ARTIFICIAL INTELLIGENCE IN IMAGING 2018

EARLY ADOPTERS SPEAK OUT

KLAS® | FEBRUARY 2018 | PERFORMANCE REPORT

TABLE OF CONTENTS


DISCOVER
FINDINGS
OIL
100/1.25

ARTIFICIAL INTELLIGENCE IN IMAGING 2018 | EARLY ADOPTERS SPEAK OUT

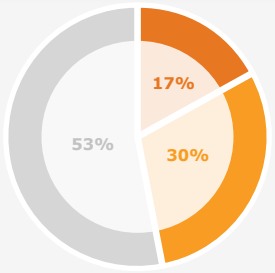
The HIT industry is abuzz with talk about artificial intelligence (AI), a broad term used to describe the use of algorithms and software to approximate human cognition in the analysis of complex data. Of all the healthcare areas with potential AI applications, imaging has received the greatest attention. Vendors and providers in this space are looking forward to using AI to improve diagnosis processes, develop treatment protocols, and personalize patient care, among other use cases. In this report, 81 healthcare organizations (primarily large IDNS) help separate hype from reality by sharing details regarding their early imaging AI deployments and plans and by identifying which vendors they see as early leaders.

State of the Market

Until recently, talk about AI in imaging has been more common than actual adoption, but progressive provider organizations and their vendor partners have begun to roll out the technology or are making plans to do so.

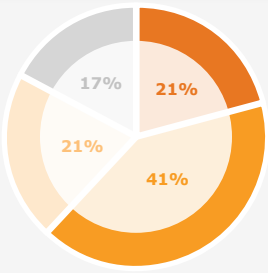
Organization Status with AI in Imaging

(n=81)



When Do Organizations Making Plans Expect to Go Live?

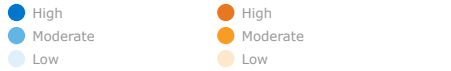
(n=24)

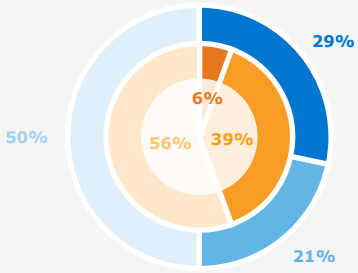


Depth of Adoption for AI in Imaging

Current Adoption (Live) (n=14)

Anticipated Adoption (Have Plans, Making Plans) (n=18)





Almost Half of Interviewed Organizations Are Live or Making Plans

Most organizations live with AI in imaging today are beta testing new technology in limited settings but have committed internal resources to further research and development. Because it is early, it is not uncommon for those live to have NDAs in place with their vendor partner. Others are actively monitoring the evolution of imaging AI, with almost one-third preparing for adoption. Those who are not live or do not have near-term plans to adopt AI in imaging say more research and time are needed to identify use cases and prove an ROI.

For Those Making Plans, Deployment Is Years in the Future

The majority of organizations who are actively planning to adopt an imaging AI strategy anticipate that they are more than a year away from adoption; just over one-third feel it will take at least three years. In the meantime, these organizations are requesting demos, discussing potential use cases with peers who are already live, and assessing the AI needs of their radiologists.

Adoption Is Limited Today, but Steady Progress Is Expected

Many organizations that are live with some form of imaging AI use the tools in a limited way and with lower adoption, typically within a single department (e.g., radiology). They are using these deployments as pilots to learn more about AI's potential. Those who are not live today expect to take a similar path, i.e., lower initial adoption in a controlled, limited setting. Both groups express the long-term desire to see AI in imaging widely deployed and deeply adopted.

Which Vendors Are on Providers' Radars?

What vendors do organizations view as best positioned to deliver AI in imaging?

Number of Live Validations

	Validations
Agfa HealthCare	1
Arterys	1
Carestream	1
EchoPixel	1
IBM Watson/Merge	4
Philips	1
Zebra Medical Vision	1
Internal development/provider partnerships	4

Additional Vendors Mentioned

	Considerations
Agfa HealthCare	2
Carestream	2
Cerner	2
GE Healthcare	6
IBM Watson/Merge	23
Nuance	2
Philips	6
Vital Imaging	2
Volpara (breast)	2
Zebra Medical Vision	6

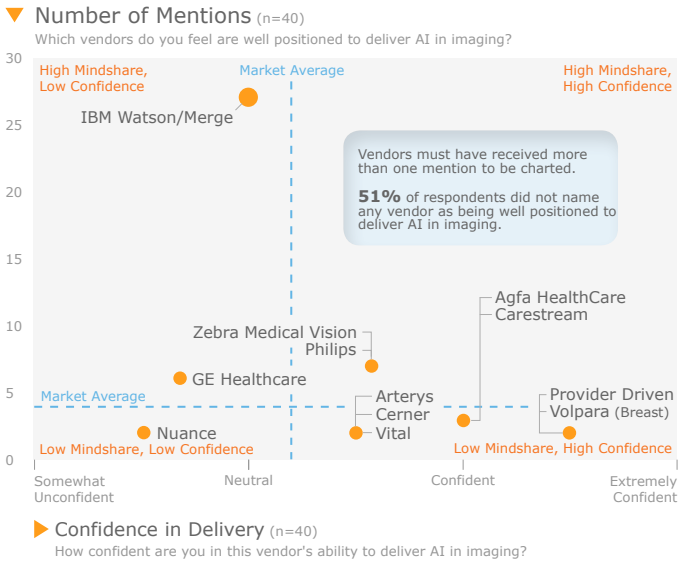
Vendors with One Mention

Ambra Health
Apple
Arterys
CancerCenter AI
Bay Labs
Butterfly Network
Entopsis
Epic
Google
HealthMine
Lexmark
McKesson
Mindshare Medical
MModal
Proscia
RADLogics
Samsung
ScreenPoint Medical
Sectra
Siemens
TeraRecon
Visage Imaging

IBM Watson's Efforts Drive Mindshare; Delivery Concerns Temper Provider Expectations

Receiving over three times the mindshare of any vendor in this study, IBM has piqued the interest of provider organizations by creating the Watson Health Imaging Collaborative, acquiring imaging vendor Merge, and commencing beta testing with development partners. Most organizations express confidence that IBM will be able to deliver a solution for imaging AI but expect that it will be years before mainstream solutions are available—they describe IBM's current progress as mostly marketing. Expectations around future delivery are also tempered by IBM's historical lack of strong customer partnerships, which some see as a potential impediment to delivery. Even among organizations currently involved in the Watson Health Imaging Collaborative, confidence in IBM's delivery is mixed. While progress is being made and IBM has committed vast resources to development, these organizations say that efforts are disorganized, current capabilities are oversold, and true delivery has yet to be seen. A handful of organizations are using IBM's early tools; reactions from these customers are also split. Some describe the development as exciting and in tune with needs, while other say it lags behind their expectations.

Mindshare vs. Provider Confidence in Delivery



Philips and Zebra Medical Vision Gain Visibility through Strong Road Maps and Partnerships

After IBM, imaging vendor Philips has made the most headway in terms of mindshare. Philips excels at sharing their road map and AI investments and has gained providers' trust through the acquisition of AI technology and through the development of PACS overlays and other tools that show competence in imaging AI. Zebra Medical Vision has piqued interest through partnerships with healthcare organizations, Google Health, and others, leading many to see them as committed to imaging. The vendor's comparatively small size has contributed to the view that they are nimbler than larger players and will be able to develop and adapt well in a rapidly changing market. GE Healthcare's extensive footprint in imaging has many organizations interested in what GE Healthcare has to offer, and providers point to a strong sales team and portfolio depth as the vendor's strengths. However, confidence in GE Healthcare's ability to deliver is lower due to the vendor's history of stagnant development, lack of strategic relationships with customers, and challenges deploying enterprise imaging technology.

Provider Perspective on Early Imaging AI Leaders

IBM Watson/Merge

"I think IBM has a lot of resources to throw at the AI problem, so that gives them a bit of an advantage over niche companies. However, I don't feel that IBM has done much to move beyond their marketing pitch. I am also not sure they really understand the imaging world the way they need to in order to really blow this thing out of the water. If we have learned anything from doing enterprise imaging, it is that we need a real partner to expand and be successful. That is not what IBM is known for, so I don't know that they are really set up to be successful."
—Director of Radiology

Philips

"We speak with and work with Philips regularly to get updates for the system. They talked with us recently about their road map. Philips tries to avoid heavily marketing things that aren't real. In that way, we have appreciated Philips' approach."
—VP of Imaging

Zebra Medical Vision

"I have looked at Zebra Medical Vision; I don't have much experience with them, but I do have some confidence in them based on the people they have been able to partner with in the imaging space. I think they have done a nice job of focusing on what imaging-specific issues need to be tackled. Even though artificial intelligence in imaging is still new, Zebra Medical Vision is a vendor to watch."
—VP of Imaging

GE Healthcare

"GE Healthcare has touted AI for a long time, so they are under the spotlight. They need to make something happen if they want to back up that hype. They are doing some things already, but it isn't where they expected it to be."
—Director of Radiology

Will the Most-Mentioned Imaging Vendors Deliver? A Historical Look at Vendor Performance

Of all the vendors that organizations view as best positioned to deliver AI in imaging, traditional imaging players are mentioned most frequently. A look at these vendors' development and delivery histories offers insight into their potential ability to meet providers' expectations for AI in imaging.

	Delivery of New Technology† (●>8.0 ●7.1–8.0 ●6.1–7.0 ●<6.1)	Bottom Line on Innovation
Agfa HealthCare PACS, cardiology, VNA, universal viewer	●	Weaker history of development in legacy products, with functionality meeting only customers' minimum requirements. Early adopters of new platform are pleased, but adoption is still early.
Carestream PACS, VNA, universal viewer	●	Development meets customers' needs. Has consistently delivered over time and has moved into imaging spaces beyond PACS. Customers are optimistic about the future.
GE Healthcare PACS, cardiology, VNA, universal viewer, advanced visualization	●	History of slow development, poor delivery, and lackluster functionality. Few customers can articulate GE Healthcare's development road map, and many often replace the vendor's offerings with more developed solutions. Still frequently considered in new imaging deals due to name recognition, strong sales teams, and portfolio breadth.
McKesson PACS, cardiology	●	PACS development is strong, though innovation in other areas can be slow and often does not meet customers' expectations. Customer optimism around future development has been mixed since Change Healthcare's acquisition of McKesson.
IBM Watson/Merge PACS, cardiology, VNA, universal viewer	●	Functionality is not as highly rated as some niche vendors', but most customers say their needs are met, development is consistent, and they are confident in vendor's development strategy. Wide adoption for multiple areas in enterprise imaging. Largest mindshare in imaging AI.
Philips PACS, cardiology, advanced visualization	●	Functionality meets most basic needs, but development speed lags and bugs are frequently reported. Many are optimistic about moving to Philips' IntelliSpace platform and express particular confidence in Philips' AI development.
Sectra PACS	●	History of delivering to customers' functionality and development expectations. Excels at meeting radiologists' needs. Successfully developing beyond PACS, but adoption is minimal. Customers are optimistic about the future.
Siemens PACS, cardiology	●	Software development lags significantly behind the imaging market. Functionality gaps, an unclear road map for customers, and a perceived lack of focus on development have many unsure about Siemens' future in imaging IT.

† Average "delivery of new technology score" for each vendor across PACS, cardiology, VNA, universal viewer, and advanced visualization. Not all vendors are measured in each space. Scores are as of January 2018 and reflect the last 12 months of ratings collected by KLAS.

What Should Providers Look for in a Vendor to Be Successful?

Over the last 20 years, KLAS has watched many emerging spaces gain momentum only for vendors to fail to deliver on the market's expectations. Where there is success, there are typically several key vendor attributes present. By looking to partner with vendors who exemplify these traits, providers can begin their imaging AI journey on the right foot.

Crystal Clear Expectations

One of the primary reasons providers are left unsatisfied with new technology is that their expectations go beyond a vendor's ability to deliver. A clear discussion about what outcomes will be achieved, when those outcomes will be realized, and the steps that both the customer and vendor need to take to realize the outcomes is key. An excellent vendor will not only set clear expectations with potential customers but also ensure that all the modules and services customers need to be successful are part of the initial sale.

Proactive, Strategic Relationships

In emerging spaces where new use cases are rapidly developing and best practices are being discovered, ongoing communication between vendors and customers is essential. Vendors who excel in this area foster strong relationships by providing dedicated account management, proactively sharing use cases and other insights, and deeply understanding their provider partners.

A Central Focus on Training

Quality of training is one of the best predictors of customer satisfaction, affecting usability, adoption, and perception of a system's functionality. Unfortunately, training (particularly ongoing training) is often taken off the table by vendors during contract negotiations to lower the purpose price. Top-performing vendors who take steps to remove financial barriers to training, pair end users with trainers who have a similar background, and provide healthy follow-up training are most likely to have satisfied customers.

Strong Data Governance

Strong data governance can make or break an imaging strategy. Starting early and making this a priority can be the difference between realizing a tangible ROI and sinking resources into a failed project. Those live with an AI strategy today emphasize the role governance played in their success, and they encourage their peers to ensure data governance is a priority by involving key stakeholders across multiple areas/departments and leveraging best practices from other organizations and vendors. Vendors can encourage customers to tackle governance and even provide suggestions and useful industry connections to facilitate customer efforts.

●>8.0 ●7.1–8.0 ●6.1–7.0 ●<6.1 Average score for each vendor across PACS, cardiology, VNA, universal viewer, and advanced visualization. Not all vendors are measured in each space. Scores are as of January 2018 and reflect the last 12 months of ratings collected by KLAS.

How Well Do Imaging Vendors Set and Deliver on Expectations? (Keeps All Promises, Product Works as Promoted)

- Sectra
- Carestream
- McKesson
- Philips
- IBM Watson/Merge
- Agfa HealthCare
- Siemens
- GE Healthcare

How Well Do Imaging Vendors Build Relationships? (Phone/Web Support, Proactive Service, Executive Involvement)

- Sectra
- Carestream
- Agfa HealthCare
- McKesson
- IBM Watson/Merge
- Philips
- Siemens
- GE Healthcare

How Well Do Imaging Vendors Train End Users? (Quality of Training)

- Sectra
- Carestream
- McKesson
- Philips
- IBM Watson/Merge
- Agfa HealthCare
- Siemens
- GE Healthcare

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KLAS' mission is to improve the delivery of healthcare technology by independently measuring and reporting on vendor performance.

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SUPPLEMENTAL EVALUATION COMMENTARY

Questions Asked in Supplemental Evaluation

What plans does your organization have to use artificial intelligence (AI) in imaging?

What vendor(s) are best positioned to deliver AI in imaging? Why?

What plans does your organization have to use artificial intelligence (AI) in imaging?

We have dabbled a little in the area of machine-learning enterprise imaging. I haven't seen an artificial intelligence solution that is ready to rock and roll yet. So far, the tools have all been very rudimentary. However, all work in AI is good. It is not rocket science to do simple stuff in the AI field. We have a lot of standardized images for various activities, and we are trying to see how reliably we can recognize patterns in CAD images. We have a lot of CAD vendors in this area, so looking at the benefits of developing machine learning versus CAD is something that needs to happen in the imaging industry. I like the idea of using machine learning on top of CAD; the two things together would be more powerful than either one by itself.

We are looking at CAD solutions first, but lung solutions are also very important. We have a huge volume of imaging data to review, and we risk missing something when we try to review as many as 250 chest x-rays too quickly. I think it would be nice to have something automated that could take a second look at the images and flag the images that we should look at again. We really need some functionality that can track what we do. The EMR and the VNA need to interact and let the user work whenever the user gets everything right but let the user know when he or she may have missed something.

We have CAD for mammography, but that is about as much artificial intelligence as we have implemented. We haven't done any machine learning. We really do not have a budget or the resources for that kind of thing.

Any vendors that are partnered with IBM can have artificial intelligence. Outside of IBM, vendors don't have AI technology; they would have to partner with IBM to get that technology.

Most PACS products are just now getting BI functionality. Providers are running reports on things like dose usage, radioactive exposure, and gate times. We are starting to capture that kind of data for BI reports. Actual machine learning is a few steps beyond BI functionality in PACS products. Most vendors do not offer machine learning in their PACS on their own; they have to partner with someone to get that kind of technology.

There is a huge difference between BI and both artificial intelligence and machine learning. Machine learning and AI functionality allow a system to actually look at, let's say, 10,000 chest x-rays and 10,000 chest x-ray reports. Then, those functionalities can use a chest x-ray to interpret a patient's condition based on what the system saw in the 10,000 x-rays and x-ray reports. Machine learning and AI functionality allow a system to actually read the data within an image. That is very different from business analytics, which largely involves taking data points that are captured through basic clinical workflows.

We have been watching and working with or talking to quite a variety of AI deep-learning and machine-learning vendors. We are working with 3D printing and virtual reality, but we don't have any active projects underway. We have done a few tests and there is a pilot underway, but there are no active projects. The pilot is with a company called EchoPixel.

We read a lot about artificial intelligence, and everyone talks about it. I don't see any widespread implementation, and other technologies like CAD have been around for a long time. The good radiologists don't change the readings based on the tools that I provide. That is a great secondary tool, but it hasn't made a big impact.

There are different levels of artificial intelligence. We have software now that categorizes breast density, and that has some potential. The marketing for that will start to pick up.

AI will help with chest CT scan interpretations and occupational health exposures because they can be tedious. There are very few readers for that. I have to send our occupational exposure images somewhere else. Our new partners will help with that, but we have to send our studies to another location with a specific reader. It would be helpful to have a tool for that workload, but I am not sure that PACS vendors will pick up that technology. It would be easy to market, but no one does that yet.

We have some artificial intelligence integrated into our clinical workflow for reading CT scans of the chest, abdomen, and pelvis. When a CT scan is done, it goes to CARESTREAM Vue Motion, and the system sends a copy to our third-party server by another vendor. That vendor has algorithms that read the CT scans for different findings, such as emphysema, coronary artery disease, fatty liver, and bone density. We will do more findings in the future. We hope to add more in the coming months for compression fractures and brain bleeds. We expect our library of algorithms to expand.

Our app reads the images. When the radiologists open studies on the worklist, there is a widget on the screen. If the findings are normal, the widget is green so that the radiologists immediately know there are no positive findings. If there are positive findings, the widget is red, and the radiologists click on the icon to reveal the findings. They can then copy and paste the canned text into the reports. There is a link between CARESTREAM Vue Motion and our server, and that link has been working well. As far as our needs go, we just need more robust and impactful algorithms. However, we are using artificial intelligence, and that is a good start.

Carestream demonstrated on artificial intelligence for imaging, and they are the only vendor that I am aware of that offers some AI solutions to imaging. Our department chair was very impressed with some of the AI functionality directed at report accuracy, although we haven't implemented any of that functionality yet. It sounds like moving toward incorporating AI in imaging, though.

We were moving toward the NLP functionality for CARESTREAM Vue Archive, but some of the advantages of using artificial intelligence for error detection in reports have caused us to rethink that. If using AI functionality helps us save money and allows us to retire our old system, then we will probably implement it in the coming year.

We probably won't be on the leading edge of artificial intelligence in imaging. We are starting to identify which company to partner with. I haven't seen anything from Carestream that I would consider to be AI technology. We are considering a company called DeepRadiology. There are so many variations of what AI means. We will be going forward with AI technology as soon as we can find a vendor who is far enough along in developing that technology, and we anticipate that we will be able to do that within the next year. We would like to participate in an alpha-release program. We will probably go with Volpara or ScreenPoint Medical. Both vendors are in the breast-imaging market, but they provide two totally different things. Volpara was comparing breast density a couple of years ago, and they have branched out a little to incorporate AI into mammography. ScreenPoint Medical does AI on CAD images of breasts. They marry next-generation CAD technology with AI to help providers make intelligent decisions.

We currently use CAD technology for mammography and prostate studies. We are going to deploy another CAD system for lung readings. We plan to heavily rely on CAD. We are going to exploit every advantage so that we can make patient care the best that it can be. We aren't familiar with specific vendors in the artificial intelligence space, though.

Innovators are talking about artificial intelligence in imaging, but they don't really talk about what that means. There is a lot of buzz about AI among my colleagues, and it seems like innovators are planting seeds that start conversations about it. I am not sure that anyone has a good handle on AI in imaging. From an IT perspective, AI seems like a CAD system. I imagine that AI in imaging

could start with computers being taught to detect certain pixel densities in certain locations on an image so as to determine whether there is calcification. I have been working in my position for a long time, and sometimes I still don't see the bone fractures that doctors show me. I am sure that there are a lot of routine things that computers can be taught to detect.

We have seen what is going on with artificial intelligence, and it hasn't really manifested yet. It is still very early technology.

We don't have plans to use artificial intelligence in imaging. However, IBM acquired Merge, and IBM is very interested in accumulating big data image sets and integrating AI. We have no current plans, but we can see the benefits of AI. We don't know what will come of the AI area, but whatever happens will be interesting.

Artificial intelligence is a real buzzword, but in some respects we have already been using it because we have CAD in mammography. We have the DynaCAD in MR for prostates and breast. We have the front end speech recognition software. So we are already using forms of it. We are certainly not developing applications on our own, but as vendors come out with applications, I am sure we will integrate the ones that we deem useful to us. CAD, the computer assisted diagnosis for mammography, has been around for 10–12 years, and we use that. And then we use DynaCAD for MR; that highlights suspicious areas for the radiologist to look at.

We are a big organization, and there is a lot of work happening with AI. I work next to a group of radiology research people who work on AI. We plan to use it when it matures to the point of productivity. The research people who work on AI are also involved in the clinical side. The clinical side will always use innovations that benefit them.

One area that will probably be good to use artificial intelligence in is the setting of radiographs, such as chest x-rays and bone films. We may see some developments in that area that would facilitate the early detection of abnormalities and the alerting of patient-care teams about abnormalities before radiologists even see the images.

Initially, artificial intelligence will play into the existing strategy. We would be looking for companies to document the improvements made possible by the implementation of AI technology, and then we would decide whether the tools were compelling enough to invest in. This idea of a box that interprets imaging studies as they come out of a PACS would be a little hard to see integrated and accepted into the system. Some really strong champions from within and outside of radiology would need to show a business case.

We are planning to do machine learning and artificial intelligence projects, but mostly for research at this point. We have been approached by some big players and some smaller players who would like to partner with us. Their main interest seems to be access to our imaging. We are planning on entering a partnership to pilot something and test some things out. There is currently no plan for us to adopt any enterprise-level machine learning. That idea has been discussed, but the enterprise has decided to not proceed in a formal fashion. Our machine-learning exercise will be at the departmental level with some clinical, radiology, and biomedical-informatics people.

Many AI vendors are approaching us because of our volume of images. We are trying to figure out what we need to do to make our data more usable. We are still in distribution mode with DICOM. We have to analyze why we use AI; we could use it for quality initiatives, for reducing scan times, or for reducing report turnaround times. For patient care and quality, we want to know the cost of errors and slow turnaround times, and then we want to assess solutions.

We have looked at several AI solutions already, but I am not sure that companies do a good job of determining the problems that AI will solve. The solutions look great, but they look like sales ploys because we haven't put any measurements or data into them.

We don't currently have any plans to use artificial intelligence in imaging. That kind of technology is too far down the road. We need to focus on getting a solid PACS, cardiology PACS, VNA, and viewer strategy in place first. Our people are asking questions about AI so that they can understand what technologies we should keep in mind, but we definitely don't have any strategy for or investigation into AI technology in imaging.

I am currently investigating artificial intelligence in imaging. Nothing we have seen so far has really impressed us, but that is because we are a highly specialized facility. If our needs were more like those of a run-of-the-mill hospital, maybe there would be some AI imaging solutions that we would be implementing. We are actively looking for a partner as we look into AI imaging solutions, but I don't think that there is anything out that is going to blow our socks off, so to speak.

We are implementing an artificial intelligence solution, but the focus of that solution is entirely on the reporting process; it isn't reading images. Our emphasis at the moment is on creating structured reports that are customized to our users' needs. We want to be able to create longitudinal reports and translate those reports into various languages.

I think the next big thing in enterprise imaging will be artificial intelligence and machine learning. We are already talking to Philips about future functionality for the detection and auto-segmentation of images. At some level, all the things that radiologists are required to measure are probably things that can be done more easily and more objectively by a computer. Radiologists look at many more images today than they used to, so there has been a huge change in the way that radiologists function. We are all trying to figure out how to work with and use the data we have more intelligently. We are looking at AI and deep learning, and we are thinking about how those things will change the way we interact with images in the future.

We are a couple years away from implementing artificial intelligence correctly. Most people want to know when they will be replaced by technology, but I don't actually see that happening in radiology for at least the next 50–100 years. There have been a lot of predictions about machines overtaking human expertise in one area or another, but a lot of those predictions haven't come true. A lot of people are telling medical students to avoid going into radiology because those people believe that we won't have radiologists in 10 years, but I don't think that will happen. Radiology will just be different with AI. Computers will be doing basic radiology tasks, and radiologists will be doing higher-level differentials and diagnoses. AI will assist radiologists; it won't replace them. Radiology is very different from assembly-line tasks that require people to do the same basic things over and over again; radiology is extremely complex. Computers just aren't smart enough to replace radiologists.

We have heard a bit about artificial intelligence in imaging. I really pushed our organization toward getting a consultant because hearing about things like AI, machine learning, and analytics at conferences gets so overwhelming. I think the consultant has allowed us to look across our organization and see our clinical-imaging needs, our current state, our future needs, and the industry's direction. The consultant has helped us carve a path. I think the consultant is trying to get us thinking more about structuring things across our enterprise and putting ourselves in a position to get new technology, such as AI or machine learning.

I think that going to artificial intelligence in imaging is going to be a little bit of a stretch for our physicians. It sounds really exciting, but I am hearkening back to my nursing days, when we were trying to do clinical pathways. Physicians were chafed about cookbook medicine and looked

with jaded eyes at anything meant to automate their decision-making processes. Going to AI might take a little bit of time. Because of the relationship we have with our physicians, it will be interesting to see what we will be able to do with AI.

We have developed a relationship with a consultant for imaging. That person is really helping us out with strategy and looking at things such as artificial intelligence. We are a basically a very large community hospital, and we sometimes lag behind in terms of adopting new technology. Things are going to be interesting.

We have leveraged direct APIs within the VNA to allow researchers to extract data on the fly. Instead of having to download data onto CDs or other external media, we can request data with the VNA.

When it comes to developing artificial intelligence functionality for radiology, I think we will see five vendors rise to the top, but those vendors won't necessarily be typical radiology vendors. Vendors who have done well with 3D imaging and vendors who have created good PACS products will lead the pack on AI functionality.

As far as I know, we don't currently have any plans to use artificial intelligence in imaging. Our systems are locked down for security reasons, so incorporating that kind of technology is a little harder for us.

We have an artificial intelligence division, but it has changed over the years. We are developing an in-house system for calcium scoring. Our division does work on AI, but we don't have any self-propagating software. There aren't really any products available in the marketplace. We have had our division for years, and the people have worked on different things. However, some things just aren't available for certain areas, such as cardiology, nuclear medicine, and reporting.

I don't know whether we have any plans regarding artificial intelligence. I have seen a lot of emails about AI coming in from a lot of different organizations. I try to make time to read those emails because I am curious, but I am still confused by the topic. I don't know much about the topic or when we will start looking at things in AI.

We are not doing anything related to artificial intelligence in our PACS. We are talking to a company about doing something in our EMR, though, so there are AI plans. The company we are talking to is doing some development. We have conversations and betas going on with outside groups. One beta offers some AI around the PACS and radiologists' performance. Another beta is AI for the EMR. We have looked at an algorithm this company has created; it looks at the radiologists' quality report, the things the radiologists indicate, and the discharge and diagnosis codes. The algorithm is able to say why a patient attended our facility, what the radiologist identified in the report, and what the ultimate discharge code or impact was. The algorithm can then assign a score. The company with this algorithm is proactively trying to make an impact on care.

We are starting to look at using artificial intelligence in imaging. We need feedback from the radiologists to see whether they are okay with using artificial intelligence. We aren't currently using it, but we may look into artificial intelligence more seriously if the radiologists want to take a look at it. However, we currently are not very interested in it.

Our organization talks about artificial intelligence all of the time, but we never talk about specifics. Our radiologists like the CAD piece, but we don't know that they will be receptive to AI interpreting exams through them. If the radiologists had AI technology read the forms, they would get paid less, so they probably would not want to be involved with AI. The radiologists were receptive to the breast CAD technology because it helped them avoid litigation. Based on

my understanding of AI, the doctors probably won't be receptive to it. We will see whether health organizations embrace AI.

Essentially, we do have plans for artificial intelligence. We are working with Vital. They will examine the DICOM data that comes into the archive and use a big data algorithm to analyze and provide trends related to the data we adjust. We do have plans to leverage something similar to AI. We are creating more of an aggregate view of oddities that we wouldn't notice by just looking at specific examples.

I am not aware of any plans for us to use artificial intelligence in imaging. Our strategic priorities are upgrading our imaging equipment, staying as close to the cutting edge as we can, and growing our system to be a bit more standardized. We are a relatively new healthcare system with many entities, and it takes a lot of work to coordinate, get value out of our scalability, standardize where we can, and get various stakeholders all pointed in the same direction. In terms of imaging, artificial intelligence is not very high on our list right now.

We haven't had any really strong conversations about CAD. We would use it for very specific service lines. We are investigating lung-cancer screening, and there are tools out there that help identify and track lung nodules. That is the only artificial intelligence functionality that really comes to mind as something we may use. We are a teaching institution, so I don't know that we really want computers doing our work for us. We need to show our trainees how to identify things themselves. I would be interested to see how things develop in the academic setting.

There has been no talk about artificial intelligence at all in our organization. I know AI is always the hot topic at RSNA meetings and such, but as far as I know, we haven't talked about it.

We have used digital reasoning, and we have begun to deal with technology to help us with processing some of our data for our ACR registries and such. That work has been successful. However, that success has come after we have worked with several vendors on things. In watching our deconstructed PACS fail, we have decided that we need to spend some time on just simplifying things. We will need to see where the artificial intelligence world goes, and in a year or two, when things are a little more mature and we can see who the winners in that race are, we will jump on the bandwagon and see where we can go. Our organization is big enough that somebody might want to utilize us to do some research and development; we would be happy with that. But we need to take a step back for a year or two or so to see where the dust settles before we do anything deeper.

We have no plans at this time, but we are watching to see where things go. We feel that using artificial intelligence in imaging is further away than what the market talks about.

We are piloting artificial intelligence, but it isn't quite live. We are looking at real data, and we are running some algorithms. We are still early in the process, so we can't say too much about AI. Some of our early use cases will be related to breast and lung studies. Providers should watch the modality vendors.

We are using artificial intelligence to review reports for quality purposes. Every report that a radiologist dictates gets sent to our system that uses artificial intelligence. It reads through the report, processes the data, and matches it up against predefined quality rules that we have. It the system finds a report that violates the rules, it sends a notification to the radiologist and puts out an addendum list for the radiologist within 10 minutes of looking at the report.

We are live on some things and piloting others. We are working with a vendor on developing future applications. I am not able to share much more at this point, but I am excited to see where

things go. I don't think artificial intelligence is coming fast enough, and I am close to the end of my career. I don't know whether I will be able to see artificial intelligence in its prime. I think it will take some time, but it is here, and more of it is coming.

Talks about artificial intelligence would be done at the corporate level, so I don't know what people at that level plan to do. We are not doing anything with AI yet, but I am sure that people are talking about it at the enterprise level.

We don't have any specific plans for artificial intelligence. We have looked into it, but we are waiting for a product that can deliver value for the cost.

We are planning to use artificial intelligence in imaging, but I am not sure about the time frame. AI is interesting to read about, and some of our physicians are talking to others about AI, especially in research. However, I don't think we are ready to jump in at this early stage. I think there will be a lot of uses for AI, but I do not think it will replace our radiologists. I do hope that it will help radiologists be more productive. I do think that there is a very strong use case for AI outside of the US because people from other countries do not have much access to radiologists.

We plan to work with Philips.

We have no solid plans to use artificial intelligence in imaging. We have interest in what is out there, but we haven't begun planning or making decisions. We have heard good things about IBM Watson Health. We are going to keep a close eye on the space.

We have seen demonstrations of artificial intelligence technology, but we have not used it. We can understand the value of AI, but right now, we are just looking. Nuance has technology for the querying of reports and free text. We have looked at the IBM Watson tool, but we haven't really talked about it. We are very interested in pursuing AI. We are talking to some of the AI vendors about the problems we have here. We don't want to just track whether someone has ordered a follow-up CT; that is easy. We want to track whether the doctor talks to the patient afterward; we have been amazed to learn how often doctors forget to follow up right away. Tracking follow-up data is hard because that data is in free text. That is why we would like to incorporate AI functionality that can work with free text. We may also want to use AI tools for lung-cancer screenings. We are trying to figure out how AI tools could be useful to us.

When a radiologist reads an exam and finds something significant, such as a problem with a lymph node, the radiologist can use PowerScribe to input the fact that there is a significant finding. We can then run a report on all significant findings and find out what the recommendations are. Significant findings can be tracked in our Epic system easily. But data about any follow-up or biopsy decisions must be entered in free text. We want to know about any follow-up work, and that requires someone to review charts. One FTE's schedule is halfway filled by reviewing charts for this purpose. Because doctors don't document in a standard format when they talk to patients, reviewing a patient chart requires checking five different spots in Epic's system. Artificial intelligence might be able to help us in this area.

Artificial intelligence is a tricky subject for us because our lawyers are stuck in the 80s. We would like to use AI. We have ideas about what we would like to start off with to see how AI works; we wouldn't necessarily roll it out to everybody. But there are legal concerns. Things are so complicated that we probably won't be able to do AI without some very high-level authorization. We are still paying attention to AI; just because AI would be tough doesn't mean that we will stop talking about it. But my guess is that we won't do anything with it anytime soon.

We are looking heavily at artificial intelligence and testing a few things now, but it is too early for me to talk about what we are doing.

I haven't heard of any talk regarding artificial intelligence yet, but I wouldn't be surprised if I heard people talking about it next year. It seems that every year, we have some kind of meeting at which people mention some ideas. We will see whether we get a sales pitch from Merge sometime next year. For the most part, 8–10 years is usually the life cycle of our HIS, PACS, and dictation applications here. At that point, we generally start looking around. Instead of upgrading, we might as well look for a different vendor.

On the imaging front, we have implemented Zebra Medical Vision, who has automated algorithm-generating software. It has been running in production for a few months. Zebra Medical Vision has five algorithms approved by the FDA that we are running in our production system and monitoring. The next phase we are working on is integrating the results from the Zebra algorithms into the dictation process directly so that the discrete data elements and the content from the algorithms is shown to a radiologist during dictation. We hope to be able to insert discrete data elements that come either from a modality or an algorithm into the reports so the radiologists have it as they are dictating and can edit, review, approve, and sign it. We are looking to create very discrete, synoptic elements in every report.

We have a development project that has been ongoing for probably 18 months or so. We construct the template that we want for each clinical scenario by having the clinicians define all the data elements that should be captured for each scenario. The clinicians author the templates and the discrete data elements that need to be captured, and we developed software that gives context and content about an interpretation to the radiologists when they are doing their interpretation. The radiologist is required, during the dictation, to enter certain discrete data elements based on the clinical context. That project is in pilot. We store the discrete data elements in a database in which we can do analytics and clinical reviews and all of those kinds of things. The next phase will be to send the discrete data elements into Cerner to trigger actionable activity in the EMR.

Our images are associated to a longitudinal record, so we can get the clinical data about a patient, all the reports, and all the images. We have hundreds of millions of images, and we perceive that to be an asset that is really important as digital algorithms and machine-learning advances. One opportunity that our organization has is to leverage the large archive of images for the purpose of developing new algorithms. We have some interest in that. Obviously, it would be likely done as a partnership with a company, but I believe that the image archive that we have is an asset for developing algorithms and associating especially because we can associate to clinical outcomes as well.

AI is in its early stages right now. Each PACS vendor has ideas about what to do with AI, but there isn't any consensus. Everyone is trying to solve a different problem. AI solutions are more like workarounds at this point. CMS can't decide what to do, and everyone knows we aren't getting paid for everything. In the PACS world, radiologists receive orders and are supposed to look at ICD-10 to ensure the order is appropriate. However, radiologists are too busy to do that unless the order is a CT scan or an MRI and it comes from a protocol physician. Some vendors are designing solutions based on decision support for cardiology and radiology, but we don't see anything yet. AI still seems like a solution searching for a problem.

Everybody should be using artificial intelligence in terms of CAD for mammography, so we do have AI technology. We have also looked at another product for CT lung nodules, and it is pretty good. However, I don't think the technology is where it needs to be yet.

Any way we could leverage AI to solve ongoing problems would be very helpful.

There are plans for us to use artificial intelligence in imaging, and we have a big project going on in that area. We are doing research and are interested in the topic. We have engaged a vendor. That is probably all I can say on the subject.

We will be using artificial intelligence in imaging. I met with some developers at RSNA who are working with Carestream, and they have some algorithms they are working with. At some point, we will adopt some of those algorithms.

We are researching artificial intelligence in imaging. That technology isn't quite here yet, but it is coming. The difficulty is that we as an industry haven't even defined what AI in imaging means. When vendors talk about AI and machine learning, they speak broadly, and they are vague. We all have an idea of what AI in imaging means, but I don't know if we even know what all is possible with AI in imaging.

I believe that it is crucial for large healthcare organizations to partner with vendors and to provide good data. Some large organizations are sitting on goldmines of data, and that data is essential to the success of AI in imaging.

Artificial intelligence is such a departure from what the incumbent vendors do. The 3D vendors and the decision support vendors are probably the most uniquely positioned for AI, but we don't see any vendors making great innovations.

I have talked to Merge, Philips, and other vendors that have wanted to pitch their PACS products, and none of those vendors are pitching artificial intelligence or new tools. They are offering new versions of the platforms they have always offered. Each PACS just does what a PACS should do and is a good version of what I wanted 10 years ago. The next 3D-mammography technology will come out, and there will be huge data sets. The vendors will respond to make sure the technology functions okay. I don't see a lot of innovation in this space. I see a lot of optimization. The people who are going to disrupt the market are going to be coming from different scenarios and will be able to really focus on innovation. Some investors will come from out of the woodwork after building something that worked well at some university.

I would argue that PACS and EHR vendors are the best positioned to deliver artificial intelligence in imaging. The people from outside of the clinical workflow don't know what problems to solve. Those are vendors such as Philips, GE Healthcare, Siemens, Cerner, Epic, and McKesson. Google or Apple can make a better algorithm, but that doesn't mean they know how to solve clinical problems. They can make a product, but it may not be a product that is needed.

What vendor(s) are best positioned to deliver AI in imaging? Why?

Agfa HealthCare

We have had discussions with our team and looked at the data. We think Agfa HealthCare is in a good position because of the amount of data they have.

I am not familiar with what is ready today and what is in the works from Agfa, but I know they have been working on something and have been moving in the direction of artificial intelligence.

Ambra Health

I believe that Ambra is positioned to deliver an AI solution based on a few things I talked to them about, but I haven't actually experienced the product.

Ambra seems to have some plans in place, though I don't think Ambra can define those plans.

Arterys

Arterys was first to receive FDA approval for a deep-learning application, so that gives them some credibility, and it positions them to deliver artificial intelligence in imaging earlier than other vendors. I have not used Arterys' products, but I have heard respected colleagues speak of Arterys. Arterys' early offerings are tangible; one of their solutions can diagnose a heart problem in 15 seconds, while it takes 30 seconds for a person to diagnose the same problem. I don't see the Arterys solutions replacing doctors; instead, the solutions would save doctors time and make them more productive. I also have heard that Arterys has been working with GE on using MRI images to search for defects. We want to see more predictive analytics, and what we are seeing from Arterys is real and applicable.

Artisys has early FDA approval.

Cancer Center

Cancer is clearly Cancer Center's focus. They need a lot more time to develop their AI solution. They seem to want to address our market, but they are actually well behind IBM, Zebra Medical Vison, and other vendors developing AI for imaging. I am not sure that Cancer Center has a product to offer at this time.

Carestream

We already partner with Carestream, and our relationship is working well. We don't know of anyone else that is in a position to deliver artificial intelligence to our production system. We read reports about AI, but there doesn't seem to be any other commercial products. We don't know of any other AI vendors to consider. There are a lot of small start-up products working toward similar objectives, but we don't know whether those products are available.

Carestream has a number of other vendors that they partner with who provide artificial intelligence functionality. From what we have seen so far, it has been difficult to get buy-in for AI functionality that extends beyond radiologists' traditional roles. Some of that functionality takes a more population health–centered approach to imaging. We are not sure who would take the extra work if the AI functionality were to detect additional pathology. Our department chair wasn't so keen on the idea of putting extra work on the radiologists.

Carestream is very knowledgeable about imaging.

Carestream does a lot of work with worklists; I think that is unique to them. They really get things done. The workflow process is better in the Carestream system than in other PACS solutions. The Carestream tool is not just a PACS anymore, and we just get a list of patients. We are now able to designate by specialty and make worklists according to specialty and body part. The tool has gotten better in those ways.

Cerner

I don't think that Cerner utilizes the imaging data they have. I don't know whether doing that is their focus, unfortunately. They have the resources, so they are well positioned to utilize that data. They hold the key. Cerner has a lot on their plate. I am not sure that they are strong at any one thing because they are working on many things.

I don't know what Cerner is working on and offering in terms of AI, but they are well positioned because of their data repositories.

EchoPixel

EchoPixel has built a neat 3D monitor. Users wear the same kind of glasses that people wear at a 3D movie. The glasses have a circular polaroid, so users are able to see three dimensionally on the monitor. The glasses also have two little targets that allow the monitor to determine the user's head orientation, and it will adjust the picture to suit. So users could view a 3D reconstruction of the head, for example. The image is 3D, and it floats about four to six inches in front of the monitor by virtue of the 3D projection. There is a tool that looks like a pen, and it can be used to manipulate and move the 3D image. Users can turn the image around and look at the top or bottom. The technology is pretty cool, but right now the radiologists are still adjusting to the idea. It will be very useful in surgical planning, so we may see that use there soon.

GE Healthcare

GE Healthcare has demonstrated that they are on the right path with AI, but some of their recent announcements left us wondering where they will be in the future. I am pleased with what I learned about their work, but time will tell where they are focused. GE Healthcare is doing a lot with AI in multiple industries; they have a whole division. We heard from them about how data analytics will affect healthcare. They can predict almost anything, and they can diagnose things. It was stunning. They haven't done much with imaging, but I am very interested in what they are doing with service. They can codify what will break and when it will break. Unfortunately, they can't always get me the things I need. They need to look at their installation base and their service. We use third parties for a number of things because GE Healthcare is too slow to recognize that customers need to take on more risk. Good third parties are important.

GE has resources, data, and modalities. In my mind, they have an advantage, but unfortunately, GE doesn't always deliver on their promises.

GE says that they are positioned well to deliver artificial intelligence, but we don't believe much of what GE says these days.

I don't see any vendors that are ready to deliver their AI solutions, but we are looking at smaller vendors. Big companies like IBM, GE Healthcare, and Philips aren't nimble enough for us. IBM's Watson product has seen a lot of talk with no action, and the other vendors have the same problem. Some smaller vendors show promise. Those are physician-driven organizations that have written code based on their knowledge, so I am more excited about those companies.

GE Healthcare has touted AI for a long time, so they are under the spotlight. They need to make something happen if they want to back up that hype. They are doing some things already, but it isn't where they expected it to be.

Homegrown

I think that what will determine the accuracy of any future artificial intelligence technology will be access to the most standardized image sets to train the technology on. The algorithms are seriously simple, and a lot of AI software is freeware. The question will be how tuned up the algorithms are and which data sets are used to create the patterns. I don't think the usual vendors will come up with the solution. I think the solution will come from weird places, such as a single person with access to a huge number of images. I would keep an eye on large-volume university hospitals and large, complicated organizations. Those groups could identify the images in their archives that would be most helpful, and then the images could be curated.

I don't really know about vendors that are positioned to deliver artificial intelligence in imaging. In my experience, it seems that when vendors determine that another vendor has a good idea, vendors will partner with that other vendor. Consider what Dr. Keith Dreyer has done with his people over at Massachusetts General Hospital with voice recognition and decision support. AI is the same kind of thing. I am sure that we will see something crazy from that group in terms of AI. People in the academic setting can see AI's real-world usefulness. Vendors are looking at their bottom line; they have to figure out how to market AI technology and make it profitable, and that approach isn't very patient focused.

IBM Watson Health/Merge

Vendors have to partner with IBM to get machine-learning functionality. No vendors have that functionality on their own; they have to partner with another vendor to get it. Most PACS systems are just now getting BI functionality, and providers are just starting to capture data and run BI report. Actual machine learning is very different from BI.

A lot of what is being touted by the vendors and by the industry as AI is really just computer-aided detection, which isn't actually AI in my opinion. Most vendors in imaging have focused on evaluating images for pathologies that might be missed or might be hard to see, but that is really just an extension of computer-aided detection. However, I am impressed and excited about something that IBM Watson Health is offering. It was technology that used Watson Health's keen abilities to read a patient's entire medical record and make some decisions about the report that the physician just entered. So the physician entered something he or she had seen or a suggestion of what might be going on, and Watson Health would read that report and then immediately read everything else in the EMR and then notify the doctor if there was a different explanation to consider. That could spur the radiologist to give something a second look. The best-case scenario is that radiologists read the entire study, but sometimes that is almost impossible. But it isn't impossible for Watson Health, and I felt that was a really good use of AI.

IBM has had a great deal of attention because they have paid for it and made purposeful efforts to be a spectacle in the artificial intelligence field. We are partnered with IBM, but we don't have any products from them. There aren't any products that are ready to be put in. IBM has a lot of resources, funds, and a committed team of bright people. The company has made a public commitment to AI, so we imagine that they will eventually produce something. They haven't yet, though. They don't have radiology origins and are slowed down by the need for industry knowledge. We don't like the amount of hype they have generated. Their talk has been unnecessary, premature, and almost like science fiction. Algorithms can help read images, but the

algorithms will facilitate people reading images. When AI first came out, it had a different type of hype. IBM is a couple of years away from a big announcement, but they still have nothing out.

IBM is putting all of their eggs in one basket. They believe in artificial intelligence and in what it can do for outcomes and future patients. Obviously, results won't happen overnight, but IBM seems like the vendor that is leading in the AI space. It is interesting to be a customer of Merge. We didn't purposely choose the vendor that would lead in AI. We just simply had their products, and the company moved in the AI direction.

IBM has been marketing artificial intelligence for a long time and has teams of people working on it.

I am not as encouraged by IBM as the media might lead people to be. I don't think IBM is very well positioned to provide artificial intelligence in imaging. They are probably ahead of some vendors in their marketing and partnerships, but I am not sure that they are delivering much else. All vendors are overselling their technology; I haven't seen anything concrete. I have seen many vendors willing to partner with provider organizations to get the organizations' data and thereby develop something real. The difference with IBM is that they are promising some real results, but I am very skeptical about IBM's ability to deliver. After all, MD Anderson Cancer Center pulled out of their partnership with IBM.

I don't see any vendors that are ready to deliver their AI solutions, but we are looking at smaller vendors. Big companies like IBM, GE Healthcare, and Philips aren't nimble enough for us. IBM's Watson product has seen a lot of talk with no action, and the other vendors have the same problem. Some smaller vendors show promise. Those are physician-driven organizations that have written code based on their knowledge, so I am more excited about those companies.

I think IBM has a lot of resources to throw at the AI problem, so that gives them a bit of an advantage over niche companies. However, I don't feel that IBM has done much to move beyond their marketing pitch. I am also not sure they really understand the imaging world the way they need to in order to really blow this thing out of the water. If we have learned anything from doing enterprise imaging, it is that we need a real partner to expand and be successful. That is not what IBM is known for, so I don't know that they are really set up to be successful.

IBM is improving, but we have received feedback from people who have knowledge of IBM's AI developments, and those people weren't very impressed.

We are part of the Watson Health imaging collaborative, and I would say that it has been an utter and miserable failure. The vendor hasn't sent out proper invitations to meetings or had webinars with enough feeds for all of the attendees. The technology has never been delivered. We will continue trying to work with the vendor, but I will be quite surprised if they succeed.

Merge shares resources with IBM, and the investment in Watson has already been made.

IBM has been heavily marketing Watson, so they have to put something out. I don't know how many people are working on that product, but I know that several strong Merge employees have moved over to the Watson team to help. The amount money and resources that IBM is spending on Watson is staggering.

We are confident in IBM, but artificial intelligence is still in its infancy. Delivering AI technology will take some time.

We have been working with IBM for some time, and I am confident in what we are working on together. I am confident in their ability because of what I have already seen them do at our organization. We are applying some things now, and we are testing others. I am not at liberty to go into details. Artificial intelligence is still in its infancy, so it will take some time to get where the industry needs it to be.

IBM's product isn't as developed as we would like it to be, but we do think that IBM can deliver more value in the future.

We think IBM is best positioned to deliver artificial intelligence in imaging because of the partnerships IBM is setting up and because IBM has a large focus on AI. Because of the Merge acquisition, IBM has access to a lot of imaging data. I don't know how clean the data is; it is coming from all over the place. But I think if IBM can get the Merge data organized and continue to line up partnerships, IBM's data will be valuable.

I am most familiar with the Watson Health product. That doesn't mean that IBM is best positioned to deliver artificial intelligence in imaging, but we are a Merge user. Because of the research studies I have read about, I am not very confident in IBM in this area.

IBM is the only vendor I really know details about. I know there are a lot of vendors in the space. I have a neutral level of confidence because the artificial intelligence space is so conceptual. IBM seems committed to the development of AI.

Nuance's connection to artificial intelligence has to do with the dictated PowerScribe reports of the radiologists. I think Nuance can facilitate searches in Epic tools if PowerScribe is integrated with the Epic tools, but I think IBM is the vendor most open-ended in terms of working with Epic charts and finding data through reviewing charts.

We think IBM is in the best position because of their size, resources, and data that was acquired with Merge.

Watson is the product in the lead for reviewing the images and trying to assist the radiologist in doing the read. It is the product I hear the most about. IBM is doing more, and I think they will have a lot more to show this year at the RSNA conference. They do not have anything ready for release yet.

IBM did a demonstration of something they were working on. I can't remember what the tool was, but I think it was for lung screening or something similar, and it was really cool. IBM was focusing on and researching a particular diagnosis.

Merge has been acquired by IBM, and they will therefore be utilizing Watson. I suspect that they will be at the cutting edge of delivering AI in imaging.

IBM has the most resources, and they have a large amount of data and images. But IBM gets in their own way; they are too big and political. AI solution vendors need to be nimble.

IBM has already invested in AI technologies in imaging, and they have resources. They have a history in AI, so they at least have a start.

Lexmark

Lexmark gives us visibility and access to EMR data.

MModal

MModal probably has the best solution out there with artificial intelligence for reading reports.

Nuance

Nuance's connection to artificial intelligence has to do with the dictated PowerScribe reports of the radiologists. I think Nuance can facilitate searches in Epic tools if PowerScribe is integrated with the Epic tools, but I think IBM is the vendor most open-ended in terms of working with Epic charts and finding data through reviewing charts.

We aren't sure whether Nuance will be a mainstream player in artificial intelligence, but they are doing some interesting things that will help physicians save time and be more productive.

Nuance might be able to deliver a product, but we don't know whether it will be valuable to us.

Philips

I don't know that any vendors are really well positioned to deliver artificial intelligence in imaging, but if I had to pick a vendor, I might pick Philips because of their Illumeo PACS overlay. That tool does some simple image processing and takes advantage of that to deliver context to the radiologist at the time of interpretation. In their marketing pitch, Philips talks about machine learning and AI, but that terminology can be used very broadly. I don't know whether the Philips technology truly involves machine learning and AI; it could just involve traditional image-processing techniques that Philips has put into their product.

I don't see any vendors that are ready to deliver their AI solutions, but we are looking at smaller vendors. Big companies like IBM, GE Healthcare, and Philips aren't nimble enough for us. IBM's Watson product has seen a lot of talk with no action, and the other vendors have the same problem. Some smaller vendors show promise. Those are physician-driven organizations that have written code based on their knowledge, so I am more excited about those companies.

We speak with and work with Philips regularly to get updates for the system. They talked with us recently about their road map. Philips tries to avoid heavily marketing things that aren't real. In that way, we have appreciated Philips' approach.

Development is still early for Philips, but I think they have a good vision, and they are dedicated to it.

ScreenPoint Medical

ScreenPoint Medical uses AI technology with CAD technology. By combining the two, they are helping providers make intelligent decisions.

Sectra

Sectra has talked to us a bit about their plans for artificial intelligence. They spoke honestly with me, and I liked that. Sectra has a reputation for delivering, and they don't overpromise. I think Sectra will develop a good product, though they might be a bit slower in delivery and more deliberate in development than other vendors out there.

Volpara Solutions

Volpara Solutions already has a tool for density measurement. We can create enterprise-wide features that automatically order 3D ultrasounds. That is a front-end use of artificial intelligence.

Zebra Medical Vision

I wouldn't say that Zebra Medical Vision has an advantage over anyone at this point in terms of AI. They are smaller and nimbler than IBM Watson or GE Healthcare.

Zebra Medical Vision looks very interesting. I would like to see how they develop AI in imaging, but their solution is way too new. Zebra recently announced a partnership with Google Cloud, and that is really intriguing. A lot of AI imaging solutions are mostly marketing fluff at this point, but Zebra seems to have a good understanding of the needs of the market.

I have looked at Zebra Medical Vision; I don't have much experience with them, but I do have some confidence in them based on the people they have been able to partner with in the imaging space. I think they have done a nice job of focusing on what imaging-specific issues need to be tackled. Even though artificial intelligence in imaging is still new, Zebra Medical Vision is a vendor to watch.