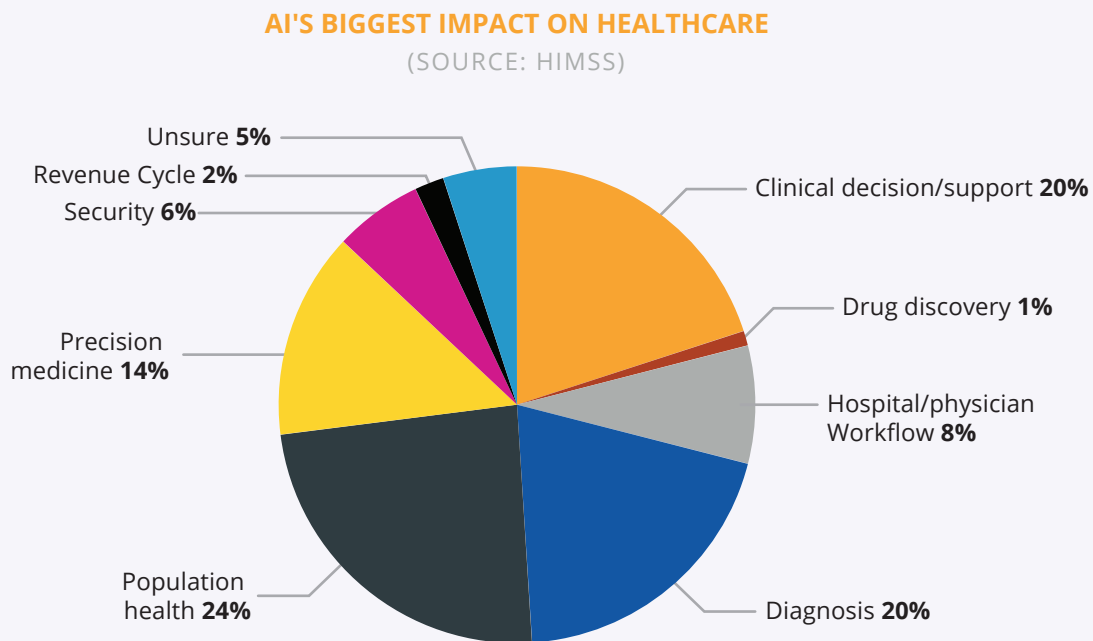AMBRA™

EXECUTIVE BRIEF

Applying Artificial Intelligence to Medical Imaging

Three Techniques to Tap into Artificial Intelligence and Machine Learning — from Radiology to Cardiology

Executive Summary

Welcome to the latest wave of innovation in healthcare. Advanced healthcare technologies, like artificial intelligence and machine learning, are in the early stages of rapid adoption. According to a 2017 HIMSS survey, about 35 percent of healthcare organizations plan to use artificial intelligence within the next two years, and over half within five.

AI'S BIGGEST IMPACT ON HEALTHCARE
(SOURCE: HIMSS)

Unsure **5%**
Revenue Cycle **2%**
Security **6%**
Precision medicine **14%**
Population health **24%**
Clinical decision/support **20%**
Drug discovery **1%**
Hospital/physician Workflow **8%**
Diagnosis **20%**

The impact is expected to be far reaching: from population health, to aiding patient diagnosis, clinical decision support, precision medicine, and helping direct hospital and physician workflows. For radiologists and other specialties that work with imaging day in and day out, artificial intelligence has the potential to provide significant benefits.

For example, with the growth in imaging, it's become a challenge for radiologists to deal with the increased volume and focus on the right studies. It's why the most commonly cited use case for AI is helping process images, detecting patterns to reduce workloads.

But how do you start applying the latest technology to imaging? Partnering with healthcare industry AI and machine learning experts at Blackford Analysis, Realize Ai, and DiACardio, we've put together this guide, with three practical ways for you to get started, from improving radiology and detection workflows, utilizing deep learning techniques, and enabling real-time interpretation of echocardiography tests.
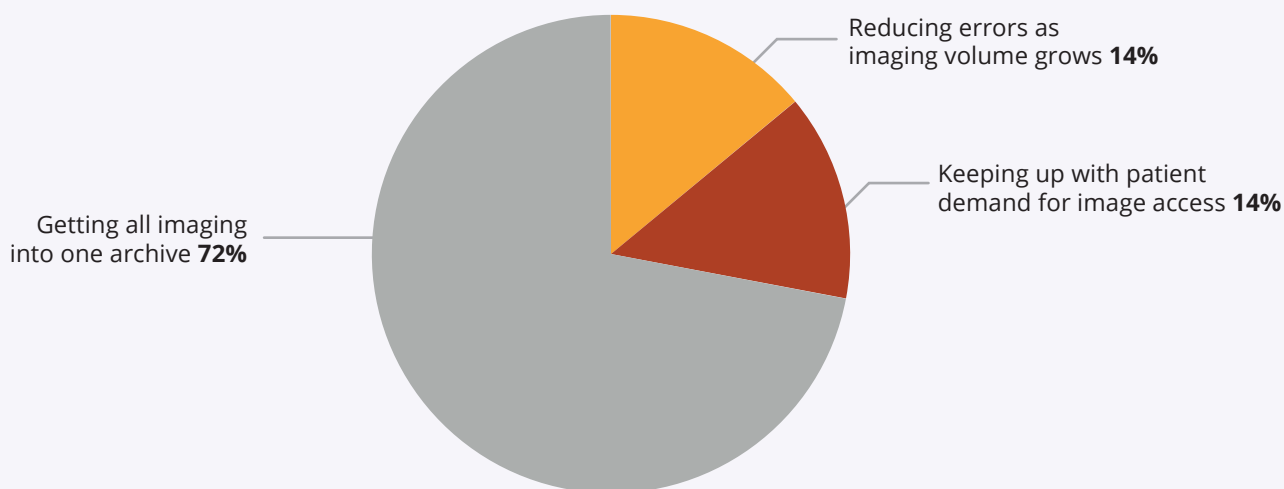
Where to Start?

APPLYING AI TO IMAGING BEGINS WITH IMAGE MANAGEMENT

The latest machine learning, deep learning, and workflow automation technology can accelerate interpretation, improve accuracy, and reduce repetition for radiologists and other specialties. We'll share specific examples later in this guide. However, the truth is most departmental PACS and archiving systems still don't provide the underlying infrastructure that enables these technologies to thrive.

Interpreting and analyzing images requires the easy access and free flow of imaging to work effectively, but studies are still often buried on CDs, file servers, or multiple hard to search locations, putting them out of reach of the latest processing algorithms. It's just one of the reasons why organizations are focused on consolidating and integrating imaging into one archive —to turn it into a strategic asset.

WHAT IS YOUR MAJOR IT/TECHNOLOGY GOAL FOR YOUR PRACTICE/FACILITY?

(SOURCE AMBRA SURVEY, N=200)

Reducing errors as imaging volume grows **14%**

Keeping up with patient demand for image access **14%**
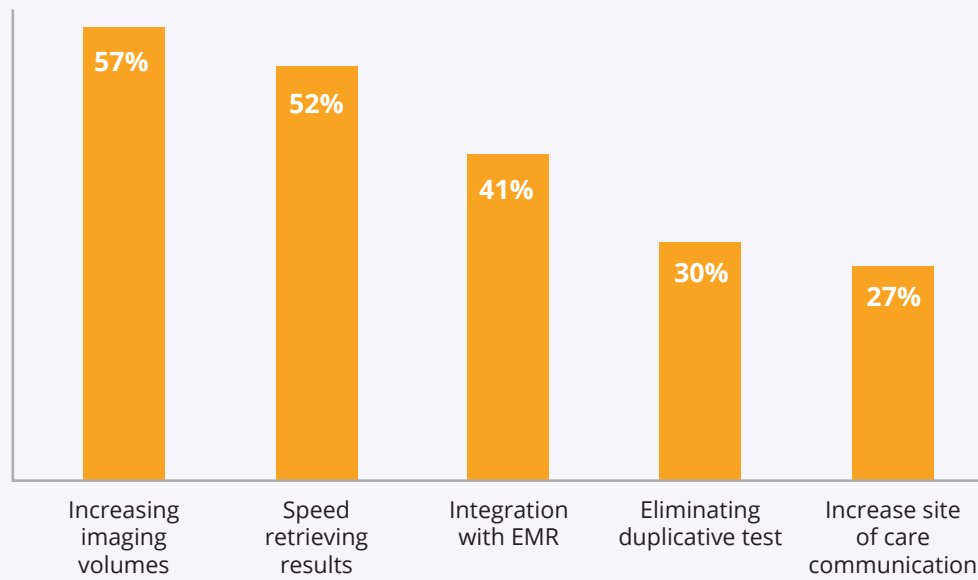
Getting all imaging into one archive **72%**

The Drivers Behind the Image Management Upgrade

A recent survey by The Advisory Board found multiple drivers behind organizations upgrading their image management technology: increasing imaging volume, a focus on speeding the retrieval of results, integrating imaging with new EMR/EHR applications, and the pressure to reduce duplicative tests, especially with the transition to value-based care. These are all drivers behind private practices, health systems, imaging centers, and specialties upgrading their PACS and on-premise VNAs.

TOP 5 DRIVERS BEHIND IMAGING TECHNOLOGY TRANSFORMATION
(SOURCE: IMAGING TECHNOLOGY PURCHASING PATTERNS, THE ADVISORY BOARD, MARCH 2017)

Increasing imaging volumes	Speed retrieving results	Integration with EMR	Eliminating duplicative test	Increase site of care communication
57%	52%	41%	30%	27%

The Foundation for Imaging Innovation

THE DECONSTRUCTED PACS

In an increasingly distributed healthcare systems, all-in-one traditional PACS system have become increasingly hard to integrate with newer healthcare technology like EHRs and Healthcare Information Exchanges (HIEs). They've also struggled to meet a desire for mobile, universal viewing. A deconstructed PACS addresses these issues by allowing components of a PACS system – archiving, viewing, & exchange – to be separated and even provided by different vendors to maximize interoperability.

Deconstructed PACS enable customized workflows, hybrid storage models, and universal viewing.

CLOUD VENDOR NEUTRAL ARCHIVE

VNA is designed to be a long-term archive, a central repository for housing images from a variety of systems. A Cloud VNA takes the capabilities of a traditional VNA further by providing a flexible framework over the internet in which images can be transferred, viewed, and patient imaging and data can be joined together, enabling a holistic patient health record by unifying reporting and imaging.

Because Cloud VNAs are designed for the internet, they provide important additional benefits like ease of image transfer, custom branded portals to share imaging with referring physicians or patients, mobile medical image viewers that can be accessed directly from within the EHR patient jacket, and integration of imaging with the latest artificial intelligence and machine learning technology.

- ✓ Independent of PACS
- ✓ Patient-centric
- ✓ Designed for the internet
- ✓ Automated workflow & routing
- ✓ More than just DICOM images
- ✓ Mobile viewing
- ✓ EHR integration
- ✓ Image enable patient and physician portals
- ✓ Continuity of care when PACS is down
- ✓ Platform to integrate imaging with ML/AI

Applying Intelligence to Imaging

So, what are some of the areas where you can apply the latest image analysis, artificial intelligence, and machine learning technology to patient studies? We share some of the most promising areas below.

#1 IMAGE COMPARISON AUTOMATION FOR RADIOLOGY

Radiologists are facing increasing numbers of images per study, increasing numbers of prior studies, and decreasing reimbursement. As a result, it is becoming more and more challenging to meet productivity requirements while maintaining diagnostic accuracy. A practical area to apply technology to the problem is by using algorithms to automatically align current and prior exams for instant comparison of multiple studies to improve overall radiologist productivity.

By embedding intelligence in a Cloud VNA, radiologists can use technology to automate radiologist navigation workflows to the same location across a series. So, when looking at one or more priors for a patient, radiologists can speed up the process of finding that same location in previous studies.

" Early adopters have seen significant productivity gains with between 10% and 20% improvement in overall radiology departmental productivity."

— BLACKFORD ANALYSIS

Early adopters have seen significant productivity gains with between 10 and 20% improvement in overall radiology departmental productivity. Using automation of common workflows, other reported benefits include the reduction of Repetitive Strain Injuries for radiologists. Around 60% of radiologists reported they have RSI in the wrists, in a recent report by Health Imaging, and 45% of those were due to scrolling through different image series to try and find relevant locations. Automation can help.

EXAMPLE APPLICATION

For example, patients with endovascular repair of aneurysms are routinely followed-up with an annual multiphasic CTA to assess changes in aneurysm sac size and morphology, and detect and characterize endoleak, graft migration, fractures, and kinking. A small increase in sac size indicates endoleak, but reproducing surveillance measurements at the same locations can be challenging, particularly when vascular anatomy is tortuous or the aneurysm sac is irregular in shape or size.

By enabling automatic simultaneous side-by-side like-for-like presentation of MPRs across exams and contrast phases, compared MPRs can be displayed with matching planes and displayed field of view and thickness, allowing reproducible measurements, rapid appreciation of change in aneurysm size and morphology, and determination of graft migration using the same anatomical landmarks.
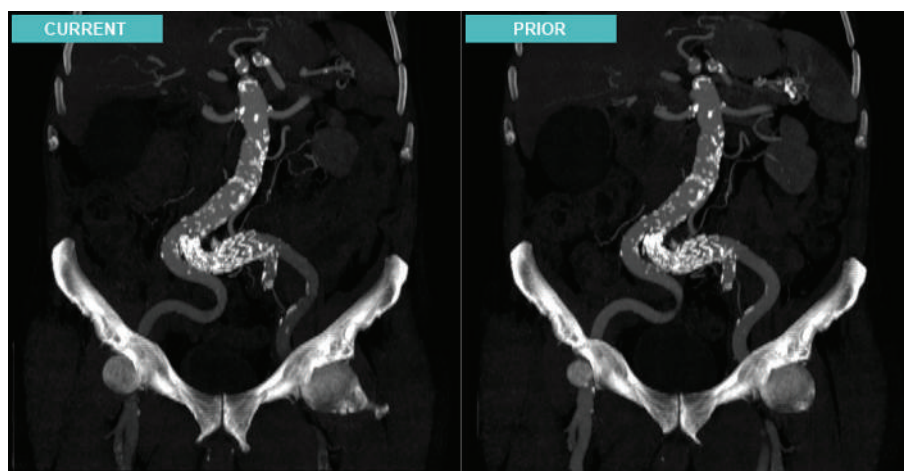
Machine learning technology can be used to instantly compare multiple studies in a series.

#2 DEEP LEARNING COMPUTER AIDED DETECTION FOR RADIOLOGISTS

Deep learning is considered one of the breakthrough technologies of the decade. It's a new area of machine learning research, which has been introduced with the objective of moving the state of the art closer to one of its original goals: Artificial Intelligence. The basic idea is that deep learning based algorithms can simulate a large array of neurons in an artificial "neural network," ideal for recognizing patterns in images, sounds, and other data.

EXAMPLE APPLICATION

One application of deep learning is for performing lung nodule detection. By training the deep learning based model on hundreds of thousands of real scans, and what a panel of radiologists said about those scans, the results have been promising. Deep learning leaders like Realize Ai are reporting their algorithms are currently performing at about a 5% missed lesion rate, with a rate of 2 false positives per scan in CT lung nodule detection, compared to 23-33% missed lesion rate from leading FDA approved alternatives that are not based on deep learning.

> **Deep learning algorithms are currently performing at about a 5% missed lung nodule lesion rate, compared to 23-33% missed lesion rate from leading FDA approved alternatives.**
>
> — REALIZE AI

Applying Deep Learning to Lung Nodule Detection.
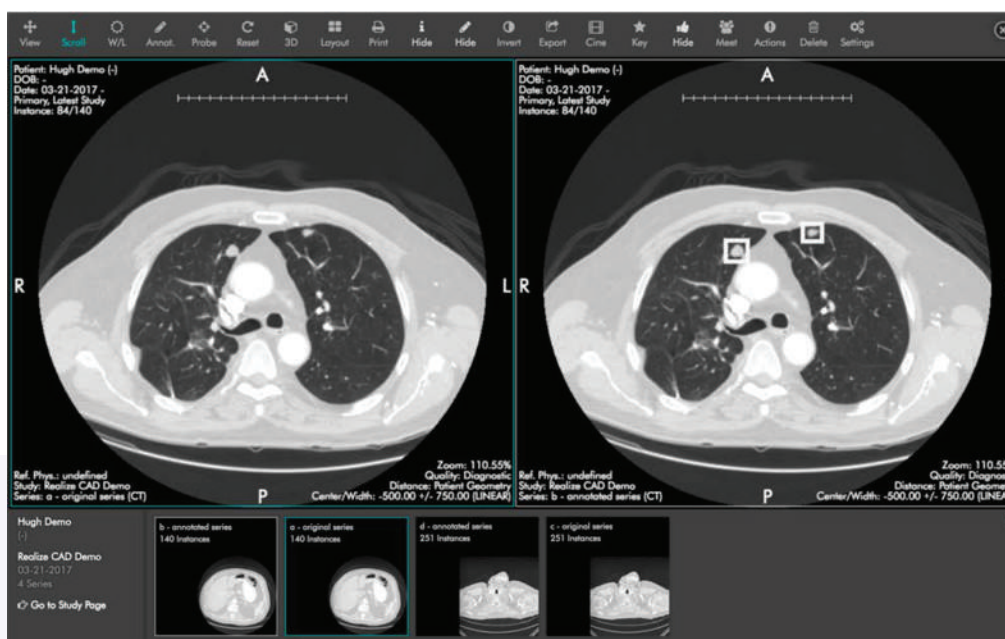
Other opportunities for deep learning include detecting pulmonary embolisms in CT scans, prioritizing to the top of the queue so that a radiology can look at them immediately, giving that report back to the emergency room physician, and facilitating faster treatment.

#3 PATTERN RECOGNITION TO OPTIMIZE ECHOCARDIOGRAM EVALUATION

Advanced pattern recognition and machine learning algorithms can also be applied to identify borders and motion —ideal for evaluating the heart. Ultrasound imaging of the heart, or Echocardiography, is the most widely used imaging technique for evaluation of cardiac heart function.

According to DiACardio, approximately 15 million echocardiography procedures are carried out worldwide each year. Yet the most common way to evaluate the echo function of the heart is by eyeballing, just looking at the image, evaluate it from experience, and identifying what exactly is going on. This all depends on the varying skill and experience of medical staff.

EXAMPLE APPLICATION

The latest technology, such as DiACardio's LVivo's image processing technology, has been tested successfully based on data collected from more than 400 patients with various degrees of LV function. It enables a fully automatic dynamic analysis of the heart in action, including full automation of both tracing and analysis processes - performed nearly instantly —across the complete heart cycle. Pattern recognition algorithms can track the LV border in each frame of the cardiac cycle, automatically calculate LV volumes, accurately identify End Diastolic (ED) and End Systolic (ES) frames, and calculate the EF of every recorded beat, all performed within a few seconds.
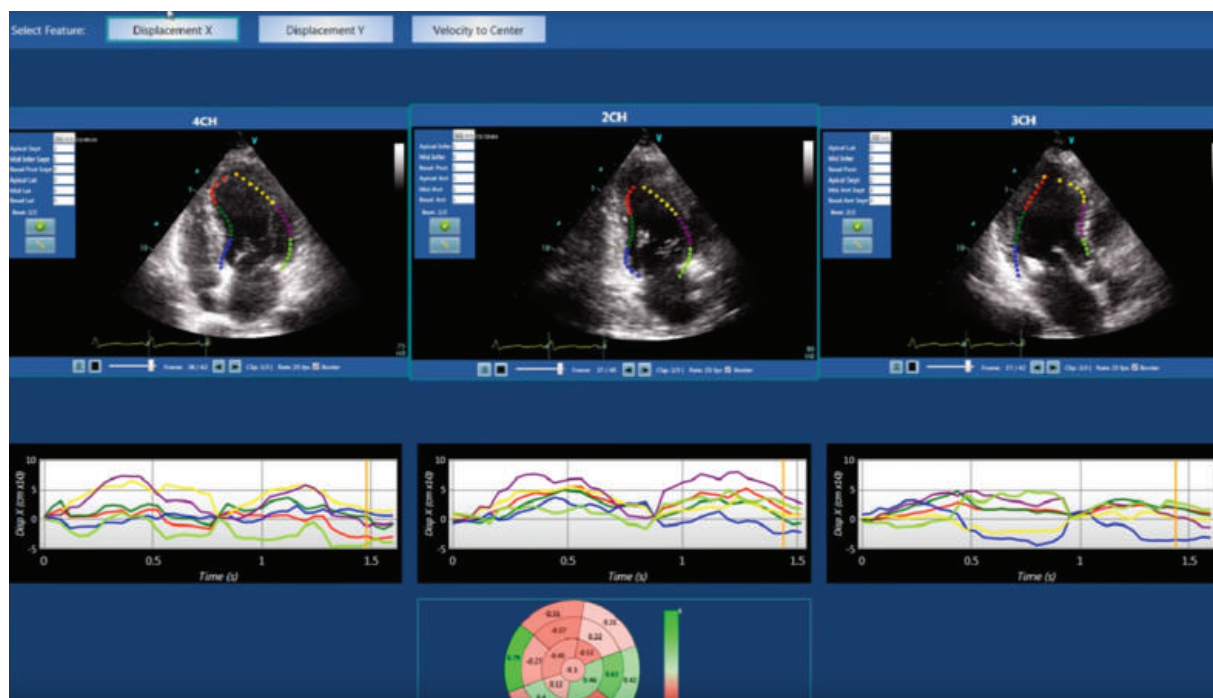

Using Image Processing to Enhance Echocardiogram Evaluations

Summary

Healthcare is one of the first industries to materially benefit from advances in artificial intelligence, and imaging is consistently a top area within healthcare where this new technology can be applied. Priming patient imaging to benefit from these innovations means laying a new image management foundation — that integrates imaging across PACS silos, connects studies with new EMR/EHR investments, and provides imaging access for the latest artificial intelligence, and machine learning technologies.

Ambra's Cloud VNA provides a platform that enables a connected archive that improves mobility, access, routing, and business continuity, while ensuring providers can deploy the latest AI innovations like those from Blackford Analysis, Realize Ai, and DiACardio with confidence so that they can be applied to patient imaging easily, friction-free, and in real-time.
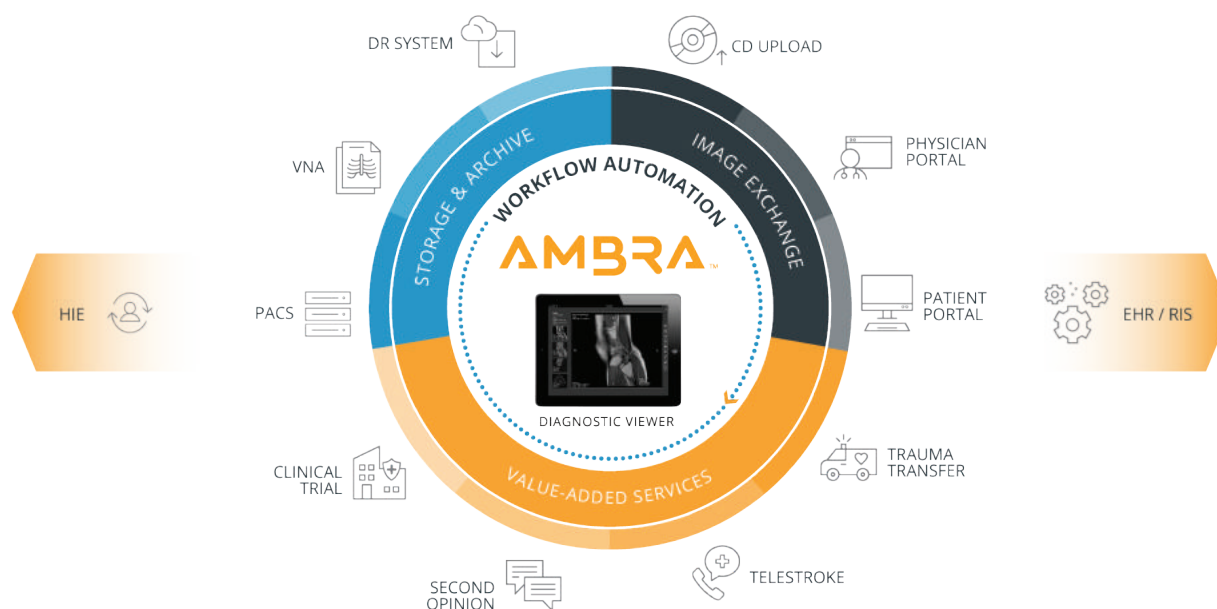
ABOUT AMBRA HEALTH

Ambra Health is a medical data and image management SaaS company. Intuitive, flexible, scalable and highly interoperable, the Ambra cloud platform is designed to serve as the backbone of imaging innovation and progress for healthcare providers. It empowers some of the largest health systems such as Memorial Hermann, Stanford Children's Health and New England Baptist Hospital as well as radiology practices, subspecialty practices and clinical research organizations to dramatically improve imaging and collaborative care workflows. As expert partners, we listen to our customers, understand their needs, and apply our extensive knowledge to deliver innovative medical image management solutions for the future of healthcare, now. Discover what the Ambra medical imaging cloud can do for you at **ambrahealth.com**.