PHILIPS

Diagnostic Imaging

Position Paper

A call to action:

Creating imaging confidence

through purposeful innovation

Executive summary

Remember when a healthcare provider's primary worry was getting patients back on their feet? When information was a source of confidence vs. a source of stress and added burden? When new technology spurred excitement – and the case for its procurement centered on value to the patient, not impact on the budget? Sadly, many clinicians feel like the days are gone when they had full confidence in the path forward to best meet the needs of their patients, their team and the institution they serve.

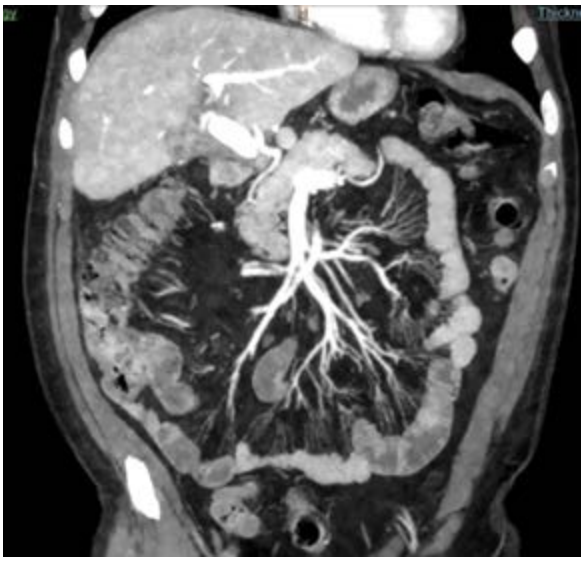
The healthcare system always seems to be under pressure, but the compound demand (by payors, administrators and patients) to perform at maximum efficiency while balancing competing priorities has never been greater. Several complex factors – from an aging global population to a growing prevalence of chronic disease and the mounting costs of technology – make it difficult for healthcare providers to focus on what matters most: delivering better patient outcomes. The radiology department is not immune to these pressures. Indeed, imaging is, in many ways, at the heart of the storm, which makes it a perfect place to start the transformation.

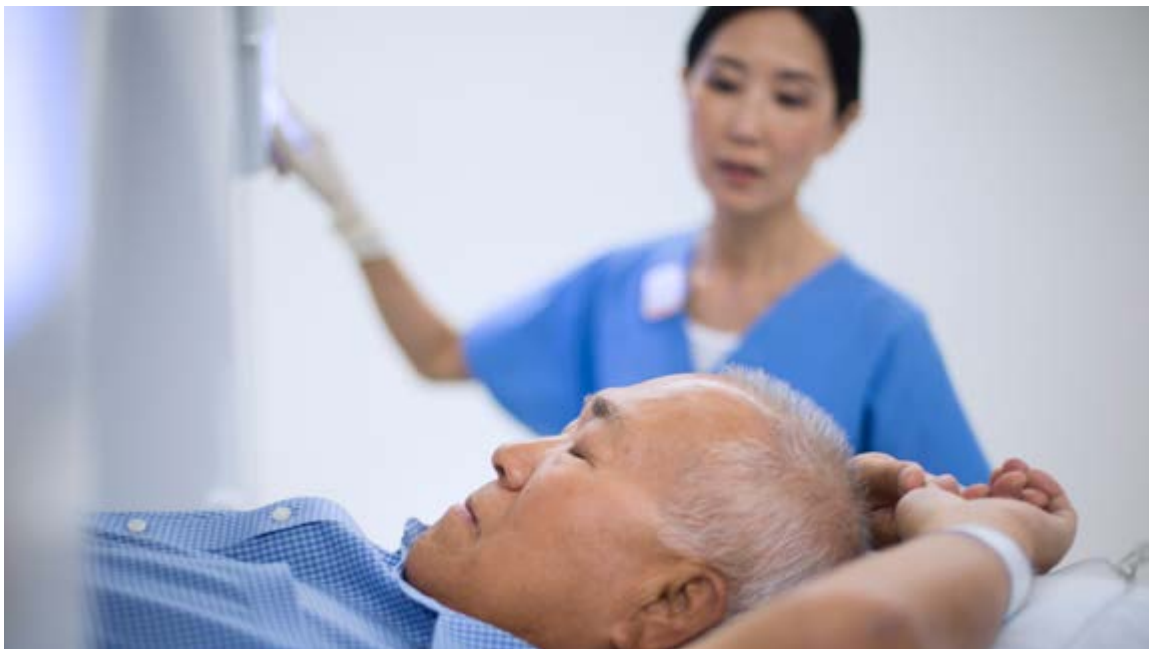
Radiologists know the intrinsic value they provide within the continuum of care. After all, acquiring the right image at the right time offers a literal line of sight to a confident clinical diagnosis and path to treatment. But while radiologists are famously enthusiastic adopters of new technology, the technology they rely upon poses sustained capital and operational finance challenges for health systems. And in systems transitioning to value-based care, radiology's role as a profit center has migrated to the cost column. Is it any wonder, then, that imaging is in a confidence-eroding conundrum?

Here's what we're hearing from radiology leaders:

- How do we keep pace with innovation that improves outcomes AND at the same time reduce costs?
- Is it even possible to make big data meaningful in real time to benefit patients?
- Is standardizing imaging to speed acquisition and workflows compatible with personalized, patient-centric care?
- What is a good patient experience in radiology, and how much can we control it?

"Our inspiration is an approach to **innovation that puts people at the center.**"



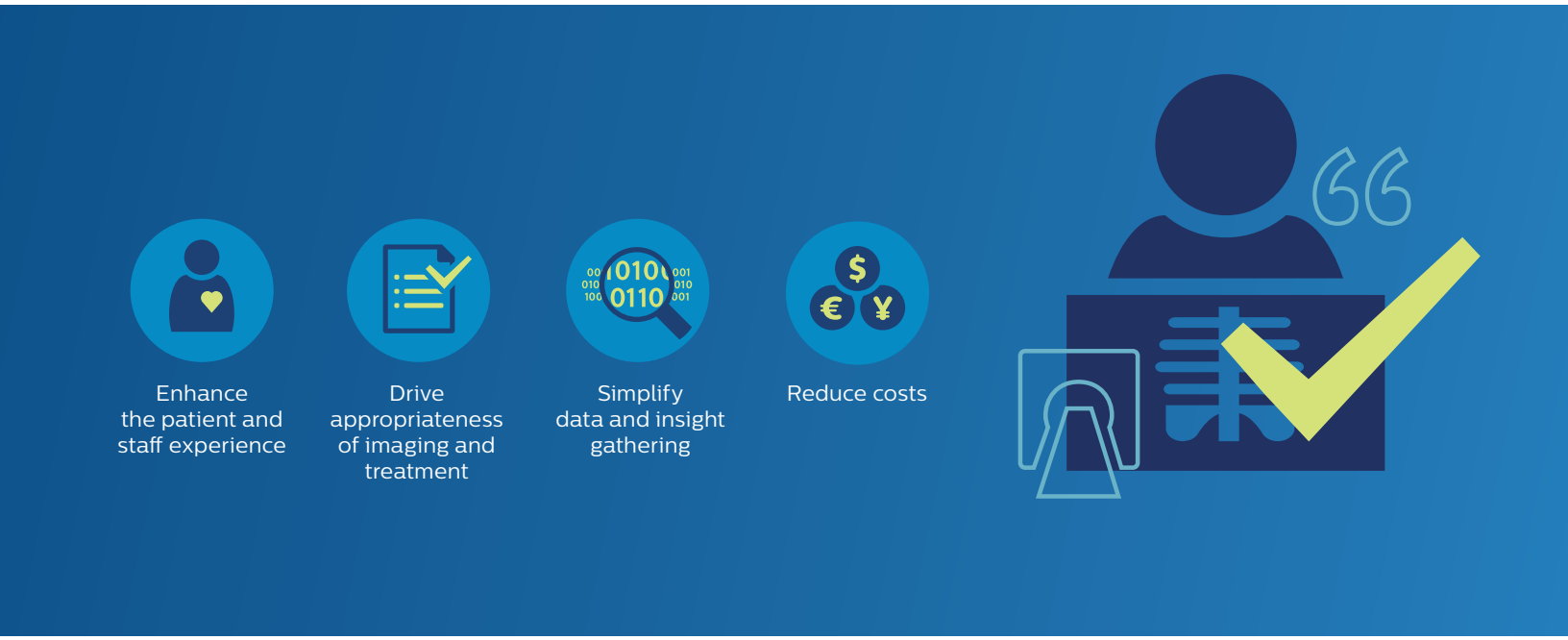


Daunting as these challenges might be, addressing them will enhance the value of diagnostic imaging within the continuum of care and enable radiologists to focus on what matters most – i.e., achieving a simpler, faster, smarter path to confident clinical decisions, enabling better outcomes at a lower cost. This does not mean losing our dependency on – and enthusiasm for – innovation and technology. Rather, it means prioritizing precious innovation resources for the things that matter most in an era of value-based, patient-centered care.

At Philips, we recognize that innovation in imaging includes solving problems by the simplest and most intuitive means possible. In diagnostic imaging, our inspiration is an approach to innovation that puts people at the center. Grounded in insights from radiology leaders and healthcare executives around the world, we're combining smart technology with clinical expertise to try to reduce systemic, imaging-related anxiety at the source. By concentrating our innovation efforts in this way, we believe we can enhance value for the imaging suite, the health system and, most critically, patients.

Our approach to innovation in imaging begins with remembering the people behind the images – the patients anxiously awaiting the outcomes of their examination and the radiologists and technologists who seek a simpler path and greater confidence in helping that patient. Purposeful innovation to support those people is driving our approach to care, which in turn strives to help clinicians and healthcare providers:

- **Enhance the patient and staff experience** with solutions that ease the stress of the imaging for patients and help technologists focus more on patients and less on machines;
- **Drive appropriate imaging** by ordering the right test at the right juncture in the care pathway, to reduce the need for repeat scans while supporting speedy and accurate diagnosis in routine and high-acuity settings;
- **Simplify data and insight gathering** to create efficiencies and allow physicians to meet target metrics today while planning for the future;
- **Reduce costs** by reducing waste in the system.



A complex healthcare environment on the cutting edge of change

As chronic diseases continue to pervade an aging population and clinical innovations keep driving up costs, funding healthcare has proven to be a universal challenge.[1] On the face of it, the issues stressing the healthcare system may seem insurmountable; in fact, the current environment presents a unique opportunity for positive disruption and transformation.

The scope of the challenge

No one argues the need for change in healthcare. In fact, policymakers in Western Europe and North America have legislated to reduce wasteful errors and help patients become better health "consumers." Health systems around the world are embracing population health management and value-based care structures and moving away from traditional fee-for-service models. Whether we're talking about the nationalized healthcare systems of Europe and Canada, the hybridized private-public market in the U.S., or the rapid-growth new systems in emerging economies such as India and China, health systems around the world are focused on delivering value. This new, metric-driven standard of healthcare has doctors and health institutions juggling their primary concern – patient outcomes – with competing needs related to cost reduction, staff management, market differentiation and patient satisfaction.

> Change is not a threat, it's an opportunity. Survival is not the goal, **transformative success** is."[3]
>
> Seth Godin, author and entrepreneur

As an example, the UK's National Institute for Health and Care Excellence (NICE) has developed a threshold for measuring cost-effectiveness by evaluating the benefits of potential new healthcare system offerings against the cost implications, leading to new ways of working and new sources of stress.[4] And just as an institution learns to adapt to this change, policymakers threaten even more legislation, leading to renewed uncertainty among healthcare providers and their patients. It's no surprise that healthcare providers and patients alike are increasingly anxious.[5]

The challenge for those in the imaging realm is even more complex. The need to balance the value of sophisticated innovation with the capabilities of a limited workforce and the pressure to see more patients while reducing costs puts palpable tension on the radiology team – and translates to patients. In many cases, the opportunity to reduce that pressure lies in conceiving of innovation through a different approach to imaging.

What if the equipment was intuitive enough for any technologist to use? If equipment was designed with the patient in mind, would it lead to fewer rescans? Could you gain greater confidence in the appropriateness of your imaging decisions if you could easily unlock patient and population data at the point of care?

Until now, technology providers and clinicians have generally pursued a "better, faster, sharper" innovation strategy to drive progress in imaging. This mindset has yielded extraordinary gains in diagnosis and treatment for patients. But, like the mobile phone industry, which has innovated to the point of parity, imaging today is facing an innovation crossroads. In many of the most relied upon modalities, we have achieved eye-popping image quality standards. It's time to take innovation down a different road – one that pursues the simplicity, efficiency, patient comfort and staff effectiveness that will result in reduced stress and new value across the care continuum.

Our approach to imaging prioritizes the needs of the patient and technologist to enable easy access to identify the right information at the right time for the right patient in the right order – with the aim of moving that patient as quickly as possible toward the most appropriate course of treatment.

Four imperatives for transforming imaging for the future

One: Enhance the patient and staff experience

While radiologists and technologists are passionate about the work they do each day, a visit to the imaging suite is not high on most people's list.

Radiology is critical to clinical diagnosis, but for patients it's a necessary evil that is fraught with apprehension and discomfort. Traditionally, patients have engaged with the imaging service that a referring physician – a doctor they trusted – recommended. But today, they are much more likely to entertain choices. The evolving "consumerization" of healthcare has put patient experience at the forefront of care, and choosing where to have a diagnostic procedure is something over which the patient increasingly has control. Ultimately, patients are moving towards a healthcare experience that mirrors the convenience and transparency of their banking, retail, transportation and other purchasing experiences.[6, 7] This isn't in conflict with what the radiologist wants: after all, most healthcare providers want to do everything they can for the patient. Rather, it's the complexity of providing care that can often seem in conflict with a positive patient experience.

In some markets like the U.S., payor shifts have resulted in patients bearing a larger portion of their medical costs, resulting in an understandably higher patient demand for better access to their health information, a higher degree of collaboration with health providers and a bigger voice in their diagnosis and treatment plans.[7, 8] In addition to the traditional quality metrics of the past, healthcare executives are now challenged to achieve high satisfaction

scores to maximize reimbursement for their services. Keeping patients happy is tantamount to maintaining competitive advantage, as we see more and more patients "shopping around" for the best healthcare services in the community.[9]

Many patients experience feelings of uncertainty and apprehension in the radiology suite. Difficulty obtaining accurate images can lengthen the duration of tests that often require patients to lie in uncomfortable positions for long periods of time. Delays in report delivery can impact the speed at which a diagnosis is reached and treatment can begin, not to mention the added costs of rescans.[10] Not surprisingly, patients list issues such as "waiting for an appointment," "delayed appointment times" and "waiting to receive results" as significant factors in choosing an imaging facility.[11] Many people decide where to have imaging scans performed based on where they can receive same-day results,[12] to avoid the anxiety of postponing a life-changing diagnosis.

So how do we improve the patient experience in imaging? It has to start with understanding the patient perspective. Patient-generated insights can lead to solutions that can give patients a sense of control and ease their concerns throughout the imaging journey. Virtual reality applications can help patients preview what their MRI scan experience may be like before getting into the scanner. Positive distractions such as Philips' multimedia MR In-bore Solution can assist them in remaining calm and lying still during the scan. The Philips KittenScanner pediatric CT simulation toy prepares young patients for their scan experience. And targeted, patient-centered research can reveal how to calm patients at critical points in the in PET-CT uptake process.[13]

Helping staff be at their best for patients

Optimizing the staff experience is also crucial in ensuring the patient's care and outcome isn't compromised. Staff burnout has adverse effects on professionalism, academic and clinical performance, personnel retention and patient safety and satisfaction. To address these issues, we can use the lens of "staff support" to focus innovation on helping technologists acquire appropriate and high-quality images the first time, through features like standardized equipment user interfaces that promote easy transitions between modalities. The result is innovative solutions such as SmartExam for MR. SmartExam* assists in delivering reproducible planning results in more than 80%

SkyFlow gridless imaging is a Philips innovation that eliminates the need to position a cumbersome grid behind the patient, enabling a fast and smooth workflow, more patient comfort, and excellent image quality at low dose settings.

With the Philips MR In-bore Solution, engaging visuals are displayed on the back wall and can be seen via a mirror on the head coil, while patients can listen to music/sound through the headphone.

of procedures by using intelligent software which automatically plans the scanning geometries, based on validated scanning preferences. This enables staff to standardize the MRI exam process, helping to enhance consistency in follow-up exams of the same patient and from patient to patient.[14] Another example is IQon Spectral CT ExamCards, which allow exams to be customized based on specific clinical questions – and spectral results to be shared without additional planning by operators.

When it comes down to it, an accurate and timely diagnosis promotes a positive outcome and cost savings for patients and health systems. To reduce the burden of this mission, it's critical that we simplify the technology we use by investing in purposeful innovation that prioritizes an expedited path to treatment.

> **Burnout is a concern for radiologists…greater for diagnostic radiologists than all other physicians.** Risk factors for burnout include inadequate training, work overload, lack of control, severe time constraints for work output, prolonged stress, introduction of many changes quickly…"[15]
>
> *Journal of the American College of Radiology,* 2016

* SmartExam is not available to patients with MR Conditional Implants

Making the case: **Helping patients feel comfortable with MRI exams**

The problem

At Herlev Getofte University Hospital in Denmark, patient experience is a crucial factor for the successful operation of their radiology department.

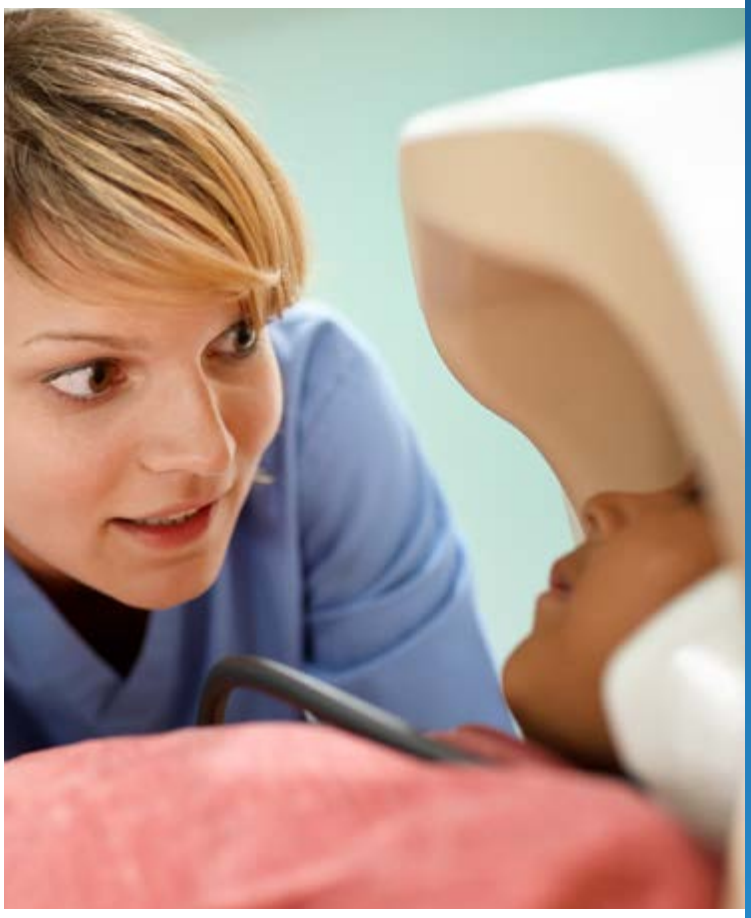
The solution

The staff at Herlev Getofte University Hospital installed the Philips Ambient Experience In-bore Solution in their Ingenia 3.0T imaging room, designed to help patients feel calm and relax during MRI examinations. The patient In-bore Solution diverts head-first patients when they move into the MR bore, providing a calming and positive distraction.

The outcome

When the radiology team surveyed patients scanned using the In-bore Solution, about 30% said time went by quickly. Staff reported that patients are positive, and that these features help calm patients, reducing motion-related problems and providing excellent images..
"We're trying to move away from being a 'disease repair shop' to being a 'temple of health' as I sometimes call it," said Dr. Michel C. Nemery, Chairman of the Department of Radiology at Herlev Hospital. "The MR suite with the Ambient Experience and the In-bore Solution is a substantial element in that change."[16]

Visuals combined with sound give patients a comforting and engaging experience where it is needed most: in the bore.



Engaging visuals are displayed on the back wall and can be seen via a mirror on the head coil, while patients can listen to music/ sound through the headphone.

“The importance of the patient experience has also been recognized by our peers and is now predicating a significant amount of payment for us, so that enhances the import of measuring how we’re doing.”[17]

Christoph Wald, MD
Chairman Radiology, Lahey Hospital
and Medical Center

Two: Drive appropriateness of imaging and treatment

> Innately, imaging can be very complex, and complexity leads to errors. We should do things in as simple a fashion as possible, and as standard a fashion as possible. **Simplicity and uniformity [in imaging] lead to higher quality and greater reproducibility."**[18]

Lawrence Tanenbaum, MD, Medical Director East Region, RadNet, Inc

According to a report from the Altarum Institute, "use of advanced imaging has increased significantly in the past decade, resulting in considerable increases in [U.S.] national spending and patient safety risks....Of specific concern is the well-documented finding that more than 25% of all imaging studies are not considered medically necessary and are ordered due to a lack of awareness of previous imaging studies or lack of alignment with evidence-based guidelines."[19] Given that imaging constitutes a huge portion of general healthcare spending, that's a pretty sobering analysis.

The best clinical outcome for a patient rests upon an accurate and timely diagnosis. To this end, it's crucial that each step in diagnosis and treatment is appropriate and delivers the basis for confident decision-making. Research has shown that human error poses a challenge, with images regularly misinterpreted. A study conducted in a high-income country found that approximately 5% of adults experienced diagnostic errors in outpatient settings each year, more than half of which posed the potential for severe harm; evidence shows the rate of diagnostic errors in low-income countries may be much higher.[20]

> For imaging information, simple or integrated, to have relevant value, **it must be the right information, it must be in the right location, and it must be delivered fast and reliably at the right time."**[21]

Dieter Enzmann, MD, Chair and Professor
Department of Radiological Services at UCLA Medical Center

Dramatic system-related errors can also occur if images don't match the medical question because of communication problems.[22] Similarly, outdated equipment with inadequate image quality can also lead to misdiagnosis.[23]

Knowing the stakes and understanding the pressures on radiology means that every imaging device should be used to its fullest capacity, providing high-quality images that give radiologists and referring physicians the shortest path to the information they need to make sound clinical decisions on behalf of their patients. To do this, the imaging community needs to redefine value by taking the simplest approach to accessing actionable insights that drive an accurate diagnosis, every time. And that means addressing routine imaging problems, such as variability in images, which stems from factors such as technologist error and clinical image interpretation.

Innovative tools that support data confidence, unifying data from disparate imaging sources and providing clinical context to drive meaning and insight, can enable more confident diagnoses. Machine learning lets us build on that knowledge to support improved selections of imaging in the future. Imagine the benefits to patients and value-driven financial outcomes when these solutions are integrated into our standard practices and implemented with an eye toward continuous improvement. Here again, the potential to save patients from stress and risks of delayed diagnosis aligns well with potential cost savings to the system.

Making the case: **New paths to diagnostic confidence**

The problem

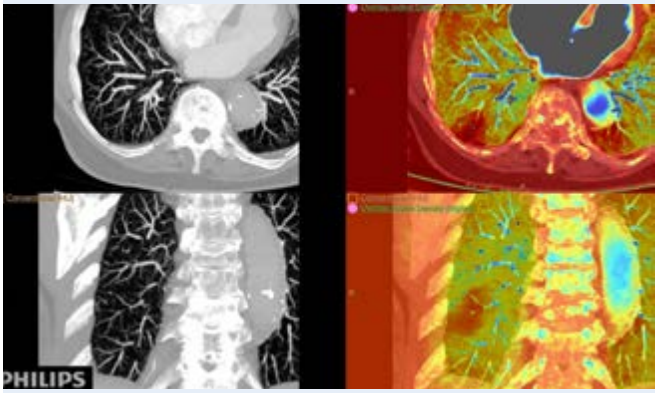
CT is the primary method for identifying a pulmonary embolism (PE); however, small PEs are often difficult to identify on a conventional CT scan.

The solution

At the University Clinique Louvain (UCL) in Brussels, Belgium, an elderly patient complaining of chest pain and shortness of breath was scanned using the IQon Spectral CT.

The outcome

Radiologists then reviewed the fused Z effective spectral results, which demonstrated a perfusion defect in the right lower lung. This allowed radiologists to retrospectively identify the small PE in the right lower lung corresponding to the perfusion defect and confidently guide the patient's subsequent course of treatment.[24]



Fused Z effective images demonstrating the perfusion defect in the right lower lung.

Three: Simplify data and insight gathering

Optimizing performance across the enterprise

The World Health Organization states that though most of the world's health-care providers and system administrators have not been trained in data science, implementing big data strategies could ultimately enable more precise management of individuals and improve the health of entire populations.[25]

> **...we have a need to get real-time analytics to be able to react in real time** and improve our flow, improve our patient throughput and improve our patient experience. One way Philips can help is by harvesting and harnessing the information that is already in Philips products and getting them to us in a much easier interface."[26]
>
> James V. Rawson, MD, Chair of Department of Radiology and Imaging, Medical College of Georgia

Until now, collecting the data to drive performance improvement across the imaging department was the charge of radiology administrators and chiefs. Today, data generated by disparate systems from multiple vendors and across separate facilities and services has made tapping into the data that would drive operational improvements an uphill battle.

Healthcare organizations are overloaded with data. From electronic medical records, to picture archiving and communications systems (PACS), to clinical databases and billing systems, vital data is often distributed and sequestered across multiple departments and applications. This creates a difficulty in compiling a comprehensive, longitudinal view of patients and populations.

Garnering meaningful insights from these various sources is an overwhelming challenge characterized by information overload. For most departments, it's a struggle to keep up with daily clinical and administrative duties, let alone paradigm-shifting technological advancements. Staff often lack the appropriate infrastructure to tap into existing data solutions offered

by the technology they already have. Many struggle to measure and report on the compliance and outcomes data related to quality, performance, efficiency and workflow metrics that determine their overall funding and staffing needs.

What if we could simplify clinical and operational data in a way that puts actionable information in the hands of those that need it, when they need it? What if we could aggregate that data to address current state problems and help imaging departments plan for the future? What if we had tools to support the unique needs of individual organization and their patients? This is where we need to focus innovation.

The primary objective of Philips' PerformanceBridge Practice is to give our customers an enhanced edge by providing information and directional support to assist department leadership in decision-making, help radiology practices adapt to continuous change, and drive value for the overall healthcare system. This solution uses data intelligence and imaging expertise to spotlight what radiology departments need to transform their practice, improve the patient experience, and make their workflow more efficient. The offering is vendor agnostic and can be tailored for radiology practices of all sizes.

Breakthrough innovation to simplify insights

By merging data with clinical experience at the modality level, Philips is innovating the development of real, actionable solutions in low-acuity as well as emergency situations. In oncology patients, for example, the Philips IQon Spectral CT system can enhance diagnostic confidence by allowing complete (morphological and functional) assessment of lesions.

Making the case: **Streamlining data sources to improve patient care**

The problem

Across many different modalities and high-traffic areas of their service, Lahey Hospital and Medical Center's radiology department needed technology to support a timely and effective report that accurately informs an expedited diagnosis for patients.

The solution

At Lahey Hospital and Medical Center, radiologists are using the Philips IntelliSpace PACS, a workflow management system that allows quick access to images from multiple modalities and can easily streamline workflow and enhance patient care.

The outcome

The department has been able to pair the system with critical tools at the workstation level, allowing radiologists to produce more effective and actionable reports for clinicians.[27]

With quick, easy access to images from multiple modalities, unconstrained by your location, IntelliSpace PACS has the power to transform workflow and enhance patient care

Global healthcare spending is expected to reach

$8.7 trillion by 2020,

from $7 trillion in 2015[28]

Deloitte 2017 global health care sector outlook

Four: Reduce costs

Previously a main source of revenue for many health systems, radiology departments are increasingly being asked to justify their challenging capital equipment demands in the context of value-based care. As global healthcare spending continues to rise, so does the demand for health systems to do more with less.[29] Declining reimbursements for imaging studies and the rise of outpatient facilities further add to the disruption, burdening radiology departments with fewer financial resources to deliver the quality care patients need.

For CFOs, radiology poses a big target for cost reductions, though identifying opportunities for cost reduction beyond equipment purchase and service remains elusive.[30] To be viable in a value-based world, administrators have to move beyond traditional capital/operating expense discussions in their search for value. Every element of the radiology value chain must be scrutinized for opportunities to either reduce cost or increase value – from the individual system focus to the fleet, facility, and enterprise level.

Identifying sources of untapped value and waste

Implementing corrective measures at an operational level can help move the needle on cost and value. With almost all operational costs residing in staffing, training and increased throughput, reducing costs to existing systems is certainly feasible.

But beyond operational support at the systems level, there's an opportunity for innovation to bring down costs related to variation and standardization of image acquisition, image quality, and image processing. Establishing overall efficiency and repeatability in imaging holds the promise of significantly improved efficiency and accuracy of diagnosis, which turns into substantial savings for the health system.[31]

Integrating costly, state-of-the-art technology adds a whole new level of complexity to the imaging department. While we've all been conditioned to believe that "cutting-edge" technologies automatically result in better diagnoses, the reality isn't that simple. Often these "enhancements" are not intuitive enough to meet the needs of an already overburdened team of technologists; the added costs associated with new equipment as well as the resources required to appropriately train staff make the return on investment questionable.

This is not to say that innovation doesn't matter: it is critical. But to be meaningful, it must be aligned to the needs of all participants in the imaging journey. The balance of innovation and value is critical, especially when we consider that many imaging departments around the world deliver the most basic of imaging techniques, regardless of the equipment's level of sophistication. So imagine if R&D efforts were fully focused on democratizing the process. The easier the

> **"If you can't measure how you're performing, you really have little ability to influence factors like patient experience."**[32]
>
> Perry Kirwan
> Vice President of Technology Management Banner Health System

path to the right image, the less pressure could be felt by staff, the radiologist and most importantly, the patient. Getting that image right the first time could reduce the time to diagnosis, waste due to rescans, burden on the staff and inconvenience to the already stressed-out patient.

So if innovation for innovation's sake isn't the answer, what is? We're focused on purposeful innovation in such areas as adaptive user interfaces and machine learning, standardized exam cards, on-demand remote support, and other automated design features that can help technologists acquire the right image, based on specific patient needs, the first time around. On top of this, we're pursuing ever-smarter software applications that support patient irregularities and artifact reduction; innovations such as free-breathing MRI applications that let patients breathe normally during abdominal exams, fat-suppression applications, or techniques that help in increased visualization of soft tissue and bone in the near vicinity of MR-conditional orthopedic implants hasten our progress toward image quality goals.

Making the case: **Data-driven cost savings**

The problem

Highly variable imaging exams make optimal scheduling an issue for hospitals. This can negatively impact the patient experience and increase operational costs for longer exams. Hospitals need a way to automatically identify which imaging exams take longer and have higher variability, so they can account for these discrepancies in scheduling.

The solution

Our solution was to identify target protocols by looking at the hospital's MRI volume and scan durations. We utilized machine log files to obtain accurate information and update protocols accordingly, resulting in a reduction in exam duration.

The outcome

There was a 20% reduction in time per exam, which is expected to generate significant cumulative cost savings over time. The learnings from this process have changed the way the hospital schedules exams.[33]

Summary

Imaging remains at the heart of healthcare delivery. The work done in the radiology suite informs clinicians on the decisions and treatments that save patient lives. There's no question that the value of imaging and the role of radiologists and their teams must be improved to better handle a complex, ever-changing health environment.

Philips is unraveling the complexity of imaging to empower healthcare providers to deliver an accurate diagnosis and a better experience to patients right from the start. We recognize the central importance of alleviating the stress of every person in the imaging ecosystem, and our innovation teams are inspired to solve it. Taking this approach helps us enhance the value of imaging throughout the continuum of care, because it asks us to focus on one key component: improving patient outcomes.

Innovation can no longer be about "nice-to-have" technology features that benefit small segments of patients and physicians. Purposeful innovation today lies in enabling a process that delivers repeatable and reproducible outcomes that touch more lives, at a faster rate. By focusing innovation on the things that matter most to the radiology community – and expanding the definition of innovation to encompass the clinical, operational, and financial dimensions of these challenges – we can solidify the rightful role of patient-centered imaging in today's health world. Philips has over a century of creating and driving innovation by partnering with clinical leaders and health systems to meet emerging needs. Together, we can shepherd a new age of innovation, one that transforms healthcare by focusing on the people behind the image and getting it right from the start.

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