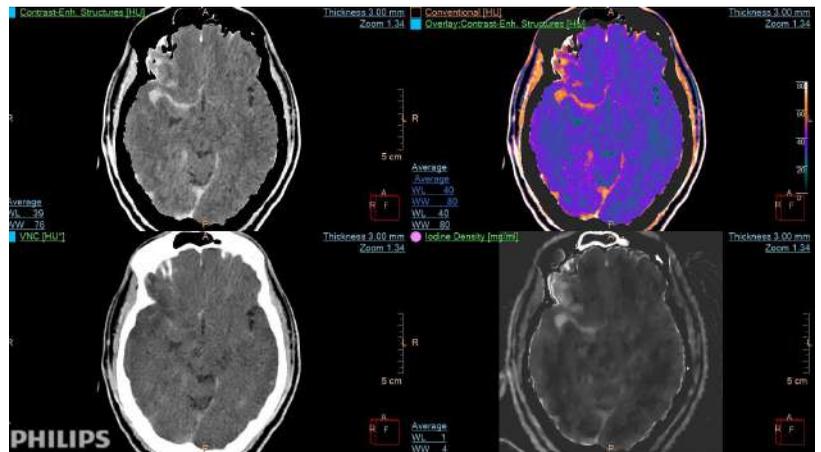
Routinely better

Having worked with the IQon Spectral CT for about a year now, Dr. Lee says the benefits of spectral technology are also apparent during image reconstructions. IQon Spectral CT reconstructions are completed on the scanner; then Dr. Lee performs advanced analysis using IntelliSpace Portal, allowing him to obtain a comprehensive understanding of the patient's neurovascular status. When complete, the images are saved to the medical center's picture archiving and communications systems (PACS).

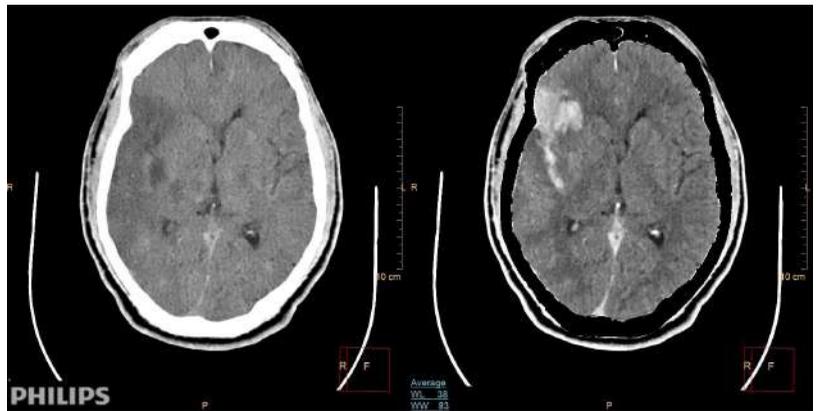
"On the post-processing side, there was a bit of a learning curve in understanding the different reconstructions available, but it has become second nature to those of us that routinely use it," notes Dr. Lee, who adds that the workflow change has had little impact on scheduling or accessibility. The IQon is located in Einstein's emergency department, which also gives that department's physicians easy access when necessary for cases of suspected stroke.

Sharing experience

Dr. Lee says there are plans to formalize, write, and publish the workflow data and resulting changes in stroke patient management so that other institutions can benefit from Einstein's experience. Additionally,



IQon Elite Spectral CT: Post-angio CT to determine the presence of contrast versus hemorrhage. Spectral results.



IQon Elite Spectral CT: Post-angio CT to determine the presence of contrast versus hemorrhage. Left: Virtual non-contrast; Right: Contrast enhanced.

the radiology team is making the most of the experience by adapting the same changes to other clinical areas and procedures as appropriate, such as in middle meningeal artery embolization, which is used to reduce the size of patients' chronic subdural hematoma.

"Middle meningeal artery embolization, says Dr. Lee, "can result in a similar diagnostic dilemma as those for post-intervention stroke patients. It is difficult to discern contrast from hemorrhage on our regular scanners just like with the post-intervention stroke cases, so we are performing these studies on the IQon scanners as well."

Vereos PET/CT: Leveraging Digital Precision for Innovative Approaches

by Claudette Lew



Because of the high quality and the precision of the counts we're getting with the Philips digital PET/CT system, we can get a precise determination of the PET activity.

Michael V. Knopp, MD
Novartis Chair of Imaging Research and Director of the Wright Center
Ohio State University
Columbus, OH

Frequently used in oncology, cardiology and other clinical areas, PET/CT has become an indispensable diagnostic and prognostic imaging tool in health care. Contributing to this growth of utilization of PET imaging are such advances as the digital detector technology in Philips' Vereos PET/CT. Digital detectors improve sensitivity and quantification, allowing for higher-definition imaging and detection of smaller lesions.

Leveraging these advancements and commercial availability, work is now under way to further optimize image quality, low dose protocols, and image acquisition times. The Vereos digital PET/CT, for example, is being used at the Wright Center of Innovation in Biomedical Imaging at Ohio State University's Wexner Medical Center in several initiatives aimed at achieving high-quality images at low doses and fast acquisition times.

A digital future

"There's really no question anymore that digital PET is the future," says Michael V. Knopp, MD, Novartis Chair of Imaging Research and Director of the Wright Center of Innovation. "What we're doing now is applying the benefits of the different technological advancements of digital technology. One of the areas we're focused on is improving image quality while

imaging faster and at a low tracer dose, which is very relevant for whole body imaging, but also for specific disease applications such as prostate, and neuro and cardiac imaging."

Dr. Knopp and his team at the Wright Center collaborated with Philips on the initial evaluation of the digital PET technology in 2014. This partnership led to the commercialization of this innovation by Philips as a Vereos PET/CT system. The Wright Center has been using the Vereos ever since. Dr. Knopp retains a keen interest in optimizing PET/CT capabilities to produce high-quality images at the lowest possible radiation doses and fastest possible acquisition times.

The average speed for whole-body PET imaging is about 90 seconds per bed position using traditional PET/CT, with a whole-body acquisition averaging ~20 minutes table time. In Phase II clinical trial findings released by Dr. Knopp at the 2018 Annual Meeting of the Radiological Society of North America (RSNA),¹ the investigators concluded that, using the Vereos system, ultra-fast whole-body PET/CT scans are achievable at one-tenth of the time — in just two minutes — and that consistent acceptable image quality was achievable with Vereos' proprietary digital photon counting detector technology. The ultra-fast, two-minute whole-body PET/CT scans acquired with digital detector technology also presented with

substantially fewer motion artifacts than traditional PET/CT images, the researchers found.

In addition to improving visual and quantitative quality, Dr. Knopp indicates that digital PET/CT enables the use of significantly lower tracer dose in clinical imaging.

Improving speeds and effecting change

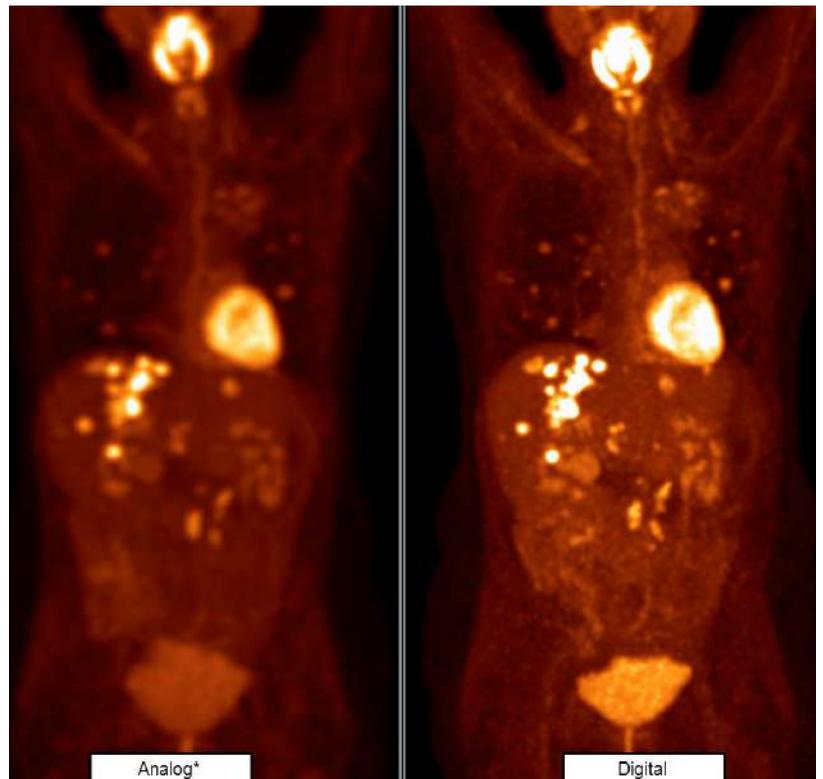
Dr. Knopp's work supports the possibility of PET/CT imaging at a temporal resolution improvement factor of ten and more. With this increased acquisition speed, Dr. Knopp is able to implement new approaches for dynamic imaging.

"We have taken all three of these components — image quality, low dose, and acquisition speed — and continued to evolve into more dynamic PET imaging, where we are reconstructing the imaging at a very high temporal resolution to look at the accumulation kinetics of PET tracers on target tissue," he explains.

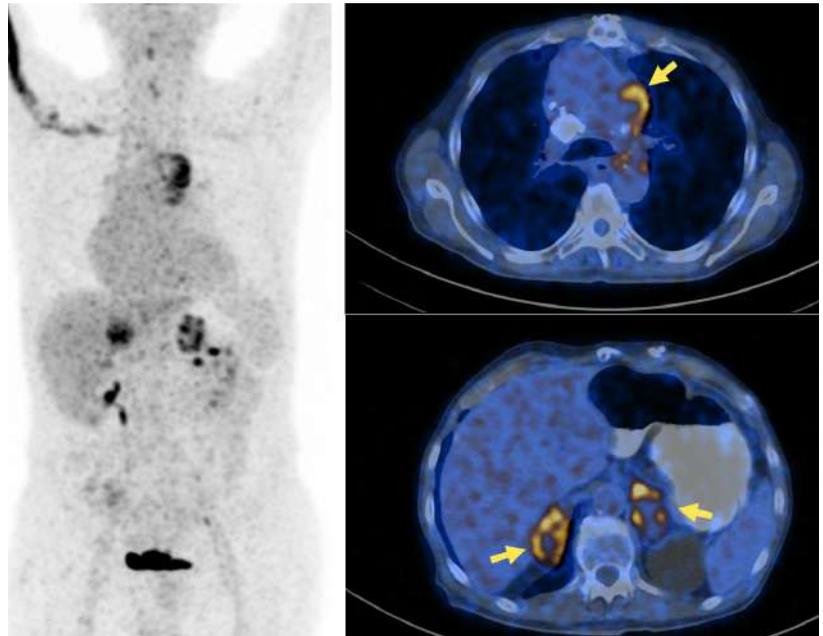
The ability to visualize the kinetic process has always been a hallmark of PET imaging, but according to Dr. Knopp, clinicians did not have these capabilities available anymore when whole-body static imaging with PET/CT was initially introduced."

"PET can provide a lot more insight into the pathophysiological process and is so important in our molecular understanding of disease and in the molecular targets we are pursuing," he says. "Because of the high quality and the precision of the counts we're getting with the digital photon counting PET/CT technology, we can get a very precise determination of the PET activity within the patient."

1. Knopp,MV, Knopp,MI, Porter,T, Binzel,K, Zhang,J, Giesel,F, Wright,C, Ultra-Fast Whole-body PET/CT Enabled by Digital Photon Counting PET Detector Technology: Findings from a Phase II Clinical Trial. Radiological Society of North America 2018 Scientific Assembly and Annual Meeting, November 25 - November 30, 2018, Chicago IL. archive.rsna.org/2018/18020222.html. Accessed September 30, 2019.



Comparison of analog vs. Vereos PET/CT digital detector technology. 'There's really no comparison that digital PET is the future,' says Dr. Knopp. *Analog system is Gemini TF.



Dr. Knopp and his team at The Wright Center have found that the ultra-fast, two-minute whole-body PET/CT scans acquired with Vereos' digital detector technology also presented with substantially fewer motion artifacts than traditional PET/CT images.

DigitalDiagnost C90 X-Ray: Enhancing the Patient's Healthcare Journey

by Claudette Lew

Digital X-ray (DXR) is the widely acknowledged workhorse system in medical imaging, but all too often, radiology departments and clinics pass DXR by when making strategic investments, which seem to go mostly to MRI, CT, and other more advanced technologies.

That is not the case at Cedar Rapids' Physicians Clinic of Iowa (PCI), where the clinic's leadership team recently saw the great potential in upgrading to Philips' DigitalDiagnost C90. As a result, PCI today is enjoying the fruits of increased clinical exam capabilities, newly created workflow efficiencies, faster exams, and higher staff and patient satisfaction.

Improved imaging capabilities

Performing an estimated 600 X-ray exams per month in each of its six exam rooms, PCI focuses on providing its large patient base in the Midwest with superior imaging services. In recent times, however, the equipment in one of the rooms began falling behind the growing demand. Rather than installing a new system merely to meet increased demand, PCI sought out a system that could also substantially impact patient and staff experience. The PCI team ultimately selected Philips' DigitalDiagnost C90 system, which features thoughtfully redesigned user interface upgrades and other patient-friendly improvements. It can handle many types of specialty exams, including orthopedic exams that require image stitching, and podiatry exams.

"We want to provide patients with a seamless journey to better care, but sometimes we are so busy it reminds me of Target on Black Friday," explains Peggy Colbeck-Rochford, PCI's Imaging Manager and PACS Administrator. "It is truly a hardship for our team when we have

a lobby full of patients, the team is going as fast as they can, yet all they see is an ocean of people looking at them in desperation, 'When is it going to be my turn?'

"Now that we've installed the DigitalDiagnost C90, we can perform every exam for all of our specialty practices in that room and not have to segue patient care to another of our imaging suites," Colbeck-Rochford says.

In addition to advanced imaging capabilities, PCI invested in several accessories, including a Skyplate, a wireless detector held by the patient for extremity exams. "Our other CR cassettes could process as quickly as 12 seconds, and we were thrilled with that, but with the Skyplate, there is no processing needed at all. There is an instant image on our technologist's workstation. In our high volume clinic, those 12 seconds saved have contributed significantly to our faster exam times and workflow improvement," she says.

Patient focus

The PCI team is also pleased with new features that improve both staff and patient satisfaction by increasing the visibility of the technologist and their interaction with the patient throughout the exam. "PCI patients are curious," Colbeck-Rochford says. "They come to us with expectations of high-quality care. The C90 has not only met, but has exceeded those expectations." The clinic's technologists guide the patients through the imaging exam process including showing them the video camera on the 12-inch touch screen monitor on the tube head; as well as giving them the added surprise of seeing an actual x-ray image on the touch screen after the acquisition.

"Whether the patient is a child, an elderly person, or someone with a communication



Now that we've installed the C90, we can perform every exam for all of our specialty practices in that room and not have to segue patient care to another of our imaging suites.

Peggy Colbeck-Rochford
Imaging Manager and
PACS Administrator
Physicians Clinic of Iowa
Cedar Rapids, IA

barrier, the video camera has elevated the level of comfort and trust between the patient and technologist. The patient understands the technologist can see them even when they step into the control suite. This has enriched our patients' experience and strengthened the confidence they have in our team."

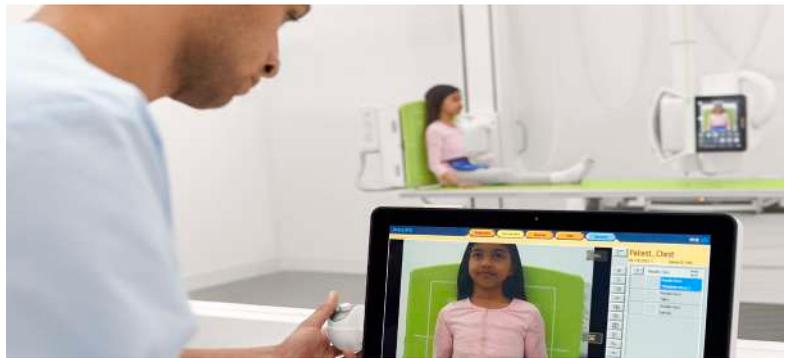
Colbeck-Rochford reflected on the team's objectives. "Our leadership team wanted to feel confident in providing our patients with the highest quality diagnostic images, so that in the event our providers are coordinating care plans with other facilities such as the University of Iowa, Mayo Clinic, or the Cleveland Clinic, the studies would not have to be repeated," she says.

Improving efficiency and staff satisfaction

The DigitalDiagnost C90 also takes efficiency and staff satisfaction to an entirely new level, making it possible for technologists to do virtually everything related to any given exam without leaving the patient's side. The tube head, for example, serves as virtually the entire workstation, displaying all parameters needed for each exam, as well as enabling the technologist to ensure all settings are correct. In addition, the live camera collimation helps accurately position each patient for imaging to prevent retakes. Indeed, with the C90, the only reason the technologist must leave the patient's side and walk to the workstation is to take the actual exposure.

"The redesigned tube head has had a major impact on reducing the physical demands on our technologists in terms of walking back and forth between the workstation and the patient," explains Colbeck-Rochford. "We are a busy practice; it's not uncommon for a technologist to average 13,000 to 18,000 steps per day. Using the C90, technologists have reduced our exam times by 30 to 50 percent of what they were before."¹

The efficiencies gained in clinical workflow and exam time have also had a significant effect on patient throughput, she says. Since the installation, PCI staff have more than doubled the number of exams performed in that once-trailing exam room from about 500 to



With DigitalDiagnost C90, Physician's Clinic of Iowa is enjoying increased clinical exam capabilities, newly created workflow efficiencies, faster exams and higher staff and patient satisfaction.

1,200 exams in one month, out of an average total of 3,700 digital exams.¹

"I think that the C90 has reinvigorated our staff and our providers," Colbeck-Rochford says. "We created a buzz to generate excitement around the C90 during construction and installation. It is humbling to think as an independent practice in Cedar Rapids Iowa, that we had the privilege of installing the first C90 in the Midwest. We are very proud to provide this latest technology for our community and have already ordered a second C90 unit to be installed later this year."

Collaborative planning

PCI holds its longtime relationship with Philips in high regard, says Colbeck-Rochford, who explains that the clinic works closely with their Philips rep on strategic planning for department growth and collaborating on new projects.

"We celebrate Philips because they are more than a vendor; we consider them an integral part of our imaging team. From sales to service, they go above and beyond to support us in all that we do — 24/7," concludes Colbeck-Rochford. "Our mission is to provide exceptional service and quality medical care to our patients, while also providing a safe and happy working environment for our team mates. Philips understands our goals, they know where we're going, and most importantly, they know what our patients' health means to us."

¹ Results are specific to the institution where they were obtained, and may not reflect the results achievable at other institutions.

Ingenia Ambition MRI: Pioneering Cardiovascular Imaging

by Claudette Lew



When we had the opportunity to replace our existing equipment and purchase the new Ingenia Ambition, we were excited. It's encouraging to have a machine where we won't have to worry about resource scarcity and how to mitigate that in the future.

Carol Melvin
Chief Operations Officer
Miami Cardiac &
Vascular Institute
Miami, FL

An estimated 92 million U.S. adults suffer from at least one type of cardiovascular disease (CVD), and by 2030, around 44 percent of the U.S. adult population is expected to have some form of CVD.¹ Miami Cardiac & Vascular Institute (the Institute) is uniquely positioned to meet this rising demand for care with cutting-edge techniques and superior technologies, supporting a vision that's resulted in the Institute becoming a leader in cardiovascular care. As part of Baptist Health South Florida, the Institute is providing patients with comprehensive cardiovascular services, top-tier clinical expertise, a visionary leadership team, and access to new technologies, such as Philips' Ingenia Ambition 1.5 Tesla MRI.

Environmentally sound

Given the current shortage of helium — what was thought to be an abundant natural resource, but instead has become notably finite in recent years — MRI operations may sustain profound impacts in the near future. As a result, Philips developed its Ingenia Ambition MRI to run on a closed loop of only 7 liters of helium, which is 99 percent less helium² than that used by conventional MRI systems and so that no helium can escape.³ The need for complicated venting to safely expel the gas is now eliminated, and the magnet does not require refilling with helium during its lifetime, potentially saving installation costs, and system downtime costs related to interruptions to MR services that can result from helium issues. These important changes offer providers additional installation location options for the MRI within a hospital to help improve workflows.

Carol Melvin, Chief Operations Officer at the Institute, was eager to speak about the importance of the new system for the Institute's future.

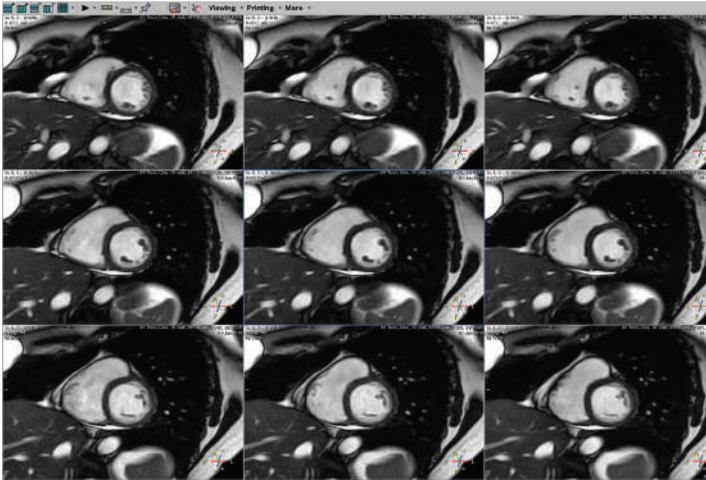
"We're very proud of our cardiovascular MRI program, and when we had the opportunity to replace our existing equipment and purchase the new Ingenia Ambition, we were very excited," Ms. Melvin says. "Not only because we felt that the image quality would be enhanced, but also for the important environmental aspect as it relates to the helium. It's very encouraging to have a machine where we won't have to worry about resource scarcity and how to mitigate that in the future."

Leading-edge cardiovascular MRI

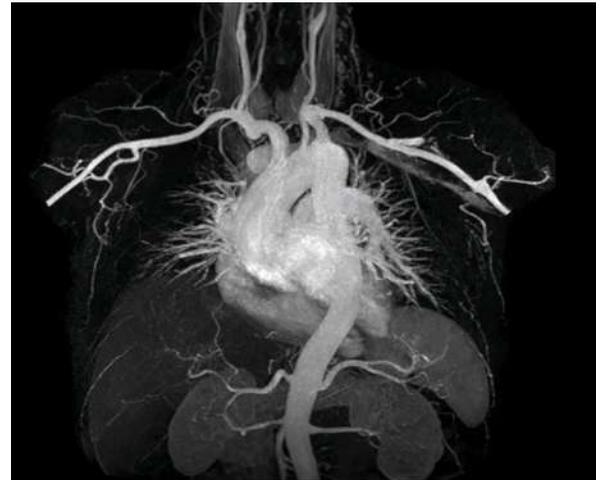
In addition to the highly desirable environmental aspect of the Ingenia Ambition, the MRI system has also proven valuable to the Institute's clinical team because of its power and ability to image faster⁴ using Compressed SENSE technology. Clinical providers at the Institute depend on the latest MRI technology to visualize not only the heart, but also the blood vessels, to provide comprehensive cardiovascular care. "We can actually see the blood traveling through the system over time. All of these are benefits of MRI," says Constantino Pena, MD, FSIR, FAHA, FSCCT, Medical Director of Vascular Imaging at Baptist Health South Florida.

"It's state-of-the-art technology. It uses compressive technology that allows us to use the magnetic field to either maximize the quality of our image or the speed of our image acquisitions. So, if we're imaging someone's heart and they're not able to hold their breath very long, we're able to minimize the time needed to take that picture. It can make a significant difference in terms of what the patient may be able to tolerate," he says.

Compressed SENSE technology has had a significant clinical effect at the Institute. "It has really impacted our diagnostic work by allowing us to change our practice to perform more



Short breath hold cardiac cine. These are some images of a cardiac cine scan with a short breath-hold time. A high temporal resolution provides a smooth cine, which helps in assessing heart function. Ingenia Ambition.



mDIXONMRA in chest. FOV 430 mm, voxels 1.3 x 1.3 x 3.0 mm, 130 slices, breath hold 16.6 sec. Performed on Ingenia Ambition.

non-contrast-enhanced sequences. We try to minimize the amount of contrast agent we use, and we're now able to do that because of the imaging power of the scanner," Dr. Pena explains.

Ms. Melvin pointed out that not only is the Institute fortunate to have such a powerful system to perform complex studies for patients, it is also fortunate to have a team of highly skilled technologists who can take advantage of the capabilities of the new MRI scanner. "Having that kind of expertise is extremely important when it comes to the sophisticated types of studies that we do from a cardiac and vascular standpoint," she says.

Upon installation, the Ingenia Ambition was coupled with Philips' Ambient Experience to increase patient comfort and lower patient stress. Philips' Ambient Experience is an approach to clinical environment design aimed at improving both the patient and staff experience. It incorporates dynamic lighting, projection, and sound to provide positive distractions for patients and an engaging environment to benefit quality of care.

"It's about the whole feeling the patient gets in the magnet. The patient feels very comfortable and I think that's extremely helpful," explains Dr. Pena.

Future ready

The Institute at Baptist Health South Florida has a long history of working with Philips and

the team recognizes Philips' commitment to their mission.

"Philips is always looking at ways to help us improve," says Ms. Melvin. "It's a great partnership in that both organization's goals are to provide the best quality health care that we can to our community. Philips really understands this and provides input to help us better serve our community from a care standpoint."

Ms. Melvin says the teams are comfortable challenging each other because of their long-standing relationship. "We don't let them rest on their laurels, so to speak, nor do they let us. They are proactive in terms of innovation and are very reactive when it comes to taking our constructive input." The result of such communication can be seen in many of the products developed collaboratively between Philips and its customers.

From an equipment standpoint, Ms. Melvin says, while not all healthcare organizations are able to have a dedicated MRI for cardiac and vascular imaging, they still need to be looking at technology that meets their needs from a broader perspective, including the environmental standpoint, and how it may affect their future costs and ability to provide services.

1. <https://www.ahajournals.org/doi/10.1161/JAHA.119.012364>.
2. Compared to the Ingenia 1.5T ZBO magnet.
3. Even in the rare case of the magnet becoming unsealed, the negligible amount of helium escaping would not materially affect the oxygen in the room.
4. Compared to Philips scans without Compressed SENSE.



It's state-of-the-art technology. It uses compressive technology that allows us to use the magnetic field to either maximize the quality of our image or the speed of our image acquisitions.

Constantino Pena, MD, FSIR, FAHA, FSCCT
Medical Director of Vascular Imaging
Baptist Health South Florida
Miami, FL

PerformanceBridge: Improving Operational Efficiency

by Claudette Lew

The radiology department at Boston Medical Center (BMC) supports the largest Level 1 trauma center in New England. To maximize the department's effectiveness in supporting the facility, the radiology team at BMC uses Philips' PerformanceBridge Practice to monitor operational data and identify opportunities to make impactful workflow changes. The team recently implemented changes to the clinical workflow in computed tomography (CT) for emergency department (ED) patients, resulting in a significant improvement in CT turnaround time (TAT).

Stephan Anderson, MD, a clinical radiologist at BMC, will present his research findings at the 2019 Annual Meeting of the Radiological Society of North America (RSNA) in Chicago, IL. As one of the industry's more progressive groups utilizing data-driven practice management, BMC has been utilizing practice data to identify opportunities for improvement in such areas as patient flow, task scheduling, and TAT. Through PerformanceBridge, the team has the flexibility to manipulate practice data to get customized dashboards and can pull in other information as needed. The availability of this data to make improvements is what inspired the work they're sharing with their peers at RSNA.

Workflow changes for efficiency

Dr. Anderson, also the Vice Chairman for radiology research at BMC, specifically targeted the emergency department CT workflow as an opportunity to improve TAT. In the ED, Dr. Anderson noted, there's always pressure to reduce TAT and get patients to the next stage of care.

The researchers evaluated TAT using the time that elapsed between a CT scan order and

its interpretation. Typically, at BMC, the details of a CT ordered by an ED physician must be documented, or protocolled, by a radiologist or resident. This protocol includes directions for the technologist on performing the exam, such as whether to use intravenous or oral contrast, or other variables based on the reason for the exam. Oftentimes, the technologist must call the radiology workroom to ask for an exam to be protocolled so the study can be performed.

Dr. Anderson's goal was to shorten the TAT for emergency CT exams. Toward that end, he worked with his team and the team at Philips to identify the six CT exams most commonly ordered in the ED, including CT pulmonary angiograms for patients presenting with shortness of breath.

"The whole process of having the technologist call radiology and ask for someone to go to the ordering system to input the protocol took a lot of time and also interrupted the radiologists who were reading scans," Dr. Anderson explains. "We're always very mindful of throughput time in the ED, so trying to eliminate any drag on that system is always a priority. The change that we implemented was to remove the need for a physician to protocol. This was possible because many of the CT examinations for the ED are the same."

A common set of terms, or indications, was created for each of the six CT exams included in the study. A few select indications were identified that technologists would be allowed to protocol themselves, without relying on a radiologist.

"The human piece of the research relied on the technologists. They needed to look at the indications the ED gave them and see if they matched the list of terms we created. If they



We can look at abdominal scans, for instance, at each step of the process, and analyze the data before and after we made this protocol change. We can very easily draw out that there was a huge impact on throughput time.

Stephan Anderson, MD
Vice Chairman for
Radiology Research
Boston Medical Center
Boston, MA

matched, the technologists could protocol the exams directly," Dr. Anderson says.

Efficiency improvements

The study started as a four-month pilot program (Oct. 2018-Feb. 2019) — which has continued and was then expanded this past summer — and used PerformanceBridge Practice to evaluate how the changes affected CT turnaround time.

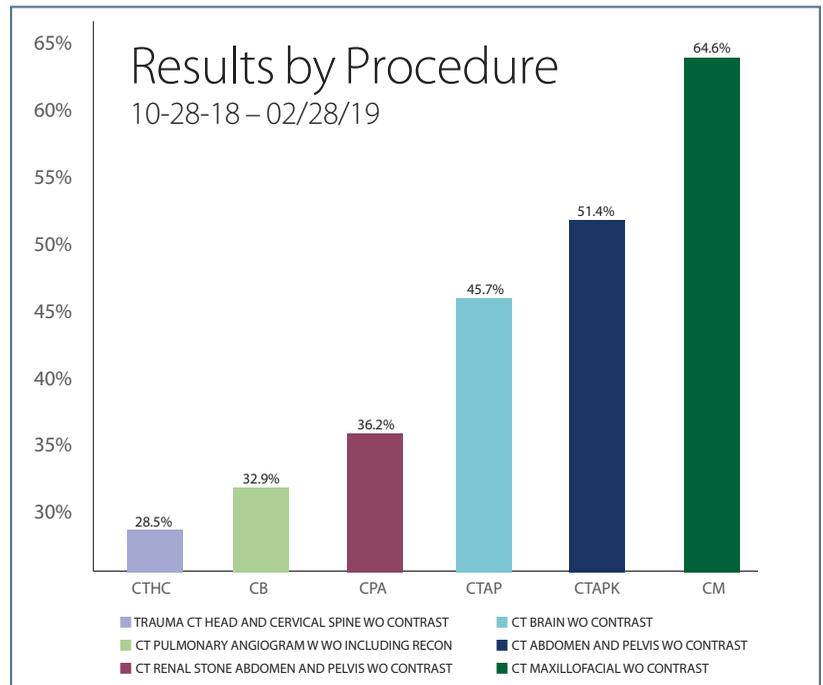
"The way we use PerformanceBridge is to analyze the impact of that change on our workflow," explains Dr. Anderson. "We can pull out all the data around a patient's flow through the ED and very quickly calculate everything we need to see as a function of the examination. We can look at abdominal scans, for instance, at each step of the process, and analyze the data before and after we made this protocol change. We can very easily draw out that there was a huge impact on throughput time."

According to Dr. Anderson, the lowest degree of TAT improvement documented was 29 percent, and the highest was 65 percent.

"One example," notes Dr. Anderson, "is an oral maxillofacial CT. The TAT went from 65 minutes to 28 minutes. That's a significant reduction in time, not only from the perspective of the ED, but also for that patient."

The lowest TAT impact was seen in CT for head and cervical spine trauma, Dr. Anderson says, noting that TAT fell 11 minutes, from 54 to 43 minutes.

"This research is very meaningful because it took only a trivial change to our workflow and no additional effort was needed from anyone," he explains, adding that without PerformanceBridge, "the project would be much more difficult to complete and require an enormous amount of human effort to get [the] data. We wouldn't be able to make these kinds of changes quickly and analyze their impacts. From a quality improvement perspective, PerformanceBridge makes analyzing improvement efforts really quite easy."



TAT percentage improvements for identified CT procedures initiated from the Emergency Department at Boston Medical Center, using Philips PerformanceBridge.

Based on the study's success and positive feedback from the ED, Dr. Anderson plans to move the project beyond the ED to outpatient imaging, where the goal would be less about reducing TAT and more about improving workflows because protocoling could be completed days ahead of patient arrival.

Operational improvements

Completing protocols for outpatient imaging is an overall good use of staff time, except when patients fail to show up for exams. According to Carlos Arellano, Senior Administrative Director of Radiology and Otolaryngology, no-shows in nuclear medicine, for example, are particularly expensive. Arellano is using PerformanceBridge to monitor daily department operations and identify areas where improvements can be made, including finding ways to predict no-shows and keep patients moving through their care journey.

"Each member of my team has their own PerformanceBridge dashboard that they have designed for their particular modality,"



PerformanceBridge brings together data, people, and services to bridge the gap between data and decision making.



A year ago, we were using PerformanceBridge for isolated projects, but now it's much more of a global tool used to manage the entire department.

Carlos Arellano
Senior Administrative
Director of Radiology and
Otolaryngology
Boston Medical Center
Boston, MA

explains Arellano, "including information they want to display day to day, and what information they find particularly useful for their department. A year ago, we were using PerformanceBridge for isolated projects, but now it's much more of a global tool used to manage the entire department."

Arellano is using PerformanceBridge Practice to follow an initiative targeting inclusion of no-show data through BMC's patient navigation system. In breast cancer screening, for example, BMC is leveraging PerformanceBridge Practice to track patient screening and follow-up appointments.

"We use the PerformanceBridge to run all the analysis and track which patients we need to be reaching out to schedule for the screening, reschedule patients who missed their appointments, and track all of the findings," Arellano explains. "Or if a patient has a lesion and needs to come back for an ultrasound, there needs to be a way to keep track of everything in one system, so a flag can be generated and someone can be alerted that a patient's care path has been interrupted. We don't want any patient to fall through the cracks."

Administrative feedback tool

The BMC team is currently realizing clear efficiency gains by using PerformanceBridge. In the

future, Arellano wants to leverage the solution's analysis capabilities even more to continue driving change at BMC. Arellano would like to create an individual PerformanceBridge dashboard for each radiologist and a feedback tool for technologists.

"In the coming year, I want to see us developing individual dashboards for our radiologists so they can understand the types and volume of cases they're reading. I also want to implement the feedback tool, currently available in the PerformanceBridge Connect application, to improve communication between our radiologists and technologists. The application allows radiologists to communicate quality issues in the images as well as provide positive feedback when technologists are creating high-quality exams," he says.

Knowledge sharing

"I know the challenges we're facing aren't unique to BMC," Arellano says. "The wonderfully unique thing about our industry is that we can share our expertise and experiences with other facilities without threat of losing competitive advantage. We're sharing our experiences to highlight the areas in which we've excelled, what we're still working on, and how we've prioritized projects, we do not have the bandwidth to work on all issues at once. The more we all share, the better we can all become as healthcare providers."

Arellano's team is excited about sharing their recent successes at the 2019 RSNA annual meeting and how PerformanceBridge is being used to identify where changes could be made to improve important metrics like patient wait times — one of the most common pain points in nearly every healthcare facility.

"There is a great deal of data available to us that can help us address various issues. It's just a matter of organizing, prioritizing and building different views, so we have the right information in the right hands at the right time — that's where Philips and PerformanceBridge are really helping us."

PHILIPS

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¹ Compared to Philips scans without Compressed SENSE.

“Compressed SENSE is a way where you are able to maximize your image quality and your time. You are the driver; you decide when you want to use one or the other.”

Dr. Constantino S. Peña, Medical director of Vascular Imaging, Baptist Hospital, Miami, FL, USA

